Does Collateral Reduce Overdues? A Regression Discontinuity Approach

August 2007

Preliminary and Incomplete: Do not Cite Without Permission

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Abstract: There is long-standing theoretical debate on the role of collateral in financial markets. There is no satisfactory evidence of the causal relationship (if any) between the amount of collateral required and the subsequent probability of overdues. We analyze an exogenous change in the number of cosigners required as collateral on small loans in South India. Our regression discontinuity approach reveals that increasing the number of cosigners reduces overdues – the effect is large and significant. Our results support the idea that collateral provides borrowers with incentives to repay but contradicts models in which collateral (1) is purely a hedge against default risk (2) sorts between high and low risk borrowers and (3) makes lenders lazy in their screening efforts.

JEL Codes: O16, D82, G21

Keywords: credit, default, cosigner, rosca

1 Introduction

There are a plethora of theories on the role of collateral in financial markets, which is not surprising given the prevalence of collateralized loan contracts around the world. There

[0]We thank Bill Gentry, Michael Gordy, Tara Watson and seminar participants at Frankfurt, Indian School of Business, Namur and Yale for helpful comments, and Martin Rotemberg for research assistance. We are grateful to the Chit Fund company (in South India) for sharing their data and their time. All errors are our own. Klonner: Dept. of Economics, Cornell University, 444 Uris Hall, Ithaca, NY 14853, stefan@klonner.de; Rai: Dept. of Economics, Fernald House, Williams College, Williamstown, MA 01267, arai@williams.edu

is only a small empirical literature on the subject: Berger and Udell (1990), Jiminez and Saurina (2004), Liberti and Mian (2006) and others report positive correlations between collateral and overdues. These papers do not establish a causal relationship, however, between the collateral required on a loan and the subsequent probability of on-time repayment. It is entirely possible for instance that omitted variables lead to a positive correlation, but the underlying causal effect is negative. A key theoretical question, does collateral reduce the likelihood of overdues, is left unanswered.

In this paper we use data on $11,688$ loans given by a non-bank financial firm in South India. The repayments on these loans are Rs. $19,200$ on average (US \$480). We exploit a discontinuity in the collateral required by the lender to secure repayment on these loans. In particular, we test if (exogenously) relaxing the collateral requirement has an effect on reducing the overdues of borrowers holding other loan terms constant. Like much of the rest of the literature we find a positive correlation between collateral requirements and overdues. But unlike the rest of the literature, we are able to investigate the causal relationship between the two. In particular we find that relaxing collateral requirement increases overdue rates.

We turn next to interpreting our results in light of the theory. As we discuss below, there are several models of collateral that our findings do not lend support to:

1. The simplest possible role for collateral is as a way to hedge default risk, i.e. to recover funds from borrowers who have not paid. We measure overdues in two ways: as arrears and as defaults. Arrears refers to payments are past due at the termination of the loan period. Defaults refers to payments that have not been recovered even after the lengthy legal process to collect on collateral has been completed. If collateral was only a hedge against default risk, we would expect relaxing the collateral requirement to increase defaults but not to increase arrears. Since this is not what we find, collateral must be doing more than simply hedging against default risk.

2. Several theoretical papers predict that collateral can overcome the adverse selection problem in financial markets by inducing self selection from a menu of contracts that

differ in collateral requirements and interest rates (Bester, 1985; Chan and Kanatas, 1985; Besanko and Thakor, 1987a and Besanko and Thakor, 1987b), These models predict a negative correlation between collateral and overdue rates (contrary to what we find). This finding is not new (the other empirical literature on the subject has consistently reported positive correlations).

3. In an influential paper, Manove, Padilla and Pagano (2001) discuss the role of collateral when banks have a potential information advantage over borrowers. In their model, it is efficient for banks to screen borrowers ex ante (and not to fund low return projects). But if loans are collateralized, then banks become lazy (since screening is costly). In this model, screening and collateral are substitutes for the bank. So relaxing the collateral requirement will (causally) lead to better screening and hence lower defaults. On the other hand, collateral and default probability will be positive correlated. We find that though there is a positive correlation, the causation is negative. So our evidence directly contradicts the lazy banks hypothesis.

Next we discuss theories that are consistent with our findings. In moral hazard models, posting collateral reduces the incentives to shirk and hence reduces the probability of default (Chan and Thakor, 1987 and Boot and Thakor, 1994). In incomplete contracting models (Aghion and Bolton, 1992), collateral plays a similar disciplinary role. Our negative causation finding for both arrears and defaults is consistent with these models of collateral as improving borrower incentives. That said, however, there is no variation in ex ante borrower riskiness in any of these models. To match our positive correlation *and* negative causation results, we would need to supplement the simple moral hazard stories. One such model is by Boot, Thakor and Udell (1991). In their model, borrowers differ in terms of observed riskiness and are subject to moral hazard. Observed riskiness and effort are substitutes – so the marginal productivity of increased effort is higher for risky borrowers than for safe borrowers. They derive the optimal (second-best contract). In this contract, risky borrowers must post collateral to commit to high effort. Collateral lowers the probability of default for risky borrowers. Loans to safe borrowers are unsecured

in their model (because safe borrowers take the first-best level of effort even in the absence of collateral. There are two cases: (a) safe borrowers are assumed to have an even lower probability of default than risky borrowers who are induced to take effort and (b) safe borrowers have a higher probability of default than risky borrowers who are induced to take effort. In the former case, collateralized loans are associated with a higher ex post default probability compared with uncollateralized loans, consistent with our findings.

To summarize then, our results are consistent with models such as Boot, Thakor and Udell (1991) that predict a positive correlation between collateral and overdues but a negative causal link between the two. More generally, our findings suggest that collateral increases repayment incentives. We cannot distinguish between moral hazard and adverse selection explanations for improved repayment incentives, however. It is possible to write down models of unobserved riskiness could also explain our findings. For instance, borrowers may differ in both their unobserved and observed riskiness with collateral as a screen to keep unobserved riskier borrowers out of the credit market.

Finally, we should point out that the measure of collateral used in this paper is the number of cosigners on a loan. For the loans in our sample, a borrower's repayment is backed by the personal guarantee (in the form of future salary income) of one or more cosigners.[1] Cosigners act much the same way as traditional collateral in providing repayment incentives both in adverse selection models (Besanko and Thakor, 1987a) and in moral hazard models (Banerjee, Besley, Guinnane, 1994). The exogenous relaxation in collateral requirement that forms the basis of our empirical strategy is a reduction in the number of cosigners required for otherwise identical borrowers.

[1] Such loans are extremely common all over the world, today as well as in the past. Cosigned loans are popular in the contemporary United States (Berger and Udell, 1998), in Europe (Pozzolo, 2004) and in many developing countries. For instance, in Vietnam, 40% of formal credit is backed by cosigners (Tra and Lensink, 2004). There are also many historical instances of this lending practice, including early 20th century United States (Phillips and Mushinski, 2001), 19th century Britain (Newton, 2000), Germany (Banerjee et al, 1994), Russia (Baker, 1977), and early renaissance Venice (Chojnacki, 1974).

Plan for the Paper

We proceed as follows. In section 2, we provide background on the non-bank financial institution underlying our analysis. In section 4, we discuss our identification strategy and the results. We conclude in section 5.

2 Data and Institutional Background

The financial institutions we study are Roscas or Rotating Savings and Credit Associations (Besley et al, 1993). In these schemes a group of people get together regularly and each contributes a fixed amount. In bidding Roscas, the highest bidder receives the collected pot at each meeting. Once a participant has received a pot she is ineligible to bid for another but is required to make regular contributions till the Rosca ends. The recipient of a pot may choose to default subsequent to winning (i.e. may choose to stop making contributions). To prevent such defaults, the Rosca organizer requires recipients to provide cosigners. We exploit a discontinuity in the cosigner requirement – there are fewer cosigners required for recipients in the second half of the Rosca than in the first.

The bidding Roscas we study are large scale: the participants typically do not know each other and the Rosca organizer (a non bank financial firm) takes on the risk of default. Bidding Roscas are a significant source of finance in South India, where they are called chit funds. Deposits in regulated bidding Roscas were 12.5% of bank credit in the state of Tamil Nadu and 25% of bank credit in the state of Kerala in the 1990s, and have been growing rapidly (Eeckhout and Munshi, 2004). There is also a substantial unregulated chit fund sector.

In this section provide institutional background on bidding Roscas and on enforcement of loans.

Rules

Bidding Roscas are sophisticated savings and credit schemes. Each month participants contribute a fixed amount to a pot. They then bid to receive the pot in an oral ascending bid auction where previous winners are not eligible to bid. The highest bidder receives the pot of money less the winning bid and the winning bid is distributed among all the members as a dividend. Consequently, higher winning bids mean higher interest payouts to later recipients of the pot. Over time, the winning bid falls as the duration for which the loan is taken diminishes. In the last month, there is no auction as only one Rosca participant is eligible to receive the pot.

Example (Bidding and Payoffs) *Consider a* 3 *person Rosca which meets once a month and each participant contributes* \$10. *The pot thus equals* \$30. *The law caps bids at* \$12. *Suppose the winning bid is* \$12 *in the first month. Each participant receives a dividend of* \$4. *The recipient of the first pot effectively has a net gain of* \$12 *(i.e. the pot less the bid plus the dividend less the contribution,* $30-12+4-10$*). Suppose that in the second month, when there are* 2 *eligible bidders, the winning bid is* \$6. *And in the final month, there is only one eligible bidder and so the winning bid is zero. The net gains and contributions are depicted as:*

Month	*1*	*2*	*3*
Winning bid	*12*	*6*	*0*
First Recipient	*12*	*-8*	*-10*
Second Recipient	*-6*	*16*	*-10*
Last Recipient	*-6*	*-8*	*20*

The first recipient is a borrower (he receives \$12 *and repays* \$8 *and* \$10 *in subsequent months, which implies a* 43% *monthly interest rate. The last recipient is a saver: she saves* \$6 *for* 2 *months and* \$8 *for a month and receives* \$20*, which implies a 25% monthly rate. The intermediate recipient is partially a saver and partially a borrower.*

In what follows, we shall often refer to the winning bid or the liability relative to the pot size. The winning bid in the above example in round 1 is $\frac{12}{30}$ or 40 percent of the pot size. The liability is the total owed (i.e. the sum of contributions less dividends for a Rosca winner). The liability for the round 1 borrower is 18 or 60 percent of the pot size.

Next we discuss some of the main features of Roscas in practice:

The Sample

The data we use is from an established Rosca organizer with headquarters in Chennai, India. We collected data in December 2005 on all Roscas started in the year 2001. Descriptive statistics for the $11,688$ observations in our sample are in Table 1. Each observation refers to a pot awarded to an auction winner:

1. Since we are most interested in trend breaks in the middle of the Rosca, we only include Rosca winners for the 15 rounds before and after the middle of the Rosca.

2. About one third of all Rosca participants are institutional investors. These institutional investors never default and are exempt from collateral requirements. For this reason we have excluded pots allocated to institutional investors from our sample.

The Rosca organizer offers Roscas of various denominations to match borrowers and savers with different investment horizons. From Table 1, the mean duration is 34 months and the mean contribution is Rs. 1399. The Roscas range from 25 month to 50 months in duration, and the contributions range from Rs. 250 to Rs. $10,000$. For instance, a common Rosca denomination is 40 months and Rs. 250 (with a pot of Rs. $10,000$).

The liability for an average borrower in our sample is Rs $19,233$. This represents the total (undiscounted) contributions that the borrower must make after winning the pot, less the dividends that he will receive as a fraction of the winning bids in the subsequent months, The typical loan duration for our sample is 15 months.

The winning bid 17 percent of the pot on average in these Roscas. That represents (roughly) the fraction of the pot that the borrower is willing to forego to other participants

in order to borrow. Notice that the maximum winning bid is 30 percent of the pot. This is because of a government imposed ceiling on bids (discussed further in Klonner and Rai, 2006).

3 Cosigners and Enforcement

The Rosca organizer takes on the default risk. If a participant fails to make a contribution, the organizer will contribute funds on his/her behalf. In this way, a round t borrower who defaults in round $t+5$, say, will not reduce the pot available to the other Rosca participants in round $t+5$. In exchange the organizer receives a commission of 6 percent of the pot in each round, and the entire first pot (at a zero bid).

To prevent borrowers from defaulting, the organizer asks for cosigners on the loans it gives. The central office issues guidelines for the number of cosigners required on loans taken. The guidelines specify a reduction in the cosigner requirement from three to two at the middle of the Rosca. For instance, for the 40 month, Rs. 250 Rosca denomination, three cosigners with monthly income of Rs. 3500 each are required until round 20, and two cosigners with monthly income of Rs 3500 are required after round 21.

After a participant wins a pot, he or she is asked to provide cosigners. The decision on how many cosigners to ask for is at the discretion of the loan officer (though the guidelines stipulating a relaxation do play a role, as we shall document later). The loan officer uses a variety of observable characteristics of the borrowers (including the winning bid, or the participant's history of making on time contributions). If the winner of a pot is unable to provide sufficient cosigners, then the pot is reauctioned at a subsequent Rosca meeting (but this happens very infrequently). The mean cosigner requirement is 1.2 with considerable variation in our sample (Table 1). Cosigners are required to be salaried employees. This is because the organizer has a legally enforceable claim against their future salary as collateral for the loan. Relatives (even spouses) can act as cosigners on loans.

After winning the pot, a borrower's income may also be verified. This verification occurs in less than half the cases (see Table 2). The largest fraction of borrowers (among

those for whom income is verified) are self employed (Table 2).

Collecting overdue repayments from borrowers (and their cosigners) is a lengthy and costly process. When a borrower misses an installment, then the organizer sends a legal notice to the borrower (after 5 months), another legal notice to borrower and cosigners (after 6 months) and takes them to court (at 12 months if the amount is still overdue). The court begins to collect money from the cosigners approximately 27 months after the missed instalment, and remits collection proceeds to the Rosca organizer around 4 years after the missed installment. The court also collects a 24 percent per year interest penalty on overdues. Our field interviews indicate that the Rosca organizer pushes through with this long costly collection process to make its collateral threat credible.

Arrears and Defaults

We will use two measures of overdues: arrears and defaults. Arrears refer to overdues at the maturity of the loan (at the end of the Rosca). Defaults are a measure of eventual repayment performance (after the Rosca organizer has collected on the loans from borrowers and defaulters). Defaults for our sample are from December 2005 when data was collected from the Rosca organizer.

If cosigners screen out risky borrowers or monitor borrower effort (or project choices), then the effect will be in differences in arrears. If cosigners pressure borrowers to repay ex post or simply hedge against default risk then that will be observed in changes in defaults.

We discuss both the incidence and the rate of arrears (and defaults). The incidence is an indicator variable if the borrower has any overdues. Of the borrowers in our sample, 60 percent are in arrears and 15.7 percent are in defaults. The overdue rate is the proportion of the liability that is unpaid. The arrear rate is 12.5 percent, while the default rate drops to 3.9 percent.

4 Results

Our identification strategy relies on the exogenous change in collateral required at the middle of the Rosca. In this section we first discuss the first-stage regression (the loan officer's collateral requirement). We next use the instrument suggested by the trend break in collateral required to estimate the causal effect of collateral on overdues.

Trend Break in Collateral Required

We first regress the number of cosigners against time dummies and variables that act as controls for collateral requirements:

$$z_{it} = \alpha_t + \gamma x_{it} + \varepsilon_{it},$$

where z_{it} is the number of cosigners attached to the loan of the borrower in round t of Rosca i and x_{it} is a vector of controls. The controls are the relative winning bids, relative liability, dummies for 18 branches and 18 denominations, and the 10 borrower employment category dummies from Table 2.

The point estimates of α_t are plotted over borrower rank in Figure 1.[2] The rank of a borrower is normalized around the median rank in each Rosca. To be precise, denoting by n the number of Rosca members, we define the median rank as $n/2$ if n is even and as one plus the integer of $n/2$ if n is odd. The crosses depict the point estimates, the triangles and squares the lower and upper 95% confidence bounds, respectively. The figure clearly exhibits a roughly linear downward trend and an additional downward jump around the median borrower.

To formally test for the trend break, we regress the series of estimates $\widehat{\alpha}_t$,on a quadratic trend polynomial and allow for a change in the intercept after the median borrower. More precisely, we estimate

$$\widehat{\alpha}_t = a_0 + a_1 t + a_2 t^2 + d\ late_{it} + u_t, \tag{1}$$

[2] For considerations of space the underlying estimation results are not set out in a table.

where $late_{it}$ equals one for all borrowers later than the median and zero otherwise. The results of this estimation are in Table 3. As suggested by the graphical analysis, the quadratic term is insignificant in this estimation. The coefficient of the late term, on the other hand, is negative and statistically significant. The resulting quadratic trend line with the intercept change after the median borrower is also depicted in Figure 1.

To apply this methodology to the sample directly, we next regress the number of cosigners required against the time trend and the $late_{it}$ indicator:

$$z_{it} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta\ late_{it} + \gamma x_{it} + \varepsilon_{it}.$$

The results are in Table 4. They parallel those in Table 3: The quadratic trend term is insignificant, and late ranked borrowers have significantly fewer cosigners, controlling for the downward trend.

Next we turn to the relationship between collateral and defaults. A regression of overdues on trend terms and the number of cosigners simply provides a correlation:

$$y_{it} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta z_{it} + \gamma x_{it} + \varepsilon_{it}, \tag{2}$$

where y_{it} is either arrears or defaults in Rosca i in round t, z_{it} are the number of cosigners attached to the loan, and ε_{it} is an error term. Our regression discontinuity suggests an instrument for z_{it}: the variable $late_{it}$ indicating whether a borrower received a loan after the median round. The null hypothesis of ineffectiveness of collateral can be tested through $\beta = 0$. A negative value of β is evidence for the effectiveness of cosigning in causally reducing overdues.

Though we find a positive correlation between cosigners required and overdues, the causal relationship is negative. The results of a probit regression of the incidence of arrears and defaults are in Table 5. The number of cosigners and overdues are significantly positively correlated in columns 1 and 3. The point estimate in column 1 illustrates that loans with more cosigners are riskier: there is an increase in the probability of an arrear by 6.4 percentage points with each additional cosigner. For the default probit, an additional cosigner implies an increase in the default probability by 2.9 percentage points.

A reduction in cosigners causes an increase in the overdues, however. This can be seen by the instrumented regressions in columns 2 and 4. The coefficient β in column 2 is negative and large, and statistically significant at the 99% significance level. The marginal effect implied by these results suggests a huge effect of adding a cosigner to a loan. Ceteris paribus, an additional cosigner reduces arrears by 41.2 percentage points and reduces default incidence by 22 percentage points when the number of cosigners is instrumented.

We also conduct a regression analysis with arrear and default rates as dependent variables. Here a tobit specification is warranted as the dependent variable is censored at zero and one. The results are in Table 6. We observe the same pattern as in the preceding probits in Table 5. There is a positive correlation and a negative causal impact of cosigners on arrear and default rates. All coefficients of interest are statistically significant at the 95% significance level except for the default rate tobit (column 4). A possible explanation is that default rates have less variation than arrear rates (recall only 16 percent of the default rate observations are non-zero in Table 1 while 40 percent of the arrear rate observations are non-zero).

5 Conclusion

In this paper we have used an exogenous change in the number of cosigners required on a sample of South Indian small loans to isolate the causal effect of relaxing the collateral requirement. Our results suggest that relaxing the collateral requirement increases overdues, both arrears (at the termination of the loan) and defaults (after the collateral has been seized). This leads us to conclude that cosigners (and collateral) play an important role in increasing borrower incentives to repay. While this may seem the obvious role for collateral, our results help distinguish between a few common stories given for collateral use in financial markets.

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Figure 1. Trend Break in the Number of Cosigners Required.

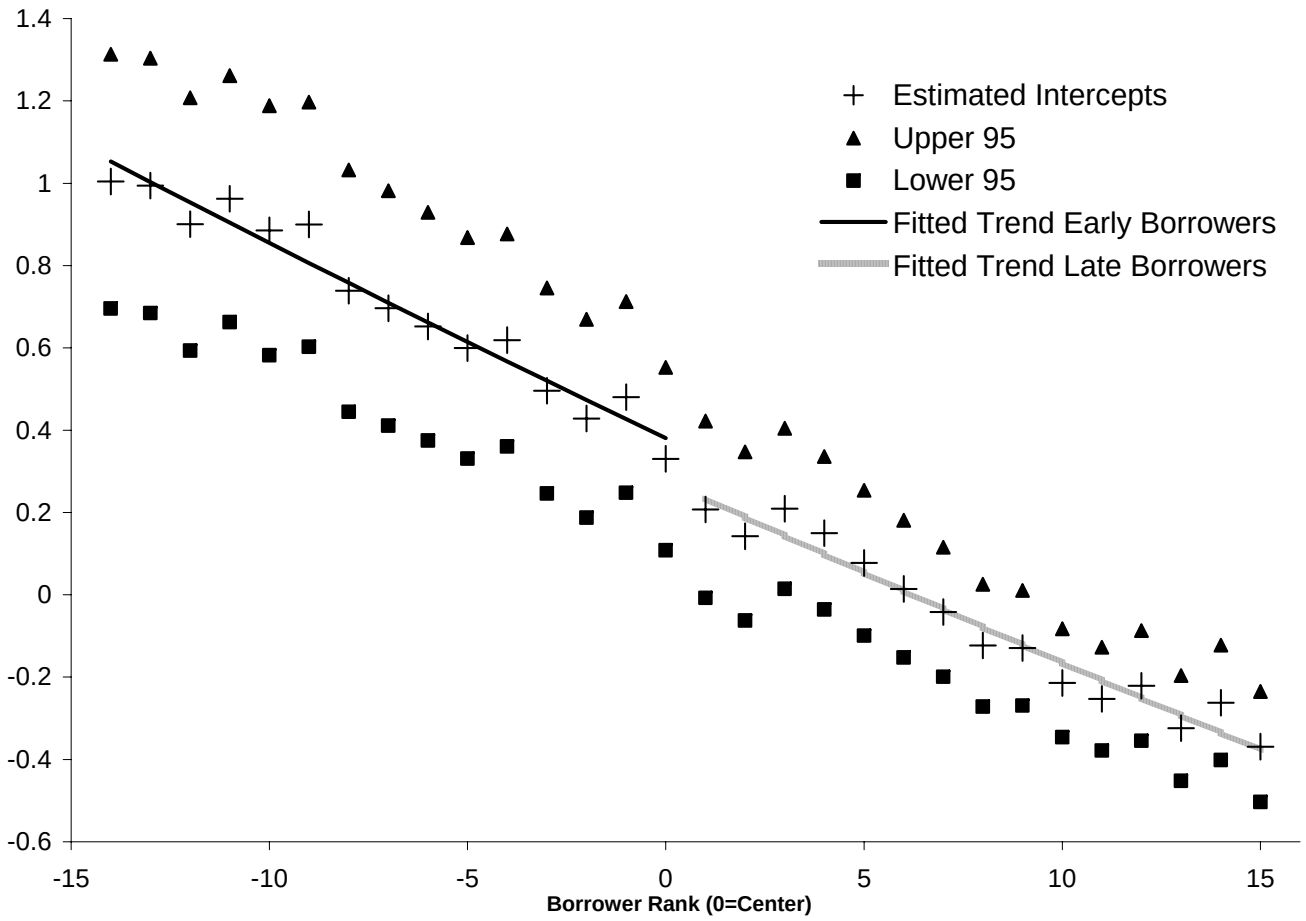

Table 1. Descriptive Statistics.

	Mean	Std Dev	Minimum	Maximum
Monthly Contribution (Rs.)	1,399	1,520	250	10,000
Rosca Duration (Months)	34	7	25	50
Pot (Rs.)	45,482	46,736	10,000	300,000
Liability (Rs.)	19,233	24,098	776	241,372
Liability/Pot	0.417	0.214	0.06	0.86
Loan Duration (Months)	15.329	8.926	2	39
Winning Bid (Rs.)	8,507	11,341	500	90,000
Winning Bid/Pot	0.174	0.099	0.050	0.300
Number of Cosigners	1.220	1.183	0	6
Arrear Incidence	0.600	0.490	0	1
Arrear Rate	0.125	0.185	0	1
Default Incidence	0.157	0.364	0	1
Default Rate	0.039	0.139	0	1

Notes: 11668 observations from Roscas started in the year 2001 in 18 branches and 18 Rosca denominations. Liability is the sum of net contributions (required contributions less dividends) due from a Rosca winner in round t in rounds t+1, t+2...T, where T is the last month of the Rosca. Loan duration for a round t winner is T-t. Arrears are measured at the end of the loan period, defaults in December, 2005. Arrear incidence is an indicator of whether or not the loan has been repaid; arrear rates refers to amount outstanding relative to liability.

Table 2. Occupational Characteristics of Borrowers.

	Frequency	Percent
Services	604	5.18
Education	747	6.4
Banking and law	584	5.01
Government	331	2.84
Health	281	2.41
Manufacturing	1,039	8.9
Self-employed	1,218	10.44
Agriculture	155	1.33
Retiree	328	2.81
Not Verified	6,381	54.69

Table 3. Time Trend and Trend Break in Number of Cosigners.

Dependent Variable:	Estimated α_t of equation (1)
Method:	OLS
Rank	-0.0460
	(0.0019)**
Rank Squared	0.0001
	(0.0001)
Late Rank	-0.1008
	(0.0333)**
Intercept	0.3808
	(0.0202)**
R-Square	0.991
Observations	30

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Table 4. Determinants of the Number of Cosigners.

Dependent Variable:	Number of Cosigners
Method:	OLS
Late Round	-0.0890
	(0.0348)*
Relative Winning Bid	2.9031
	(0.1912)**
Relative Liability	0.1399
	(0.1708)
Round	-0.0432
	(0.0042)**
Round Squared	0.0001
	(0.0001)
R-Square	0.471
Observations	11668

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Notes: dummies for 18 Rosca denominations, 18 branches and 10 borrower occupation categories are not reproduced

Table 5. Probit Regressions of Arrear and Default Incidence

Dependent Variable:	Arrear Incidence		Default Incidence	
Method:	Probit	IV Probit	Probit	IV Probit
	(1)	(2)	(3)	(4)
Number of Cosigners	0.1662	-1.0372	0.1401	-0.7496
	(0.0149)**	(0.0814)**	(0.0166)**	(0.3120)*
Relative Winning Bid	0.5420	3.4723	0.4562	2.8472
	(0.2922)	(0.2667)**	(0.3449)	(0.7714)**
Relative Liability	2.4244	1.0542	-0.4765	-0.1517
	(0.2676)**	(0.3807)**	(0.3200)	(0.3225)
Round	0.0316	-0.0385	-0.0421	-0.0672
	(0.0066)**	(0.0085)**	(0.0078)**	(0.0067)**
Round Squared	-0.0016	-0.0003	0.0000	0.0001
	(0.0002)**	(0.0003)	(0.0003)	(0.0002)
Observations	11668	11668	11668	11668

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Notes: dummies for 18 Rosca denominations, 18 branches and 10 borrower occupation categories are not reproduced

Instrument in columns 2 and 4: round in second half of Rosca

Table 6. Tobit Regressions of Arrear and Default Incidence

Dependent Variable:	Arrear Rate		Default Rate	
Method:	Tobit	IV Tobit	Tobit	IV Tobit
	(1)	(2)	(3)	(4)
Number of Cosigners	0.0322	-0.6241	0.0577	-0.4365
	(0.0030)**	(0.3008)*	(0.0073)**	(0.3615)
Relative Winning Bid	0.1576	2.1264	0.2882	1.7993
	(0.0621)*	(0.9224)*	(0.1552)	(1.1020)
Relative Liability	0.0080	0.2311	-0.3459	-0.1811
	(0.0572)	(0.1367)	(0.1473)*	(0.1732)
Round	-0.0026	-0.0296	-0.0221	-0.0411
	(0.0014)	(0.0138)*	(0.0035)**	(0.0168)*
Round Squared	-0.0001	0.0000	0.0002	0.0002
	(0.0000)	(0.0001)	(0.0001)	(0.0001)
Observations	11668	11668	11668	11668

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Notes: dummies for 18 Rosca denominations, 18 branches and 10 borrower occupation categories are not reproduced

Instrument in columns 2 and 4: round in second half of Rosca