Coexistence or Conflict in the Indian Financial Markets

by
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Abstract

This paper investigates the relationship between formal and informal financial institutions in India. Traditional views treat formal financial institutions and the informal ones as substitutes, in which case previously credit-constrained entities will replace their informal financing by formal financing eventually as they gain access to bank loans. However, in this paper, I take a close look at a particular yet critical type of financial institutions, namely the bidding ROSCAs (Rotating Savings and Credit Associations), and show both theoretically and empirically that formal and informal financial institutions can coexist and benefit from each other. Specifically, I have not found a significant effect of nearby bank openings on ROSCA participation, and the emergence of formal financial institutions significantly reduces the cost of participating in the ROSCAs and lower the amount of default in the ROSCAs as well. Moreover, different types of banks are found to have differential impacts on ROSCAs in terms of participation, winning bids, and the amount of default.

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I welcome any comment on the paper. All errors are my own.

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1 Introduction

1.1 Overview

This paper discusses formal and informal financing channels for impoverished individuals and small and medium enterprises (SMEs) in India with implications for other developing countries as well. In their expansion of production, many such individuals or firms are credit-constrained due to limited collateral and low financial credibility (Banerjee, 2008; Madestam, 2005). Instead, they seek informal financing from private banks, trusts or credit agencies. However, as Allen et al. (2009) conclude from a substantial survey conducted among 212 SME executives in 2004, the significance of formal financing channels has been overestimated and that the reliance on informal financing options persists even after the firms have gained access to formal financing opportunities. In some cases, informal finance accounts for more than 80% of their total financing sources. This intriguing result implies the opposite to some traditional views: informal financing channels, instead of being the last resort for credit-constrained firms, are preferred by many SMEs and hardly can be substituted by formal financing channels (Allen 2005b & 2009; Jain 1999). In fact, there have been many previous studies trying to investigate whether or why formal and informal financial institutions coexist. For instance, Madestam (2005) argues that weak legal institutions contribute to the coexistence of formal and informal financial institutions in developing credit markets, while Fang and Ke (2006) suggest that informal financial markets play an insurance role for investors participating in formal finance and thus coexist with the formal ones.

Inspired by the model of bidding ROSCAs developed in Besley et al. (1993), this paper uses a game-theoretic approach in order to understand how informal financing channels are influenced by the presence of formal financial institutions. Specifically, given outside financing options, such as loans offered by state-owned banks nearby,

it is useful to capture how participants of bidding ROSCAs alter their bidding and participation strategies. Finally, the implications from the theoretical model will be tested by geographical information and interest rate data of 219 ROSCA branches and 5292 banks in Andhra Pradesh, a large state situated on the southeastern coast of India. The change in ROSCA participation, winning bid, and default due to bank openings will effectively reflect the influence of neighboring formal financial institutions.

1.2 Motivation and Research Questions

Bidding ROSCAs (Rotating Savings and Credit Associations) constitute an important part of non-banking financial institutions worldwide. They serve otherwise credit-constrained entities via an auction scheme. In general, a ROSCA can be defined as "a voluntary grouping of individuals who agree to contribute financially at each of a set of uniformly-spaced dates towards the creation of a fund, which will then be allotted in accordance with some prearranged principle to each member of the group in turn" (Calomiris and Rajaraman, 1998). The detailed procedures regarding the auction scheme of a bidding ROSCA is explained in the literature review.

Previous literature of informal finance and the non-banking financial sector suggests that the more state-owned banks there are within some neighborhood of a non-banking financial institution, which, in this research, is represented by a bidding ROSCA, the closer the interest rate in this particular ROSCA is compared to the mean interest rate of all the bidding ROSCAs. Moreover, not only do formal financial institutions have influence on the interest rates of informal lending and borrowing, but their presence is also correlated with an increased level of participation in the informal financial activities (Besley et al., 1994).

This paper address the broad issue of the coexistence or conflict of formal and informal financial institutions. In other words, the general issue to be discussed is:

are banks and ROSCAs complements or substitutes? If they are substitutes, as the traditional view suggests, then the emergence of banks will decrease investors' incentive to participate in bidding ROSCAs via various channels, such as higher costs or lower returns. On the contrary, if banks and ROSCAs are complements, then the emergence of banks will provide people with more incentive to participate in the bidding ROSCAs, and vice versa. In this paper, I examine three difference aspects of bidding ROSCAs, namely ROSCA participation, winning bids (which is also the cost of borrowing), and the amount of default, and determine how the emergence of banks in the neighborhood will affect these three aspects. This way, not only is it possible to tell whether banks and ROSCAs coexist or have conflict, but also it will be clear enough to see the exact channels by which banks influence ROSCAs.

Specifically I address the following questions theoretically and/or empirically. The existing literature on bidding ROSCAs has shed light on the questions below, but through a theoretical investigation tested by an empirical study, this paper provides a more compelling perspective on these issues related to different aspects of bidding ROSCAs in developing counties.

1. Suppose there were no banks at all. What are the bidding behaviors of the participants of the bidding ROSCAs? Specifically, suppose they can observe everyone's productivity, do they overbid or underbid with regard to their true valuation of the "pot?"

2. How are the bidding behaviors different between individuals with highly profitable investment plans and people without good investment plans?

3. With the emergence of banks, how do participants' bidding behaviors change? That is, do they bid more, less, or the same regardless of the banks?

4. With the emergence of banks, how will the participation change in the bidding

ROSCAs? Are the previous participants more likely, less likely or equally likely to stay in the bidding ROSCAs?

5. How will the amount of default change in the bidding ROSCAs with the presence of banks?

The first two questions are especially important for the theoretical model in order to compare the bidding behaviors of ROSCA participants before and after the emergence of banks. The rest three questions are crucial for both the theoretical model and the empirical study. By investigating ROSCA participation versus banking openings, one can immediately tell if banks "steal" ROSCAs' business or not. In other words, the direction in which ROSCA participation moves in reaction of bank emergence immediately suggests whether banks and ROSCAs coexist or not. The questions regarding ROSCA winning bids and default examine how banks influence the operations of the bidding ROSCAs. For instance, if ROSCAs winning bids decline after the entrance of banks, then ROSCA participants might be better off since the cost of borrowing decreases. Similarly, if the amount of default of the bidding ROSCAs declines with bank emergence, then banks can be regarded as "an invisible hand" that provides some regulation to the bidding behaviors in the ROSCAs. In this case, more banks are expected to promote better existence of banks with decreased amount of default.

1.3 Description of the Theoretical Approach

This paper will construct a two-period, two-player game as a model for the bidding ROSCAs. Different Nash equilibria or Bayesian Nash equilibria, if any, will be calculated under different circumstances, that is, with the presence of banks and without the presence of banks. With the control on different parameters, I model the

situations as described in the questions above. The implications of the model are able to provide theoretical answers to the questions above, that is, how bidding behaviors, participation, and default changes with regard to the emergence of banks nearby or additional formal financing channels.

1.4 Description of the Empirical Study

Although this paper is not purely focused on data analysis, this empirical study in this paper is intended to test the theoretical model and its implications. Here are some predictions from the theoretical model to be tested in this section.

1. The effect on participation is, in fact, ambiguous. Although a traditional view might expect the emergence of banks to *decrease* the participation rate in the bidding ROSCAs compared to the case when there is no bank, it must also be taken into consideration that increased availability of banks (and potentially increased financing channels) will enable those in severe poverty to participate in the ROSCAs. Thus, participation may actually *increase*. Hence, the overall effect of bank openings on ROSCA participation is unclear, and it will be shown in the theoretical analysis in subsequent sections that in most cases, the emergence of bank *does not affect* ROSCA participation at all. Moreover, people with certain characteristics (i.e. productivity, risk-aversion) may prefer to stay in the bidding ROSCAs due to its accessibility and auction nature rather than conduct financial transactions in the banks. This hypothesis, if true, essentially shows that formal and informal financial institutions coexist and attract different customers.

2. The emergence of banks will also *decrease* the winning bids submitted by the participants in the bidding ROSCAs, which implies that banks reduce the cost of borrowing from the bidding ROSCAs.

3. The presence of banks will *decrease* the default rates of the participants in the bidding ROSCAs, because the loans from banks, if available, can be regarded as a form of insurance against the risk involved in the auctions.

For the empirical study, I use a panel dataset containing information regarding 219 ROSCA branches and 5292 banks in Andhra Pradesh between January 1998 and December 2000. Using fixed-effects regressions for each of the three variables: ROSCA participation, winning bids, and the amount of default, I endeavor to see how the increased number of banks in the neighborhood of a ROSCA branch will affect these three variables, controlling for time and location fixed effects. In essence, I find the the emergence of banks nearby has an insignificant (yet positive) effect on ROSCA participation. Moreover, banks have a significant negative impact on both the winning bids of the ROSCAs and the amount of default. These results suggests that banks and ROSCAs coexist, and the increased presence of the formal sector in the neighborhood will reduce the cost and incentive to default for ROSCA participants.

1.5 Organization

The paper is organized as follows. Section 2 provides background for the research, which will discuss the merits and shortcomings of formal and informal financing channels. Specially, I will look at a particular type of informal finance, namely the bidding ROSCAs, in South India and its equivalent in Southeast China. It is followed by Section 3 in which I develop a game-theoretic model that describes the bidding mechanisms and incentives of the participants with and without the presence of formal financial institutions, that is, state-owned, commercial, private, or community banks. This paper will then proceed to Section 4, an empirical study of 219 ROSCA branches and 5292 banks in Andhra Pradesh, India in order to test the proposed theoretical model

and its implications on the bidding, participation, and default behaviors in the bidding ROSCAs. Section 5 is the results and the paper concludes with Section 6.

2 Literature Review

2.1 Small and Medium Enterprises

Small and Medium Enterprises (SMEs) are a rapidly growing sector of the global economy marked by its contribution to output, exports and employment, especially in developing countries such as India, China, and South Africa. Although there is no clear-cut number of employees for a firm to qualify for a "small" or "medium" enterprise, a typical "small" enterprise has fewer than fifty employees, whereas the number of employees in a typical "medium" enterprise can vary between 50 and 249, according to the distinction made by the European Union for SMEs worldwide.

Table 1: Classification of Micro, Small, and Medium Enterprises

Type	Manufacturing Enterprises*	Service Enterprises**
Micro	Rs. 2.5 million (US $55,900)	Rs. 1 million (US $22,300)
Small	Rs. 50 million (US $1.12 million)	Rs. 20 million (US $447,000)
Medium	Rs. 100 million (US $2.24 million)	Rs. 50 million (US $1.12 million)
* Investment limit in Plant & Machinery ** Investment limit in equipments Rs. 45 = 1 current US dollars (2010)		

In India, for instance, the SME sector, with an employment capacity of 29.4 million people, accounts for 40% of the gross industrial value added and nearly half of total manufacturing exports (Raju, 2008). In 2009, SMEs contributed over 22% to

the total Indian GDP and its contribution has been constantly growing over the years. According to the annual report released by the Ministry of Micro, Small and Medium Enterprises in India, recent ceilings on investment for enterprises to be classified as micro, small, and medium enterprises are given in Table 1.

2.2 Formal and Informal Financing Channels

Ideally, there are two channels through which the SMEs are financed in order to expand their production: the *formal financing channels* like banks loans, and *informal financing channels* that largely rely on reputation, trust and reciprocity with little legal supervision (Allen et al., 2007). Unfortunately, despite their significant presence in the economy, it has been widely acknowledged that credit constraints from various formal financing options have always been an obstacle that confronts almost all the SMEs. Since the SMEs often have very limited collateral due to their nature and their ability to repay is questionable, financial institutions would run a high risk of default if they issue loans to these firms. As a consequence of the priority sector reform in 1998 that allowed more SMEs the opportunity to obtain funds from state-owned or nationalized banks, the firms immediately used the additional money to expand production instead of using it as a substitute for other forms of borrowing, which is a clear indication that the SMEs are credit-constrained (Banerjee, 2008).

However, the fact that the SMEs are credit-constrained does not imply that they strictly prefer formal financing options over informal ones. In fact, not only do SMEs have an advantage over traditional banks in "relationship lending and borrowing" based on "soft information," such as personal reputation and trust, but also they finance most of their expansion expenditures through informal financing channels and claim that they would prefer to borrow more from informal sources if opportunities arise, as shown in Figure 1 (Berger et al., 2006; Allen et al., 2009).

According to the study conducted by Allen et al. (2009), only about 8% of the total funding needs of the SMEs are realized by formal sources, whereas 85% of their needs are met by alternative sources, that is, informal sources, with the remaining 7% coming from internal sources. Merely based on such information, one may argue that the reason why most of their expansion is financed by informal financing channels is that these SMEs are severely credit-constrained. However, their regression results show that SMEs that depend on alternative financing in the beginning of the firm life tend to continue to rely on it in subsequence phrases even if they gradually gain easier access to the formal financing channel.

Two explanations are proposed by Allen et al. and both of them can be validated by the results this paper generates using the survey data of the 212 SMEs in New Delhi and Hyderabad, shown in Figure 2. On one hand, sticking to long-established informal financing channels is likely to be less costly in terms of the interest rate, especially in relationship lending where families and friends are unlikely to ask for an interest rate as high as the one in the state-owned banks or other formal financial institutions. On the other hand, since SMEs value relationship history in addition to interest cost when determining where to borrow, they are more likely to take the advantage of the long-term relationship with their familiar investors than to start from the beginning to search for new formal financing options of which they have little previous knowledge. Moreover, the data in the survey also suggest that SMEs consider the financial support from family members and friends to be much more important than the availability of loans from state-owned banks, both at start-up and during the growth stage, which further implies that SMEs do have some control and preference over their financing sources, and that informal financing channels must have their own merits, especially in terms of the funding needs of the SMEs, that cannot be substituted by most of the formal financing options (illustrated in Figure 3 and Figure 4).

Although often times SMEs make decisions between formal and informal financing channels, these two channels are not independent. In fact, the presence of formal financial institutions is essential to nearby informal financial markets in the sense that the informal sector would be better informed of the interest rate and that the lending and borrowing strategies might be changed among participants in the informal lending and borrowing who have other financing options outside. In developing or underdeveloped areas particularly, where technology is insufficient to promote perfect information regarding the cost of borrowing, increasing the number of state-owned banks will increase the financing opportunities of the needy. Moreover, even if these entities are credit-constrained from formal banks, at least they are provided with some kind of reference of the interest rate that is able to determine their borrowing behaviors in the neighboring informal financial institutions.

2.3 Overview of Bidding ROSCAs in India and China

Preliminary literature review has been conducted regarding the bidding mechanisms of the bidding ROSCAs in India and China. The literature review includes seven subsections, covering the importance of bidding ROSCAs (a.k.a. chit funds companies in India), their benefits for poor individuals and small and medium enterprises, and the associated problems with bidding ROSCAs, including lack of regulations and defaults. Here is a brief outline of the major findings in the previous literature.

2.3.1 Importance and Prevalence of Chit Funds

In many developing countries including India, chit funds are considered one of the best instruments to cater to the needs of the poor (Rao 2007). On one hand, many of them barely have any information on banks available in the neighborhood, nor are they acquainted with the process of taking loans. On the other hand, banks are highly

unlikely to issue loans to the poor, who are often identified as the riskiest borrowers. Chit funds are also, more importantly, a means of easy and profitable access to finance for the small and medium enterprises due to their limited access to funds from banks and formal financial domains (Rao 2007). Before the financial liberalization around 1991, most SMEs without an established credit history were refused loans or credit from banks, either state banks or private banks. Although some credit constraints are eliminated after the financial liberalization and bank reforms, the CEOs of many SMEs have still reported that informal finance like chit funds still remains one of the major channels from which they obtain funds for their expansion of production.

Chit funds are most common in developing countries due to the prevalence of SMEs, but some immigrant groups in the United States, for example, also utilize them in some circumstances (Fang and Ke 2006). Currently, some variations of ROSCAs are also beginning to develop in other developed countries like France and Japan.

2.3.2 Characteristics of the Members of the Chit Funds

Similar as the beneficiaries of most microfinance institutions in developing countries, the majority of the participants in the ROSCAs are small traders and businesses that do not have an established credit history. In some cases, households (mainly housewives) and salaried employees also participate extensively in these schemes. In the sense of the composition of participants, bidding ROSCAs resemble the Grameen banking system and other microfinance institutions.

ROSCAs have a somewhat strict procedure in terms of the admission of new members. First of all, due to the "relationship banking" nature of the ROSCAs, members are usually connected to other existing chit members or known to the chit manager personally, which is extremely different from formal financial institutions like banks. Hence, it is somewhat easier for each participant to observe other people's

economic status and likelihood to repay. In addition, rigorous verifications are made to ensure the credibility of the member in order to minimize the likelihood of default. Moreover, even after the initial acceptance to the bidding ROSCAs, the new members are not allowed to participate in the auction for the first few months of the scheme and will only contribute to the pot during that period. Unlike most of the banks and microfinance institutions, new members of the bidding ROSCAs must have a guarantor or surety who is trusted by the chit manager. This guarantor is also sometimes known as the co-signer. Finally, collateral is also sometimes demanded from members prior to their participation in the auctions. However, once a member is formally admitted to the ROSCA and is eligible for bidding, little further documentation will required. Note that most of the companies do require the members to have a bank account since 100% of the transactions are done through check payments (Rao 2007).

It is worth noticing that not all ROSCA participants are severely credit constrained. In fact, some of them do have access to some types of formal financial institutions. For instance, in Wenzhou, a coastal city in Zhejiang Province, China, private entrepreneurs not only have access to public banks, though with some restrictions, they can also borrow from a well developed private credit market.

2.3.3 Bidding Mechanisms

In this section, I will explain the specific bidding mechanisms of the bidding ROSCAs. Note that there might be slight variations of these mechanisms of ROSCAs in different countries. However, the basic "rotating" nature of the bidding ROSCAs is the same across different countries.

1. Each bidding ROSCA lasts for a fixed number of months, and the number of participants N in the ROSCA is equal to the number of months.

2. Members contribute a certain amount of money k to the "pot" each month. Here, "Chit Value" is defined as $N \times k$.

3. The participants then bid to receive the pot in an open ascending bid auction (which is equivalent to a second-price, sealed-bid auction), where previous winners are not eligible to bid.

4. The highest bidder (i.e. prized subscriber) of the month wins the "pot" and pays the bid amount called "discount." It is worthwhile to note that if there is an equal bid, the decision of who is entitled to the loan is made by means of a lottery. If two members are equally in urgent need of the loan, the pot may be divided between them.

5. The "discount" is then distributed among the rest of the members as "dividend," so that $dividend = discount/(N-1)$.

Multiple-membership is allowed for the bidding ROSCAs[1]. However, the members can bid again only after 50% of the duration is completed. Essentially, each participant can hold up to two memberships in one ROSCA scheme.

2.3.4 Use of Chit Money

There are two major uses of the chit money obtained from ROSCAs: household expenditures and small businesses.

For individual households, participation in chit funds were mainly for the purpose of purchasing some property, or in other words, for *consumption purpose*. However, recently, there has been tremendous alteration in the constitution and functioning of chit funds (Rao 2007). In this case, consumption purposes include marriages, buying

[1]Although in reality, multiple-membership is allowed and does exist in actual ROSCAs, I only consider the case of single-membership throughout this paper, because multiple-membership can be regarded as two players with exactly the same characteristics.

property (land, vehicle, etc.), and education, especially children's secondary education and beyond. Since a large portion of the ROSCA participants are women, chit money is also regarded as a means to saving free cash by the women of the household. Sometimes, the chit funds loans may also be used to settle outstanding loans with the money lenders. However, such members may run the risk of defaulting since they may be caught in the "vicious circle of debt" or the "debt trap." This situation is very much like what has happened with many microfinance institutions. Moreover, like microfinance institutions, in general, chit managers do not require the members to specify the purpose of the funds.

In terms of chit funds used towards small Businesses, the funds are generally used as either working capital, for expansion of business or as emergency funds. Chit funds are also a welcome measure for such enterprises to overcome their financial constraints. Moreover, in chit funds, small traders can decide their own interest rates depending on the need. Hence, chit funds are a more suitable financing model than banks and formal financial institutions for small businesses mainly because the participants do not require filing of income tax returns and other rigorous documentation.

2.3.5 Regulations and Registration of Chit Funds

Most bidding ROSCA branches (or chit funds companies) are loosely regulated by the government. Although the regulation is far less strict than that for banks, regulation is generally considered to be beneficial for the bidding ROSCAs to ensure their proper operations. Like the microfinance institutions in Andhra Pradesh, ROSCA branches are required to register, and detailed terms of the regulation are outlined below. There are also some chit funds companies that are not regulated at all, namely the "unregistered chit funds," but these organizations are not the focus of this paper.

1. Registration of a chit scheme entails numerous fee payments and other required

formalities, such as filing of returns, maintaining minutes of the meeting, auditing of accounts and so on, that need to be satisfied by the chit manager.

2. Prior sanction needs to be obtained from the Registrar (an application plus a fee of Rs. 50, which is about one dollar). Then, the chit fund company needs to file a chit agreement with every member in that particular group, with a cost of around Rs. 20 (about $0.44) per member. Once the chit agreement is filed and approved, the certificate for commencement of the scheme will be issued.

3. The chit manager needs to deposit 100% of the chit value with the Registrar and the deposit will be refunded on the successful completion of the chit cycle.

4. "Bid-cap" and "Bid-floor"

   (a) All registered chit funds are required to impose a 30% cap of the total chit value (increased to 40% in 2007) on the bidding amount to ensure that the bid does not rise uncontrollably leading to subsequent default by the bidder[2].

   (b) The minimum bid is restricted to 5% of the chit value which is the ROSCA organizer's commission.

5. The registration of chit funds ensures more *transparency* and *accountability* in its operation. It also boosts the confidence of the members. The registration also decrease the risk involved.

2.3.6 Possible Failure of Bidding ROSCAs

Like banks and all the microfinance institutions, bidding ROSCAs do fail at times when their participants default. In this case, default in a bidding ROSCA is defined

[2]In the models I construct in this paper, I do not consider the presence of "bid-cap," because I assume that the players in my model behave rationally, which rules out the possibility that the bids are too high to be repaid.

as the failure of the winner in a particular round to pay the "discount" to the other participants in the ROSCA. The default rates in the chit industry hover around a meager 1-2%, but even the default by a single person will cause serious problems and affect the participation of other members.

Three steps will be taken when members fail to make their contribution for any particular month:

1. Oral correspondence
2. A reminder sent by mail (if oral correspondence fails)
3. A legal notice issued to take the person to Court (if both fails)

The Court associates the salary, collateral and sometimes even personal property of the member to the repayment of the unpaid dues. In the most serious cases, the guarantor or surety is asked to make the payment. Moreover, interest is charged on the delayed payment and sometimes even the dividends are forfeited if the delay of the payment of the "discount" is for too long.

3 Model Construction

3.1 Intuition behind the Model

In this section, a game-theoretic model will be developed in order to answer the questions posed earlier regarding the bidding behaviors and participation in the bidding ROSCAs with and without banks.

It has been suggested in many previous literatures and empirical studies that the majority of the participants in bidding ROSCAs are individuals in poverty and small and medium enterprises (SMEs) confronted with credit constraints. Hence, one

might be tempted to conjecture that once the credit constraints are removed and the free access to formal credit market is made possible, the use of bidding ROSCAs will fade since their major participants will move from informal financing options to the formal ones.

However, in a survey conducted by Allen et al. (2004) among 212 SME executives in 2004, a surprising fact is revealed that many previously credit-constrained firms still rely on informal financing options to fulfill most of their financial needs even after they have gained access to loans in formal financial institutions, namely the state banks. Not only does evidence exist in India, but the preference towards bidding ROSCAs over formal financial institutions seems prevalent in many other developing countries as well. For instance, in Wenzhou, a bourgeoning city in Zhejiang Province in southeastern China, many bidding ROSCAs are well established in order to satisfy the increasing financial needs of the small and possibly credit-constrained firms, especially at the start-up stage. In one of the two empirical facts documented in the Fang and Ke (2007), it is implied that ROSCAs are prevalent even in the presence of formal financial markets, and that many of the ROSCAs participants have reported borrowing from the formal financial institutions to fulfill their ROSCA obligations, such as the monthly contributions and the bid premiums, and saving their winnings from the bidding ROSCAs to the formal credit market to earn an additional interest.

In the model to be developed in this section, I will be able to show mathematically that the first explanation of Allen (2009) is indeed true so that the formal credit market, due to its higher and thus unfavorable interest rate on loans for borrowers, is by no means a perfect substitution of the bidding ROSCAs. A lower implicit interest rate implied by the bidding mechanism is thus the reason why these informal financial institutions are still preferred even with the existence of formal financing options.

3.2 Basic Auction Theory

In order to model the auction schemes in the bidding ROSCAs, it is necessary to review the classification of auctions and auction theory in general and outline the equilibrium conditions for different types of auctions. Special attention will be paid to second-price, sealed-bid auctions, since the similarity between the bidding mechanisms in the bidding ROSCAs and second-price, sealed-bid auctions will be discussed in the next subsection. In general, there are four basic types of auctions defined as the following.

Definition 3.1. *The four basic auction types are first-price, sealed-bid auction, second-price, sealed-bid auction, Dutch auction and English auction.*

1. First-price, sealed-bid auction*: Each bidder submits a sealed bid to the seller. The highest bidder wins and pays his bid for the good.*

2. Second-price, sealed-bid auction*: Each bidder submits a sealed bid. The highest bidder wins and pays the second-highest bid for the good.*

3. Dutch auction (a.k.a. open descending price auction)*: The seller begins with a very high price, and reduces it gradually. The first bidder to raise his hand wins the object at the current price offered by the seller.*

4. English auction (a.k.a. open ascending price auction)*: The seller begins with a very low price and increase it gradually. Each bidder signals when he wishes to drop out of the auction, and once a bidder has dropped out, he cannot resume bidding later. When only one bidder remains, he is the winner and pays the current price offered by the seller.*

In order to determine the bidder's incentives, it is worth noticing from standard auction theory (see Jehle & Reny) that the first-price, sealed-bid auction has the same Nash equilibrium as the Dutch auction, and that second-price, sealed-bid auction has

the same Nash equilibrium as the English auction. Hence, when modeling a specific bidding scheme and determining the bidder's incentives, it is enough to simply focus on second-price, sealed-bid auctions since it is equivalent to the English auction, the actual auction scheme employed in the ROSCAs.

3.3 Model for Two-Player Bidding ROSCAs without Banks

In this case, a two-agent, two-period model of bidding ROSCAs without the existence of formal financial institutions will be considered. In this case, the model is based on the assumption that information is perfectly public so that information asymmetries do not exist.

3.3.1 Assumptions

1. There are two participants and hence two rounds.
2. There is an auction only in period 1.
3. The winner in the first period will receive the "pot" and thus invest the two dollars, assuming the return of the investment is y. The term y can also be thought of as the productivity of the winner. The loser of the first period will not have any investment opportunities due to the lack of funds.
4. The productivities are drawn independently from some distribution F, and each player observes both his own productivity and the productivity of the opponent.
5. A repayment of b (i.e. the "discount") is due from the winner from the first period at the second period.
6. In the second period, the loser of the first period will receive an amount of b from the winner in the first period.

7. The bids can only be placed in discrete amount with a minimum gap of \$0.01. For instance, the highest bid below \$2 will be \$1.99, and neither players is allowed to bid \$1.995, for instance.

8. The agents do not discount future incomes.

9. Although a fixed commission in addition to the bid is usually charged in the period when agent 1 or 2 wins the auction, for the simplicity of the model, it is assumed that there is no commission paid to the managers of the bidding ROSCAs.

Note the for the analysis below, it is not necessary to take the initial contribution of \$1 into consideration because this one dollar can be thought of as a sunk cost and will not affect the bidding behaviors of the participants.

Since this paper is concerned with the type of ROSCAs with open-ascending bid auctions, by the auction theory discussed above, the computations can be simplified by modeling the auction as a second-price sealed-bid auction to find the appropriate bidding equilibrium. Note, however, that this second-price sealed-bid auction is slightly different than that in the usual sense, because in a usual second-price sealed-bid auction, the loser will not be able to make any profit. In contract, the participant who loses in the auction will still make a profit of b, where b is his own bid in the auction. In this sense, it is intuitive that the participants, especially the potential losers, might have an incentive to overbid in order to gain a higher profit.

Now, what needs to be done is to find each agent's valuation of the "pot," and it is known that his true value will be at least related to the amount of the bid. Suppose that for player i, where $i = 1, 2$ his productivity is y if he is able to win the auction and thus invest the "pot." If this participant wins the bid in the first period, then the total payoff will be $2y - b$ since his return of investing the "pot" containing two dollars

is $2y$, and he has to pay the bid premium of b in the second period.

Suppose, instead, that this agent loses in the first period. Then, his payoff is merely b, since he receives b in the second period and there is no commission to be paid to the manager.

Hence, the amount of money that this agent is willing to pay (that is, his valuation) for the "pot" in the first period is obtained by equating the payoffs in both cases described above, that is,

$$2y - b = b \Longrightarrow b^* = y,$$

where b^* is the optimal bid for the player given his productivity of y.

The chart below illustrates the assumptions and calculations outlined above:

Table 2: Payoffs for Each Participant of the Bidding ROSCA

	Payoff in the First Round	Payoff in the Second Round
Winner of the First Round	-1	$2y - b$
Loser of the First Round	-1	b

Therefore, suppose instead that the loser of the auction will not be able to make any profits, then the bidding equilibrium in this case is that each player should bid his productivity y, which is also his true value of the "pot" in the first period. Note the each player's valuation for the "pot" will not be affected even if commission is taken into consideration, because in either case, the player is required to pay a fixed amount regardless of his winning status.

3.3.2 Bidding Equilibrium

Since each player's productivity is observed before the bids are placed, no expectation needs to be formed so that the bidding equilibrium will be independent of the distribution of the productivities. Let y_1 and y_2 be the productivity of players 1 and player 2, respectively. Note that the distribution F is discrete in this case with minimum gap of 0.01. Hence, there are essentially two cases: (1) player 1 has a higher productivity than player 2, that is, $y_1 > y_2$; and (2) both players have the same productivity $y_1 = y_2 = y$.

Now, I solve for the bidding equilibrium for two different possible cases, which will verify the fact that the person with low productivity has an incentive to overbid.

Proposition 3.2. *If player 1 has a higher productivity y_1 than player 2, who has a lower productivity of y_2, then player 1 will bid y_1 and player 2 will bid $y_1 - 0.01$.*

Proof. Suppose that player 1 bids y_1, and we want to show that player 2's optimal choice is to bid $y_1 - 0.01$, that is, the maximum amount just below y_1. If player 2 bids anything less than $y_1 - 0.01$, then his will lose the auction and player 1 will be the winner. In this case, player 2 gets b_2, while player 1's payoff will be $y_1 - b_2$. If player 2 bids anything greater than y_1, then player 2 will win the auction and thus pay y_1 to player 1 so that his payoff will be $2y_2 - b_2 < y_2$. If player 2 bids y_1, his expected payoff will be y_2 since the winner will be determined by a lottery instead. Therefore, by bidding $y_1 - 0.01$, player 2 will have the optimal payoff.

Now, suppose that player 2 bids $y_1 - 0.01$, and we want to show that player 1's optimal choice is to bid y_1. If player 1 bids anything less than y_1, then his will lose the auction and player 2 will be the winner. In this case, player 1 gets $b_1 < y_1$, while player 2's payoff will be $y_2 - b_1$. If player 1 bids anything greater than y_1, then player 1 will win the auction and thus pay y_1 to player 1 so that his payoff will be $2y_1 - b_1 < y_1$. If

player 1 bids y_1, his expected payoff will be y_1 since the winner will be determined by a lottery instead. Therefore, by bidding y_1, player 1 will have the optimal payoff.

Hence, we know that $(y_1, y_1 - 0.01)$ will be the optimal strategy (bids) for each player. Note that since $y_1 - 0.01$ is the largest "allowable" number below y_1, we have $y_2 \leq y_1 - 0.01$ so that player 2 overbids in this case. □

Proposition 3.3. *If both players have the same productivity $y_1 = y_2 = y$, then both of them will bid y.*

Proof. Clearly, neither player will have an incentive to bid higher than y, in which case their net profit would be negative. Now, suppose that player 1 bids y, and we need to show that it is in player 2's best interest to bid y as well. Suppose he bids $b_2 < y$ so that his payoff will be b_2. However, if he bids y, then he has to split the pot with player 1 so that his investment return will be $1 \cdot y = y$. Since $b_2 < y$, player 2 will be able to earn a better profit by bidding y.

By symmetry, assuming that player 2 bids y, player 1's best strategy will be bidding y as well. □

3.4 Model for Two-Player Bidding ROSCAs with Banks

3.4.1 Assumptions

In this case,a two-agent, two-period model of bidding ROSCAs with the existence of formal financial institutions will be considered. All the assumptions are the same as the previous case except that both players can now borrowing interest rate of r_b and saving interest rate of r_s where $r_s < r_b$. Since each player's endowment in period 1 is only \$1, the maximum amount that can be saved is \$1. For simplicity, let us suppose that there are three options: save \$1 in the bank, borrow an additional \$1 from the bank, and participate in the bidding ROSCA with the \$1 dollar of endowment.

Below is a table showing each player's payoff in each stage:

Table 3: Payoffs for Each Participant of the Bidding ROSCA

	First Round Payoff	Second Round Payoff
Winner of the First Round	-1	$2y - b$
Loser of the First Round	-1	b
Saving	-1	r_s
Borrowing	-1	$2y - r_b$

3.4.2 Timing

There are two kinds of possible timing related to a participant's productivity and decision on whether to join a bidding ROSCA or go to the bank.

1. Player i observes his own productivity, he immediately decides on whether to join a bidding ROSCA or go to the bank. Then, the player observes the productivity of his opponent and submit the bids, if any.

2. Player i observes the productivities of both players, then he decides on whether to join a bidding ROSCA or go to the bank. He or she will submit bids if willing to join the bidding ROSCA.

3.4.3 Bidding Equilibrium

To compute the bidding equilibrium, the second timing will be considered first, where the decision between ROSCAs and banks is made after observing the productivities. The first timing, which is more complicated and less realistic, will not be considered in this paper, since each player must form an expectation of the other player's productivity based on the distribution function F. In this case, utility functions also need to be

introduced to differentiate risk-averse participants, who will choose banks, and risk-loving participants, who will choose to join the bidding ROSCAs instead.

Recall the two possibilities regarding y_1 and $y_2 : y_1 > y_2$ or $y_1 = y_2$. The first case is simple: since both players are borrowers and the cost of borrowing is y in this case, ROSCA will definitely continue to exist when $y \leq r_b$. If $y > r_b$, then both players are indifferent between staying in the ROSCA by bidding r_b and leaving the ROSCA to borrow from the bank at interest rate r_b.

Now, consider the case when $y_1 > y_2$. There are several possibilities regarding y_1, y_2, r_s and r_b.

1. $r_s < r_b \leq y_2 < y_1$ (both players have great investment plans);
2. $r_s \leq y_2 < r_b \leq y_1$ (only one player has great investment plans);
3. $y_2 \leq r_s < r_b \leq y_1$ (only one player has great investment plans);
4. $r_s \leq y_2 < y_1 \leq r_b$ (both players have mediocre investment plans);
5. $y_2 \leq r_s < y_1 \leq r_b$ (one player has mediocre investment plans and the other player only has unprofitable ones);
6. $y_2 < y_1 \leq r_s < r_b$ (both players have unprofitable investment plans).

Proposition 3.4. *There will be no bidding ROSCA if possibility (1) holds.*

Proof. For the bidding ROSCAs to exist, we claim that if $y_1 > y_2$, then the maximum bid cannot exceed r_b since if $b > r_b$, then borrowing gives a greater payoff in the second period than the maximum payoff the high-productivity player is able to gain from the auction. Now, suppose that player 1 has high productivity y_1 and player 2 has low productivity y_2. Then, as discussed above, player 1 will not bid higher than r_b.

Knowing that the opponent has a higher productivity, player 2 only has an incentive to bid slightly lower than r_b. Thus, player 2's payoff is at most $r_b - 0.01$. However, player 2 will be better off if borrowing another \$1 from the bank instead, in which case he will get $2y_2 - r_b > r_b$ instead of $r_b - 0.01$. Therefore, the bidding ROSCA will not sustain in this case. □

Proposition 3.5. *If possibility (2) holds, the bidding ROSCA will sustain in this case, where player 1 bids r_b and player 2 bids $r_b - 0.01$.*

Proof. As I have shown above, the maximum bid cannot exceed r_b. Now, suppose that player 1 has high productivity y_1 and player 2 has low productivity y_2. Then, as discussed above, player 1 will not bid higher than r_b. Knowing that the opponent has a higher productivity, player 2 only has an incentive to bid slightly lower than r_b. Thus, player 2's payoff is at most $r_b - 0.01$. If player 2 saves in the bank, then his payoff will be $r_s \leq r_b - 0.01$. If player 2 borrows from the bank, his payoff will be $2y_2 - r_b < r_b$ so that his payoff is at most $r_b - 0.01$. Therefore, the bidding ROSCA will sustain in this case, where player 1 bids r_b and player 2 bids $r_b - 0.01$. □

Note that this possibility captures the effect of banks on the bidding ROSCAs. Originally, without banks, the optimal bids are $y_1, y_1 - 0.01$ for player 1 and player 2, respectively. Now, with the emergence of banks, the new optimal bids are $r_b, r_b - 0.01$ for player 1 and player 2, respectively. Since $r_b \leq y_1$, the bids submitted by both players are lower than before so that the presence of banks contributes to decreased bids in the bidding ROSCAs.

Proposition 3.6. *If possibility (3) holds, the bidding ROSCA will sustain in this case, where player 1 bids r_b and player 2 bids $r_b - 0.01$.*

Proof. The proof is exactly the same as the previous one, because player 2's bid will be determined by only player 1's productivity and thus his bid. □

Proposition 3.7. *If possibility (4) holds, the bidding ROSCA will sustain in this case, where player 1 bids r_b and player 2 bids $r_b - 0.01$.*

Proof. The proof is almost the same as the proof for the case when possibility (2) holds, except that the equilibrium is $(y_1, y_1 - 0.01)$, and hence the proof is omitted. □

Proposition 3.8. *If possibility (5) holds, the bidding ROSCA will sustain in this case, where player 1 bids r_b and player 2 bids $r_b - 0.01$.*

Proof. The proof is almost the same as the proof for the case when possibility (3) holds, except that the equilibrium is $(y_1, y_1 - 0.01)$, and hence the proof is omitted. □

Proposition 3.9. *There will be no bidding ROSCA if possibility (6) holds.*

Proof. For the bidding ROSCAs to exist, I claim that if $y_1 > y_2$, then the maximum bid cannot exceed r_s since if $b > r_s$, then saving in the bank gives a greater payoff in the second period than the maximum payoff the high-productivity player is able to gain from the auction. Now, suppose that player 1 has high productivity y_1 and player 2 has low productivity y_2. Then, as discussed above, player 1 will not bid higher than r_s. Knowing that the opponent has a higher productivity, player 2 only has an incentive to bid slightly lower than r_s. Thus, player 2's payoff is at most $r_s - 0.01$. However, player 2 will be better off if borrowing another \$1 from the bank instead, in which case he will get r_s instead of $r_s - 0.01$. Therefore, the bidding ROSCA will not sustain in this case. □

In short, the results above can be summarized as follows:

Table 4: ROSCA Sustainability with the Emergence of Banks

Cases	Existence of ROSCAs	Winning Bids
$r_s < r_b \leq y_2 < y_1$	No	–
$r_s \leq y_2 < r_b \leq y_1$	Yes	r_b
$y_2 \leq r_s < r_b \leq y_1$	Yes	r_b
$r_s \leq y_2 < y_1 \leq r_b$	Yes	y_1
$y_2 \leq r_s < y_1 \leq r_b$	Yes	y_1
$y_2 < y_1 \leq r_s < r_b$	No	–

3.4.4 Intuition for the Results

It is easy to observe from the results above that banks will "substitute" the role of bidding ROSCAs only in two extreme cases, that is, $r_s < r_b \leq y_2 < y_1$ and $y_2 < y_1 \leq r_s < r_b$. In the first case, the two participants can be regarded as people with great investment plans since both y_2 and y_1 are large compared with the interests in the banks. Since I have already proved above that the participant with less productivity has an incentive to overbid, borrowing money from banks will be a comparatively cheaper way to obtain funds for the participant with more productivity. Consequently, the more entrepreneurial participant is willing to leave the bidding ROSCA since he would rather pay r_b to the banks than paying $y_1 - 0.01$, which is higher than r_b, to the participant with lower productivity.

On the other hand, the second case ($y_2 < y_1 \leq r_s < r_b$) indicates that if both of the two participants are incapable of conducting profitable business, then they will have an incentive to seek a "safer" and more profitable way to earn money by collecting

interests on savings from the bank. For instance, even the more entrepreneurial person of the two participants, that is, the participant with productivity y_1 is able to earn a better profit by saving money in the bank and obtain an interest of r_s after a year. For either player, due to the low productivity, it is no longer profitable to participate in the bidding ROSCA if they have an alternative financing channel.

In all other cases, however, the ROSCA will be able to sustain despite the emergence of banks. Part of the reason for this interesting fact that ROSCAs offer a relatively cheap way of obtaining the fund necessary for the expansion of the small businesses. If not both of the participants happen to be extraordinarily intelligent or incapable at the same time, then participating in the bidding ROSCA will make both of the participants better off by offering funds for the more entrepreneurial person at a lower cost and by allowing the less entrepreneurial individual to earn a better interest than the interest offered by the banks. Therefore, in most cases (and more realistic cases), I expect the bidding ROSCAs to coexist with banks due to their more favorable implicit interest rates on savings and borrowings than those available at formal financial institutions like banks.

3.5 Choice to Default from the ROSCAs

With the emergence of banks and increased access to formal finance, participants in the ROSCA will have to decide their best way to obtain the financing they need. In this case, I take a close look at the default behaviors inside the bidding ROSCAs. Specifically, I want to answer the question: as more banks become available in the neighborhood, would the amount of default (or the incentive to default) in the ROSCAs increase or decrease?

By definition, default means the winner of the auction in a particular round of the ROSCA fails to pay the bid premium or the "discount." In theory, the answer to the

question above should be ambiguous, because it would rely on individuals' productivity as well as the borrowing rates in the banks. On one hand, banks could be an insurance for ROSCAs in the sense that ROSCA participants can save their winnings in the banks. Thus, people have less incentive to default from the ROSCAs. On the other hand, however, participants might have more incentive to default from the ROSCA if the banks offer a much lower borrowing interest rate than their current cost to borrow from the ROSCAs.

Specifically, for the winner i of a particular round of ROSCA, if $b_i > r_b$, then he will have an incentive to default from the ROSCA and borrow from the bank instead at borrowing interest rate of r_b. In contrast, if $b_i \leq r_b$, then his incentive to default or the amount of default should roughly stay the same, since participating in the ROSCA is still the cheaper way of obtaining funds even with the emergence of banks.

4 Empirical Study

4.1 Data Sources

4.1.1 Descriptions

This paper depends on three important data sources:

1. ROSCA Branches and Bank Branches in Andhra Pradesh

   One of the most important data sources used in this paper contains geographical information and interest rate data of 219 ROSCA branches and 5292 banks in Andhra Pradesh. Most of the geographical information (i.e. longitude and latitude) is obtained using Google Earth with the approximations depending on the banks' pincodes (equivalent to zip codes in the U.S.). This dataset also contains the following variables:

(a) Types (state-owned, nationalized, community, foreign, or private) of the banks;

(b) Exact dates when the banks were opened;

(c) Exact dates when the ROSCA branches were opened;

(d) Winning bids in each round of the auctions in each bidding ROSCA;

(e) Number of participants/length in each bidding ROSCA;

(f) Amount of default for each bidding ROSCA; and

(g) Number of banks of each type within a certain distance (from 1 km to 30 km) of each bidding ROSCA branch. For the actual empirical study, this paper will only use 10 km as the radius.

Figure 5 to Figure 8 provide some basic information regarding the ROSCAs. Figure 5 illustrates the banks (pink dots) and chit funds branches (blue dots) in Andhra Pradesh, and Figure 6 adds a "buffering circle" with a radius of 20 kilometers to each of the 219 chit funds branches. I have already calculated the number of bank branches within each circle, indicating the level of the presence of formal financial institutions around each informal financial institution. Moreover, information such as the types and years when the banks opened has already be added to the maps.

Figure 7 illustrates the distribution of the years when the banks were opened. The earliest opening recorded is on January 1, 1900, and the latest opening recorded is on December 31, 2000. The mean is approximately January 1, 1979, and the median is January 1, 1980.

Figure 8 depicts the distribution of the years and months when the ROSCAs in each branch were started between 1998 and 2000. An interesting fact to note is

that most of the starting dates peak around March/April and October/November, which is due to two major Hindu festivals, Koli and Diwali in March and October/November, respectively.

2. Andhra Pradesh bidding ROSCA dataset

   This dataset contains information about the bids, defaults and participation in each ROSCA of the 219 locations, and these statistics will be employed in order to investigate the influence of the existence of banks on the bidding behaviors of the ROSCA participants. The author has already calculated the aggregate participation in each ROSCA branch since the empirical study will be conducted on a town/branch level instead of ROSCA level. Note that hundreds of ROSCAs usually take place in one ROSCA branch in various months.

4.1.2 Limitations

Short time span is the major limitation of the dataset. Although ROSCAs have a long history in India, only in recent years have their operations been computerized so that most of the data are from 1995 or later. Moreover, some ROSCAs last for a long period and they had not yet finished when the data were collected. Hence, I must drop those bidding ROSCAs for my investigation of ROSCA default since default is only recorded when the ROSCA ends.

As for the dataset regarding the banks, all the data are collected before 2000 so that I do not have any information on newly established banks after 2000. In this case, the only period when I have a reasonably large dataset about the ROSCAs and the banks is 1998 to 2000, which is hence chosen to be the time span for this study in this paper. Due to the short time span, there is not much variation of the number of banks or ROSCAs as desired, which might be an unfavorable factor for fixed-effects

regressions (the one used in the paper).

If the data regarding the newly opened banks after 2000 were available, I could have chosen a longer time span and the study might have shed more light on how ROSCAs evolve over time.

4.2 Overview of Methodology

In order to answer the question empirically regarding the choice between formal and informal financing channels, I will rely on the two data sources described above to test the theory regarding ROSCA participation, winning bids, and default vis-à-vis bank openings. If the implication of the theory is ambiguous, I want to use the actual data to determine which case in the theory is the "driving force."

With the theoretical model of how ROSCA participants change their behaviors when outside financing options become possible, multiple linear regression will be applied to the data on state-owned banks and bidding ROSCAs in order to see if there is any correlation between the opening of banks within a certain distance of a bidding ROSCA and the bids of that ROSCAs compared to the case before the emergence of banks. It is expected to see a negative correlation since I expect an increased number of banks around a ROSCA to decrease the bids submitted by participants in that ROSCA. In order to explore the relationship between the availability of formal financial institutions (i.e. banks) and the participation in informal financing, another multiple linear regression will be conducted, with the participation (shown as the number of participants in informal financing) being the response variable and the number of newly opened banks nearby being one of the explanatory variables. If the coefficient of this explanatory variable is significantly positive, then it can be concluded that on average, an increased presence of formal financial institutions will effectively bring about more participation in informal financial activities, and vice versa.

4.3 Regression Specification for ROSCA Participation

4.3.1 Motivation for the Regression Equation

Much effort has already been devoted to cleaning the existing datasets and creating new statistics necessary for this empirical study. Much of the work is completed using Excel and ArcGIS, a geographical software for analysis in different fields. A description of how to use ArcGIS to create and calculate the new statistics used in this study is included in Appendix B.

Here is a roadmap for the regression model in this paper:

1. The main model employed in the empirical analysis is a fixed-effects model, with a unit of observation for each town i and each month t during January 1998 and December 2000.

   Important Note:

   Since the time span of the study is not particularly long, using the fixed-effects model will not take any cross-sectional variations into consideration. Since the variation across time is small due to the unit I have chosen, I have employed the Hausman specification test between the fixed-effects model and the random-effects model to see if these models give essentially the same prediction. Standard econometric theory claims that if these two models give the same prediction, the random-effects model should be used since it is believed to be more efficient than the fixed-effects model (i.e. using both within variations and cross-sectional variations); but if not, the fixed-effects model should be employed since the random-effects model is biased and a fixed-effects one is thus the correct estimation procedure.

2. An Ordinary Least Squares (OLS) regression would be very likely to produce biased estimates of the impact of the availability of banks on ROSCA entrants

because there would be a large amount of omitted variable bias. Hence, a fixed-effects model as outlined below helps to eliminate bias from omitted variables associated with time- and town-specific characteristics.

3. By including town fixed effect, the model is controlling for any time-invariant unobservable factors that could be different between ROSCA branches that would impact individual's decision on joining ROSCAs, such as locations, types of towns (rural or urban), and the ease of transportation.

4. Moreover, by including month fixed effect, the model is also controlling for any town-invariant unobservable factors that would vary dramatically across time, such as several major bank reforms in India, the general macroeconomic activities, and seasonal effects on ROSCA activities.

4.3.2 Regression Equation

In order to see the effect of bank openings in a particular town on the ROSCA participations in the same town, a regression of the number of new ROSCA entrants on the total number of banks available in that area will be conducted. From the theoretical model, it can be expected that banks either have a negative impact on ROSCA participations or no effect at all. In several previous papers on bidding ROSCAs, the possibility of a positive effect of bank openings on ROSCA participations has been discussed, since some individual might have the incentive to borrow money from banks in order to finance their participation in the ROSCAs. Though theoretically possible in some cases, such a possibility is not implied in the simple theoretical model developed above, and the empirical study will serve as a test for the theoretical model in previous section of this paper.

The regression equation is as follows:

$$entrants_{it} = \beta_0 + \beta_1 banks_{it} + \beta_2 banks_{i(t-1)} + \gamma_t + \delta_i + u_{it},$$

where $entrants_{it}$ is defined to be the sum of the number of new participants in all ROSCA branches in town i in month t, $banks_{it}$ is the total number of banks in a neighborhood of a radius of 10 kilometer centered around a ROSCA branch i in month t, $banks_{i(t-1)}$ is the lagged effect, γ_t is the town-invariant month dummy, and δ_i is the time-invariant town/branch dummy. In order to determine whether banks have an impact on ROSCA participation, I run the hypothesis test to see if the joined effect of banks in two periods is zero, that is, $\beta_1 + \beta_2 = 0$.

Potentially, I also need to control for other time-specific and town-specific variables that also affect the number of new entrants in each month for each ROSCA branch, such as population growth and town-level GDP. However, since this study focuses on months instead of years, it is extremely difficult to find monthly town-level data on these variables. Fortunately, neither population nor town-level GDP are expected to vary by a considerable amount over a span of two years, so here, despite a slight potential omitted variable bias, the regression model is still valid due to the little variation in these variables left out in the model.

Note that I have gathered data for the number of 4 types of banks opened around each of the ROSCA branches. The four types are: state-owned banks, nationalized banks, private banks, and rural banks. Hence, I also run the following regression

$$\begin{aligned} entrants_{it} &= \beta_0 + \beta_1 StateBanks_{it} + \beta_2 NationalizedBanks_{it} + \beta_3 PrivateBanks_{it} \\ &\quad + \beta_4 RuralBanks_{it} + \gamma_t + \delta_i + u_{it}, \end{aligned}$$

and test if the effect of each type of banks on ROSCA participation is the same. Specifically, I test if

$$\beta_1 = \beta_2 = \beta_3 = \beta_4.$$

If so, then different types of banks have the same impact on ROSCA participation, and vice versa.

4.3.3 Interpretation

On average, I expect that an additional bank made available in month t around branch i is associated with $\widehat{\beta_1}$ units of change in the number of new entrants in ROSCA branch in town i. Moreover, I expect that an additional bank made available in month $t-1$ around the same branch i will be associated with $\widehat{\beta_2}$ units of change in the number of new entrants in ROSCA branch in town i in month t.

4.4 Regression Specification for Winning Bids

4.4.1 Motivation for the Regression Equation

In this case, I again employ a fixed-effects model, with a unit of observation for each town i, each ROSCA group determined by the denomination (i.e. chit value) d and an index l for every ROSCA group with denomination d in town i, and each month determined by the ROSCA round j during January 1998 and December 2000. It is worthwhile to notice that a time variable t is not explicitly included in the regression model since t be can uniquely determined by $idlj$.

Here are the three fixed effects that need to be considered for the regression model in this paper. Note that like the previous study, I again employ the Hausman specification test between the fixed-effects model and the random-effects model to see if these models give essentially the same prediction. It turns out from the Hausman

specification test that it is impossible for the two models to generate the same prediction and thus I must use the fixed-effects model in order to avoid the bias inherited in the random-effects model.

1. By including town fixed effect, the model is controlling for any time-invariant unobservable factors that could be different between ROSCA branches that would impact individual's decision on joining ROSCAs, such as locations, types of towns (rural or urban), and the ease of transportation.

2. Moreover, by including month fixed effects, the model is also controlling for any town-invariant unobservable factors that would vary dramatically across time, such as several major bank reforms in India, the general macroeconomic activities, and seasonal effects on ROSCA activities.

3. Finally, I employ a denomination fixed effect. ROSCA bid trajectories, i.e. the average bid graphed over the round of the ROSCA, vary highly by denomination, so that it is appropriate to include a fixed effect for ROSCAs in a given denomination. Notice that this fixed effect does not vary across branches or the individual ROSCA group.

To include the fixed effects described above, the appropriate subscripts would be i for town, d for denomination, j for ROSCA round, and l as an index of ROSCA of denomination d in location i. The denomination fixed effect would be δ_d. The month fixed effect can be written as

$$\sum_{t=1}^{36} \alpha_t \mathbf{1}\{month_{idlj} = t\},$$

where $\mathbf{1}\{\}$ is the indicator function and the variable month is defined as the month in which ROSCA idl's j'th round takes place. Overall, the three fixed effects in the

regression model can be written as

$$bid_{idlj} = \delta_d + \psi_i + \sum_{t=1}^{36} \alpha_t \mathbf{1}\{month_{idlj} = t\} + \cdots,$$

where the three terms are denomination-round fixed effect, town fixed effect, and month fixed effect, respectively.

4.4.2 Regression Equation

In this case, I consider the following regression equation:

$$bid_{idlj} = \beta_0 + \beta_1 banks_{idlj} + \beta_2 banks_{idl(j-1)} + \delta_d + \psi_i + \sum_{t=1}^{36} \alpha_t \mathbf{1}\{month_{idlj} = t\} + u_{idlj},$$

where bid_{idlj} is the amount of winning bid (as a percentage of the total chit value) in ROSCA idl's j'th round, $banks_{idlj}$ is the total number of banks in a neighborhood of a radius of 10 kilometer centered around the ROSCA branch in town i in the month in which ROSCA idl's j'th round takes place, $banks_{idl(j-1)}$ is the lagged effect, δ_{dj}, ψ_i, and $\sum_{t=1}^{36} \alpha_t \mathbf{1}\{month_{idlj} = t\}$ are the fixed effects described above, and u_{ijt} is the error term. In order to determine whether banks have an impact on ROSCA winning bids, I run the hypothesis test to see if the joined effect of banks in two periods is zero, that is, $\beta_1 + \beta_2 = 0$.

As I did in the previous model, I will also investigate of the effect of different types of banks on the winning bids in the ROSCAs. Hence, I run the regression

$$\begin{aligned} bid_{idlj} &= \beta_0 + \beta_1 StateBanks_{idlj} + \beta_2 NationalizedBanks_{idlj} + \beta_3 PrivateBanks_{idlj} \\ &\quad + \beta_4 RuralBanks_{idlj} + \delta_d + \psi_i + \sum_{t=1}^{36} \alpha_t \mathbf{1}\{month_{idlj} = t\} + u_{idlj}, \end{aligned}$$

and test if the effect of each type of banks on ROSCA winning bids is the same.

Specifically, I test if $\beta_1 = \beta_2 = \beta_3 = \beta_4$. If so, then different types of banks have the same impact on ROSCA winning bids, and vice versa.

4.4.3 Interpretation

On average, I expect that an additional bank made available around ROSCA *idl* in the month when its j'th round takes place will be associated with $\hat{\beta}_1$ units of increase of the winning bid in this specific round of this specific ROSCA. From our theoretical model, I will need to do the following hypothesis test:

$$H_0 : \beta_1 + \beta_2 = 0$$

$$H_a : \beta_1 + \beta_2 < 0.$$

If the p-value is below the 5% confidence level, I will reject the null hypothesis and conclude that bank openings indeed reduce the winning bids in the ROSCAs.

4.5 Regression Specification for Default Amount

4.5.1 Motivation for the Regression Equation

We will again employ a fixed-effects model, with a unit of observation for each town i, each ROSCA group j, and each month t during January 1998 and December 2000. Note that the amounts of default for all the ROSCA participants are observed at the very end of the last round of auction. Technically, the amount of default in this regression model is the money still owed to the ROSCA organizer at the end of the ROSCA that corresponds to the winner at time t in ROSCA ij.

Here are the two fixed effects that need to be considered for the regression model in this paper. Note that like the previous study, I again employ the Hausman specification test between the fixed-effects model and the random-effects model to see

if these models give essentially the same prediction. It turns out from the Hausman specification test that it is impossible for the two models to generate the same prediction and thus I must use the fixed-effects model in order to avoid the bias inherited in the random-effects model.

1. By including the town fixed effect, the model is controlling for any time-invariant unobservable factors that could be different between different towns in which ROSCAs are located that would impact individual's decision on joining ROSCAs, such as locations, types of towns (rural or urban), and the ease of transportation.

2. Moreover, by including month fixed effects, the model is also controlling for any town-invariant unobservable factors that would vary dramatically across time, such as several major bank reforms in India, the general macroeconomic activities, and seasonal effects on ROSCA activities.

4.5.2 Regression Equation

$$default_{ijt} = \beta_0 + \beta_1 banks_{ijt} + \beta_2 banks_{ij(t-1)} + \delta_i + \alpha_t + u_{idlj},$$

where $default_{ijt}$ is the amount of default (as a percentage of the total chit value) in ROSCA ij still owed to the ROSCA organizer that corresponds to time t, $banks_{ijt}$ is the total number of banks in a neighborhood of a radius of 10 kilometer centered around the ROSCA ij at time t, $banks_{idl(j-1)}$ is the lagged effect, δ_i and α_t are the town and month fixed effects described above, and u_{ijt} is the error term. In order to determine whether banks have an impact on ROSCA default, I run the hypothesis test to see if the joined effect of banks in two periods is zero, that is, $\beta_1 + \beta_2 = 0$.

As I did in the previous two models, I will also investigate of the effect of different types of banks on the amount of default in the ROSCAs. Hence, I run the

regression

$$\begin{aligned} default_{ijt} &= \beta_0 + \beta_1 StateBanks_{ijt} + \beta_2 NationalizedBanks_{ijt} + \beta_3 PrivateBanks_{ijt} \\ &\quad + \beta_4 RuralBanks_{ijt} + \delta_i + \alpha_t + u_{idlj}, \end{aligned}$$

and test if the effect of each type of banks on ROSCA default is the same. Specifically, I test if $\beta_1 = \beta_2 = \beta_3 = \beta_4$. If so, then different types of banks have the same impact on ROSCA default, and vice versa.

4.5.3 Interpretation

On average, I expect that an additional bank made available in month t around ROSCA ij is associated with $\widehat{\beta_1}$ units of change in the amount of default still owed to the ROSCA organizer at the end of the last auction in ROSCA ij that corresponds to time t. Moreover, I expect that an additional bank made available in month $t-1$ around the same ROSCA ij will be associated with $\widehat{\beta_2}$ units of change in the amount of default still owed to the ROSCA organizer at the end of the last auction in ROSCA ij that corresponds to time t.

5 Results

5.1 Effect of Bank Openings on ROSCA Participation

Table 6 through Table 9 show the effect of different types of banks on the participation in the bidding ROSCAs. Table 6 provides the regression results using the fixed-effects model, and Table 7 provides the regression results using the random-effects model. From the Hausman Specification Test (Table 7), with p-value of 0.0986, the random-effects model fails to agree with the fixed-effects model at 10% significance level, while it

might agree with the fixed-effects model at 5% significance level. Hence, I report results from both models below, with a larger emphasis on the fixed-effects model since the random-effects model might give biased estimators in some circumstances (depending on the significance level).

From Table 6 (fixed-effects model), it is shown that without month dummies, an additional bank opened in the current month is expected to increase ROSCA participation by about 14 people, while an additional bank opened in the previous month is expected to reduce ROSCA participation by about 13 people. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a ROSCA branch will increase ROSCA participation by $13.69 - 12.98 = 0.71 \approx 1$ person. Moreover, it is clear from the table that the effects in both months are significant at 5% significant level. In order to determine whether this combined effect over the two months is still significant, I conduct the joint significance test to determine whether the effects from both months are jointly significant. The test yields an F-value of 3.46, with a p-value of 0.0629, which means that the null hypothesis of no joint effect should be rejected at the 10% significance level. Hence, this implies that without considering month dummies, an additional bank opened in the neighborhood of a ROSCA branch is expected to increase the ROSCA participation for that branch by one person over a span of two months.

From the same table, it is shown that with month dummies, an additional bank opened in the current month is expected to increase ROSCA participation by about 4 people, while an additional bank opened in the previous month is expected to reduce ROSCA participation by about 4 people. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a ROSCA branch will have no impact on ROSCA participation. Note that the impacts for each month is now much smaller due to the inclusion of month dummies. Moreover, it is clear

from the table that the effects in both months are insignificant. In order to determine whether this combined effect over the two months is still insignificant, I conduct the joint significance test to determine whether the effects from both months are jointly significant. The test yields an F-value of 0.1, with a high p-value of 0.7499, which means that the null hypothesis of no joint effect cannot be rejected at all. Hence, this implies that with the consideration of month dummies, an additional bank opened in the neighborhood of a ROSCA branch might have no impact on ROSCA participation over the two months.

Table 7 provides the results using the random-effects model. It is shown that without month dummies, an additional bank opened in the current month is expected to increase ROSCA participation by about 10 people, while an additional bank opened in the previous month is expected to reduce ROSCA participation by about 10 people. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a ROSCA branch will increase ROSCA participation by $9.584 - 9.581 = 0.003 \approx 0$ person. From the same table, it is shown that with month dummies, an additional bank opened in the current month is expected to increase ROSCA participation by about 3 people, while an additional bank opened in the previous month is expected to reduce ROSCA participation by about 3 people. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a ROSCA branch will have no impact on ROSCA participation. Note that the impacts for each month is now much smaller due to the inclusion of month dummies.

After the investigation of the effects of banks of any type on ROSCA participation, it is a natural question whether this effect is actually the same among each type of banks. Due to the different characteristics of different types of banks, certain types of banks might have larger or smaller impact on ROSCA participation. For instance, rural banks might have a stronger positive impact on ROSCA participation since these banks

(including Grameen banks and community banks) are traditionally connected with the non-banking/informal financial sector, like the bidding ROSCAs. Table 9 displays the effect of state banks, nationalized banks, private banks, and community banks, on ROSCA participation. Since I only want to compare the differential impacts among the banks, I do not consider the lagged effect. From the table, it shows that an additional state bank opened in the neighborhood is expected to reduce ROSCA participation by 2.69 persons, an additional nationalized bank opened in the neighborhood is expected to increase ROSCA participation by 9.86 persons, an additional private bank opened in the neighborhood is expected to reduce ROSCA participation by 12.1 persons, and an additional rural bank opened in the neighborhood is expected to increase ROSCA participation by 20.1 persons. It seems that rural banks clearly have the strongest positive contribution to ROSCA participation, which is intuitively true by the explanation above. However, in order to determine whether these effects are truly different, I conduct the F-test to see if the four types of banks actually have the same effect, that is, $\beta_1 = \beta_2 = \beta_3 = \beta_4$. From the results on Table 9, it show that the probability that these effects are equal is 0.0266, which immediately implies that the null hypothesis should be rejected at the 5% significance level. Therefore, it can be concluded that different types of banks have different impacts on ROSCA participation.

It is worth noticing that the great impact of rural banks indicates that this type of banks, such as the Grameen banks and other banks designed for the poor in particular, not only have no negative effect on the ROSCA participation, but also they are expected to increase individuals' incentive to pursue informal finance. This result is not difficult to understand: the more community banks established, the easier it is for individuals to obtain funds, and therefore, it is more likely for these people to participate in informal finance because of a potentially better outcome (depending on their productivity). In this regard, an increased availability of formal finance and thus

a partial elimination of credit constraints will work hand in hand with the popularity of the informal finance among originally credit-constrained individuals and SMEs.

5.2 Effect of Bank Openings on Winning Bids

Table 10 through Table 13 show the effect of different types of banks on the winning bid of the bidding ROSCAs. Table 10 provides the regression results using the fixed-effects model, and Table 11 provides the regression results using the random-effects model. From the Hausman Specification Test (Table 12), with p-value of 0, the random-effects model fails to agree with the fixed-effects model even at 1% significance level. Hence, I only report results from the fixed-effects model below, since the random-effects model will give biased estimators.

From Table 10 (fixed-effects model), it is shown that without month dummies, a new bank opening around a particular ROSCA in the current month is expected to decrease the ROSCA winning bid in that month by roughly 0.24 percentage points of the total chit value, while a new bank opening around a particular ROSCA in a the previous month is expected to decrease the current ROSCA winning bid in that month by roughly 0.26 percentage points of the total chit value. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a particular ROSCA will decrease ROSCA winning bid by $0.24 + 0.26 = 0.5$ percentage points. Moreover, it is clear from the table that the effects in both months are significant at 1% significant level. Since both effects are significantly negative, this combined effect over the two months must still be significant. To confirm, I conduct the joint significance test to determine whether the effects from both months are jointly significant. The test yields an F-value of 28763.07, with a p-value of 0, which means that the null hypothesis of no joint effect should be rejected at the 1% significance level. Hence, this implies that without considering month dummies, a new bank opening

around a particular ROSCA is expected to decrease the ROSCA winning bid by roughly 0.5 percentage points of the total chit value over a span of two months.

From the same table, it is shown that with month dummies, a new bank opening around a particular ROSCA in the current month is expected to decrease the ROSCA winning bid in that month by roughly 0.014 percentage points of the total chit value, while a new bank opening around a particular ROSCA in a the previous month is expected to increase the current ROSCA winning bid in that month by roughly 0.018 percentage points of the total chit value. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a particular ROSCA will have almost no impact on the winning of the ROSCA. Note that the impacts for each month is now much smaller due to the inclusion of month dummies. Moreover, it is clear from the table that the effects in both months are insignificant. In order to determine whether this combined effect over the two months is still insignificant, I conduct the joint significance test to determine whether the effects from both months are jointly significant. The test yields an F-value of 2.95, with a high p-value of 0.0861, which means that the null hypothesis of no joint effect can only be rejected at 10% significance level, but not 5% or 1% significance level. Hence, this implies that with the consideration of month dummies, an additional bank opened in the neighborhood of a ROSCA might have no impact on ROSCA winning bid over the two months.

After the investigation of the effects of banks of any type on ROSCA winning bid, it comes again the natural question whether this effect is actually the same among each type of banks. Similarly as for ROSCA participation, Table 13 displays the effect of state banks, nationalized banks, private banks, and community banks, on ROSCA winning bid. Since I only want to compare the differential impacts among the banks, I do not consider the lagged effect. From the table, it shows that an additional state

bank opened in the neighborhood is expected to reduce ROSCA winning bid by 0.15 percentage points of the total chit value, an additional nationalized bank opened in the neighborhood is expected to reduce ROSCA winning bid by 0.05 percentage points of the total chit value, an additional private bank opened in the neighborhood is expected to increase ROSCA winning bid by 0.17 percentage points of the total chit value, and an additional rural bank opened in the neighborhood is expected to reduce ROSCA winning bid by 0.52 percentage points of the total chit value. It seems that rural banks clearly have the strongest negative contribution to ROSCA participation. This is also not difficult to explain. Since ROSCAs are often associated with rural banks in their operations, the emergence of rural banks nearby might contribute the most to the competition regarding the borrowing interest rate. With the increased level of competition, the cost of borrowing must decrease in the bidding ROSCAs, otherwise its clients will be attractive to somewhere else. However, in order to determine whether these effects are truly different, I conduct the F-test to see if the four types of banks actually have the same effect, that is, $\beta_1 = \beta_2 = \beta_3 = \beta_4$. From the results on Table 13, it show that the probability that these effects are equal is 0, which immediately implies that the null hypothesis should be rejected even at the 1% significance level. Therefore, it can be concluded that different types of banks have different impacts on the winning bids of the ROSCAs.

It is interesting to notice that the great negative impact of rural banks on ROSCA winning bid indicates that the emergence of this type of banks will in fact benefit the ROSCA participants, since their cost to borrow money from the ROSCA now decreases due to the opening of the rural banks.

5.3 Effect of Bank Openings on Default

Table 14 through Table 17 show the effect of different types of banks on the amount of default of the bidding ROSCAs. Table 14 provides the regression results using the fixed-effects model, and Table 15 provides the regression results using the random-effects model. From the Hausman Specification Test (Table 16), with p-value of 0, the random-effects model fails to agree with the fixed-effects model even at 1% significance level. Hence, I only report results from the fixed-effects model below, since the random-effects model will give biased estimators.

From Table 14 (fixed-effects model), it is shown that without month dummies, a new bank opening around a particular ROSCA in the current month is expected to decrease the ROSCA default at the end of the ROSCA corresponding to the winner in that month by roughly 0.1 percentage points of the total chit value, while a new bank opening around a particular ROSCA in the previous month is expected to decrease the ROSCA default at the end of the ROSCA corresponding to the winner in the current month by roughly 0.02 percentage points of the total chit value. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a particular ROSCA will decrease ROSCA winning bid by $0.0998 + 0.0204 = 0.1202$ percentage points. Moreover, it is clear from the table that the effect of the current month is significant at 1% significance level, while the effect of the previous month is not significant even at 10% significance level. In order to determine whether the combine effect is significant, I conduct the joint significance test to determine whether the effects from both months are jointly significant. The test yields an F-value of 1016.56, with a p-value of 0, which means that the null hypothesis of no joint effect should be rejected at the 1% significance level. Hence, this implies that without considering month dummies, a new bank opening around a particular ROSCA is expected to decrease the ROSCA default amount by roughly 0.12 percentage points of the total chit value over a span

of two months.

From the same table, it is shown that with month dummies, a new bank opening around a particular ROSCA in the current month is expected to decrease the ROSCA default at the end of the ROSCA corresponding to the winner in that month by roughly 0.06 percentage points of the total chit value, while a new bank opening around a particular ROSCA in the previous month is expected to increase the ROSCA default at the end of the ROSCA corresponding to the winner in the current month by roughly 0.03 percentage points of the total chit value. Overall, it is expected that within two consecutive months, an additional bank opened in the neighborhood of a particular ROSCA will decrease ROSCA winning bid by $0.0607 - 0.0254 = 0.0353$ percentage points. Note that the impacts for each month is now much smaller due to the inclusion of month dummies. Moreover, it is clear from the table that the effect of the current month is significant at 1% significance level, while the effect of the previous month is not significant even at 10% significance level. In order to determine whether the combine effect is significant, I conduct the joint significance test to determine whether the effects from both months are jointly significant. The test yields an F-value of 85.44, with a p-value of 0, which means that the null hypothesis of no joint effect should be rejected at the 1% significance level. Hence, this implies that without considering month dummies, a new bank opening around a particular ROSCA is expected to decrease the ROSCA default amount by roughly 0.03 percentage points of the total chit value over a span of two months.

After the investigation of the effects of banks of any type on ROSCA default, it comes again the natural question whether this effect is actually the same among each type of banks. Similarly as for ROSCA participation and winning bid, Table 17 displays the effect of state banks, nationalized banks, private banks, and community banks, on ROSCA default. Since I only want to compare the differential impacts

among the banks, I do not consider the lagged effect. From the table, it shows that an additional state bank opened in the neighborhood is expected to reduce ROSCA default by 0.17 percentage points of the total chit value, an additional nationalized bank opened in the neighborhood is expected to increase ROSCA default by 0.03 percentage points of the total chit value, an additional private bank opened in the neighborhood is expected to increase ROSCA default by 0.06 percentage points of the total chit value, and an additional rural bank opened in the neighborhood is expected to reduce ROSCA default by 0.64 percentage points of the total chit value. It seems that rural banks clearly have the strongest positive contribution to ROSCA default. This is an interesting observation. Due to the strong association between ROSCAs and rural banks, the emergence of rural banks nearby might contribute the most to the competition regarding the borrowing interest rate. With the increased level of competition, if the ROSCA participant first submits the bid and then observes the opening of a bank nearby with lower borrowing interest rate, he might decide to default from the ROSCA in order to pursue a cheaper financing channel. However, in order to determine whether these effects are truly different, I conduct the F-test to see if the four types of banks actually have the same effect, that is, $\beta_1 = \beta_2 = \beta_3 = \beta_4$. From the results on Table 17, it show that the probability that these effects are equal is 0, which immediately implies that the null hypothesis should be rejected even at the 1% significance level. Therefore, it can be concluded that different types of banks have different impacts on ROSCA default.

6 Conclusion

This paper has investigated into the role of informal finance for impoverished individuals and SMEs with credit constraints, and compared informal financial institutions

with the formal ones. Despite the traditional hypothesis that banks are more favorable than most other financial channels and that informal financial institutions are the "last resort" for credit-constrained entities, this paper manages to provide both theoretical and empirical support for the new view broached in some literature that informal financial institutions coexist with formal financial institutions. In fact, the emergence of formal finance, instead of diverting people's preference from pursuing informal finance to taking loans from banks, actually fosters individuals' incentive and ability to participate in the informal finance to a noticeable yet somewhat moderate extent (as shown in the empirical study).

In the theoretical model, I find that participants in the bidding ROSCAs are able to "choose" their optimal bidding strategies according to their own productivity, which can also be thought of as the gross return of their investment using the ROSCA earnings. Those individuals who are more productive will choose to be the borrowers by bidding a greater amount (which equals their own productivity), while those less productive individuals would rather benefit from ROSCAs by bidding as savers and hence earn the bid premium as their "interest." In this way, bidding ROSCAs are able to provide optimal financing support for people/SMEs of different types. In this regard, bidding ROSCAs have an advantage over formal financial institutions like banks in the sense that they can automatically "screen" their participants, while banks must go through complicated steps in order to assess one's ability to repay and the optimal amount of loans to issue.

In the empirical study, I take a close look at the effect of the emergence of banks on various aspects of bidding ROSCAs in Andhra Pradesh, India. The regression results show that overall, bank openings do not have a significant effect on ROSCA participation, and rural banks seem to have a largest positive contribution to ROSCA participation among all types of banks. The findings have confirmed some of the

empirical observations from previous literature: instead of being inferior substitutes for formal financial institutions like banks, informal finance represented by the bidding ROSCAs seems to survive and sometimes thrive even with the emergence of banks. In other words, the emergence of banks is expected not to interfere with ROSCA participation in a negative way.

This finding is in line with the prediction from the theoretical model: except in the two extreme cases where the banks' interests are too high or too low, ROSCAs tend to sustain even with the increased number of banks in the neighborhood. One thing to note is that in the two-player, two-period theoretical model, it is impossible to model the case where the emergence of banks actually boosts ROSCA participation. However, from previous literature, such situations are not uncommon, since the increased accessibility to financing channels will be likely to have a positive effect on people's ability and thus willingness to participate in the ROSCAs. If this fact is incorporated into the theoretical model, I would, on average, expect a very weak correlation between the availability of formal finance and the participation in the informal finance.

Then, in terms of the ROSCA winning bids, I find that the emergence of banks in the neighborhood will decrease ROSCA winning bids, which are also regarded as the cost of borrowing in the bidding ROSCAs. Hence, the competition between banks and bidding ROSCAs has made the ROSCA participants better off in the sense that funds become more affordable than before. This result also coincide with my theoretical prediction, where ROSCAs winning bids might decrease as banks enter the area. Finally, regression results also indicate a significant negative impact of the emergence of banks on the amount of default in the ROSCAs, which indicates that not only do formal and informal financial institutions coexist, but also the strengthening of the formal banking sector may have a positive effect on the informal finance.

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Appendices

A. Description of Data Work

a. Creating the ROSCA Dataset

In order to create the dataset for the bids, number of participants, and default rate for each ROSCA branch, I utilized the original data set, where the bids, number of participants (which is equal to the number of months), and the amount of default are recorded for each ROSCA that took place in the branches. Since most ROSCA started between 1998 and 2000, I deleted in the original dataset all the ROSCAs outside this time interval. Especially, all the ROSCAs that have not ended will be discarded for the analysis since I need all the bids in all months in order to calculate the interest rate and other variables. In order to deleted unwanted data points, I wrote a program using R and created a new data set only containing the ROSCAs that have ended. In Excel, I used a feature called PivotTable to obtain the aggregate number of participants for each of the 219 ROSCA branches.

b. Creating the Bank Dataset

In order to create the dataset for the banks in Andhra Pradesh, I relied heavily on the software called ArcGIS. Much of the initial work regarding finding the exact geographical location of each of the banks was done in the summer of 2009. As a research assistant to Prof. Rai, my job was basically to find the locations as accurate as possible for all the bidding ROSCAs and banks, and produce a comprehensive set of data based on the geographical and financial information provided. Since assuring both the accuracy and the consistency of the data was the key to the successful completion of my work, I carefully chose Google Earth and the banks' major websites as major tools, occasionally with the aid of other unofficial statistics and information in order to

ensure the accuracy. Then, I imported all the locations to ArcGIS to generate a map of Andhra Pradesh with all the ROSCA and bank branches. For each of the ROSCA branch, I created a "buffer circle" of various radii (from 1 km to 30 km) before I decided the best distance to use. The way I chose the best distance (10 km) to use eventually is to choose a radius such that almost all the banks are covered by the circles and the circles do not overlap too much. For each "buffer circle," I calculated the number of banks started in each month from January 1998 to December 2000 that fall into the "buffer circle." To do this, I created a set of new variables called "count_(month)" and put 1 for all the banks that started before a particular month and 0 for all the banks that started after a particular month. Using ArcGIS, I was able to sum up all the "counts" for each "buffer circle," and eventually I obtained a dataset containing the number of banks started in each month between 1998 and 2000 in the neighborhood of each ROSCA branch.

B. Tables

Here are the list of related figures and graphs included in this paper:

Table 5: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Town	6156	3411.14	62.85	3301	3513
Month	6156	199906.5	81.73	199801	200012
Number of Entrants	6156	107.93	218.93	0	2580
Winning Bid (% of Chit Value)	204260	4.133016	8.574983	0	91.556
Amount of Default (% of Chit Value)	204260	25.46024	16.4134	5	70.5
Number of Current Banks in Total	6156	104.56	199.61	0	710
Number of Current State Banks	6156	28.78	55.55	0	197
Number of Current Nationalized Banks	6156	57.33	113.98	0	403
Number of Current Private Banks	6156	13.01	26.10437	0	94
Number of Grameen Banks	6156	4.90	4.24	0	17
Number of Banks in Total in the Previous Year	5985	104.43	199.3415	0	710
Number of State Banks in the Previous Year	5985	28.75	55.51	0	197
Number of Nationalized Banks in the Previous Year	5985	57.28	113.86	0	403
Number of Private Banks in the Previous Year	5985	12.97	26.02	0	94
Number of Grameen Banks in the Previous Year	5985	4.89	4.24	0	17

Table 6: Participation in the ROSCAs and the Number of Banks Available
(Fixed-Effects Model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Entrants	Entrants	Entrants	Entrants	Entrants	Entrants
Number of Banks	0.596		13.69**	0.0819		4.092
	(0.342)		(4.41)	(0.340)		(4.21)
Previous Banks		0.285	−12.98**		−0.00615	−3.973
		(0.354)	(4.28)		(0.352)	(4.10)
Constant	45.58	80.21*	32.26	29.30	48.85	36.04
	(35.8)	(37.1)	(40.1)	(36.5)	(37.7)	(39.9)
Month Dummies	No	No	No	Yes	Yes	Yes
N	6156	5985	5985	6156	5985	5985
R-Squared	0.000508	0.000111	0.00177	0.193	0.191	0.191

Note: 1. Robust standard errors in parentheses.

2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 7: Participation in the ROSCAs and the Number of Banks Available
(Random-Effects Model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Entrants	Entrants	Entrants	Entrants	Entrants	Entrants
Number of Banks	0.0329		9.584*	0.0308		2.857
	(0.0220)		(4.05)	(0.0220)		(3.90)
Previous Banks		0.0330	−9.581*		0.0318	−2.834
		(0.0225)	(4.07)		(0.0225)	(3.91)
Constant	104.5***	106.5***	106.7***	17.11	17.00	461.0***
	(4.97)	(5.07)	(4.96)	(15.4)	(15.6)	(15.6)
Month Dummies	No	No	No	Yes	Yes	Yes
N	6156	5985	5985	6156	5985	5985

Note: 1. Robust standard errors in parentheses.

2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 8: Hausman Specification Test for Banks versus ROSCA Participation

	Coefficients			
	(b)	(B)	$(b-B)$	sqrt(diag$(V_b - V_B)$)
	Consistent	Efficient	Difference	S.E.
banks	0.596	0.0329	0.563	0.341

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

$\chi^2(1) = (b-B)'[(V_b - V_B)^{(-1)}](b-B) = 2.73$

$Prob > \chi^2 = 0.0986$

Table 9: Participation in the ROSCAs and the Number of Banks of Each Type

Default	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval
StateBanks	−2.69	5.49	−0.49	0.624	[−13.4, 8.07]
NationalizedBanks	9.86	3.32	2.97	0.003	[3.35, 16.4]
PrivateBanks	−12.1	4.84	−2.51	0.012	[−21.6, −2.65]
RuralBanks	20.1	9.25	2.17	0.030	[1.96, 38.2]
Constant	−406.5	171.6	−2.37	0.018	[−742.9, −70.13]

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4$;

$H_a : \beta_1, \beta_2, \beta_3, \beta_4$ are not all equal.

(1) $StateBanks - NationalizedBanks = 0$

(2) $StateBanks - PrivateBanks = 0$

(3) $StateBanks - RuralBanks = 0$

$F(3, 5946) = 3.07$

$Prob > F = 0.0266$

Table 10: ROSCA Winning Bids and the Number of Banks Available
(Fixed-Effects Model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Winning Bid	Winning Bid	Winning Bid	Winning Bid	Winning Bid	Winning Bid
Number of Banks	−0.499***		−0.242***	0.00479		−0.0139
	(0.00281)		(0.0268)	(0.00245)		(0.0228)
Previous Banks		−0.492***	−0.258***		0.00491*	0.0184
		(0.00282)	(0.0261)		(0.00246)	(0.0222)
Constant	108.8***	107.0***	108.4***	44.29***	45.37***	44.72***
	(0.469)	(0.468)	(0.493)	(0.398)	(0.398)	(0.424)
Month Dummies	No	No	No	Yes	Yes	Yes
N	263234	258524	258524	263234	258524	258524
R-Squared	0.113	0.111	0.111	0.500	0.495	0.495

Note: 1. Robust standard errors in parentheses.

2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 11: ROSCA Winning Bids and the Number of Banks Available
(Random-Effects Model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Winning Bid	Winning Bid	Winning Bid	Winning Bid	Winning Bid	Winning Bid
Number of Banks	−0.0194***		1.018***	−0.0128***		−0.151***
	(0.000422)		(0.0267)	(0.000308)	(0.0239)	
Previous Banks		−0.0194***	−1.038***		−0.0127***	0.139***
		(0.000426)	(0.0268)		(0.000309)	(0.0239)
Constant	30.43***	30.34***	29.84***	48.52***	48.41***	48.34***
	(0.134)	(0.135)	(0.127)	(0.167)	(0.166)	(0.166)
Month Dummies	No	No	No	Yes	Yes	Yes
N	263234	258524	258524	263234	258524	258524

Note: 1. Robust standard errors in parentheses.

2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 12: Hausman Specification Test for Banks versus Winning Bids

	Coefficients			
	(b)	(B)	$(b-B)$	sqrt(diag$(V_b - V_B)$)
	Consistent	Efficient	Difference	S.E.
banks	-0.497	-0.0194	-0.477	0.00276

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

$\chi^2(1) = (b-B)'[(V_b - V_B)^{(-1)}](b-B) = 29977.30$

$Prob > \chi^2 = 0.000$

Table 13: ROSCA Winning Bids and the Number of Banks of Each Type

Default	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval
StateBanks	−0.148	0.0361	−4.10	0.000	[−0.218 , −0.0770]
NationalizedBanks	−0.0505	0.0247	−2.04	0.041	[−0.0990, −0.00200]
PrivateBanks	0.169	0.0361	4.69	0.000	[0.0985, 0.240]
RuralBanks	−0.517	0.116	−4.44	0.000	[−0.745, −0.289]
Constant	57.2	1.94	29.5	0.000	[53.4, 61.0]

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4$;

$H_a : \beta_1, \beta_2, \beta_3, \beta_4$ are not all equal.

(1) $StateBanks - NationalizedBanks = 0$

(2) $StateBanks - PrivateBanks = 0$

(3) $StateBanks - RuralBanks = 0$

$F(3, 248323) = 17.21$

$Prob > F = 0.0000$

Table 14: ROSCA Default Amount and the Number of Banks Available
(Fixed-Effects Model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Default	Default	Default	Default	Default	Default
Number of Banks	−0.118***		−0.0998***	−0.0342***		−0.0607**
	(0.00209)		(0.0201)	(0.00253)		(0.0235)
Previous Banks		−0.117***	−0.0204		−0.0333***	0.0254
		(0.00211)	(0.0196)		(0.00255)	(0.0229)
Constant	28.61***	28.15***	28.87***	14.22***	14.03***	14.41***
	(0.432)	(0.433)	(0.457)	(0.501)	(0.502)	(0.523)
Month Dummies	No	No	No	Yes	Yes	Yes
N	204260	200636	200636	204260	200636	200636
R-Squared	0.016	0.016	0.016	0.038	0.038	0.038

Note: 1. Robust standard errors in parentheses.

2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 15: ROSCA Default Amount and the Number of Banks Available
(Random-Effects Model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Default	Default	Default	Default	Default	Default
Number of Banks	−0.00101***		0.174***	−0.00103***		−0.00499
	(0.000170)		(0.0188)	(0.000155)		(0.0222)
Previous Banks		−0.000994***	−0.175***		−0.00101***	0.00400
		(0.000171)	(0.0189)		(0.000156)	(0.0222)
Constant	4.774***	4.765***	4.742***	7.159***	7.533***	7.117***
	(0.0607)	(0.0609)	(0.0591)	(0.147)	(0.146)	(0.147)
Month Dummies	No	No	No	Yes	Yes	Yes
N	204260	200636	200636	204260	200636	200636

Note: 1. Robust standard errors in parentheses.

2. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 16: Hausman Specification Test for Banks versus Default Amount

	Coefficients			
	(b)	(B)	$(b-B)$	sqrt(diag$(V_b - V_B)$)
	Consistent	Efficient	Difference	S.E.
banks	-0.118	$-.00101$	-0.117	0.00208

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

$\chi^2(1) = (b-B)'[(V_b - V_B)^{(-1)}](b-B) = 3179.69$

$Prob > \chi^2 = 0.000$

Table 17: ROSCA Default Amount and the Number of Banks of Each Type

Default	Coef.	Std. Err.	t	$P > \|t\|$	95% Conf. Interval
StateBanks	−0.165	0.0372	−4.45	0.000	[−0.238, −0.0924]
NationalizedBanks	0.0328	0.0254	1.29	0.197	[−0.0170, 0.0827]
PrivateBanks	−0.0552	0.0372	−1.49	0.137	[−0.128, 0.0176]
RuralBanks	0.644	0.133	4.83	0.000	[0.383, 0.905]
Constant	9.81	2.54	3.86	0.000	[4.83,14.8]

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4$;

$H_a : \beta_1, \beta_2, \beta_3, \beta_4$ are not all equal.

(1) $StateBanks - NationalizedBanks = 0$

(2) $StateBanks - PrivateBanks = 0$

(3) $StateBanks - RuralBanks = 0$

$F(3, 192597) = 12.91$

$Prob > F = 0.0000$

C. Figures and Graphs

Here are the list of related figures and graphs included in this paper:

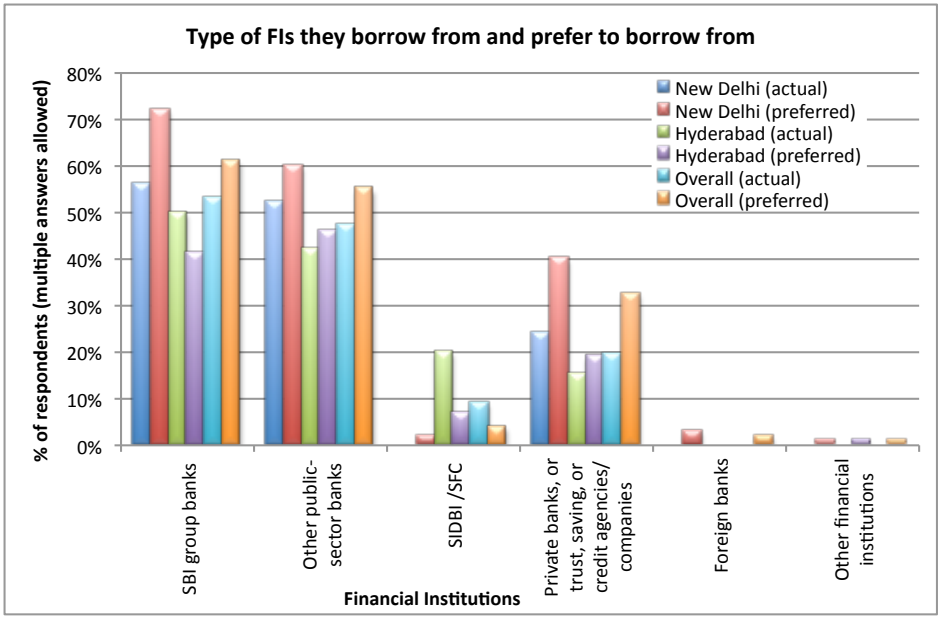

Figure 1: Type of financial institutions SMEs prefer to borrow from

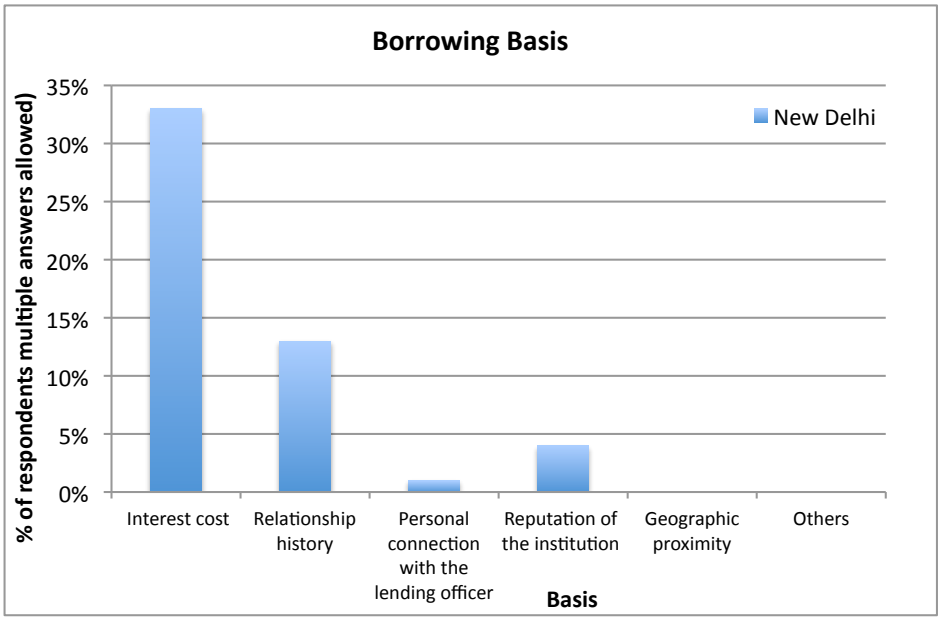

Figure 2: The factors based on which SMEs choose their financing sources

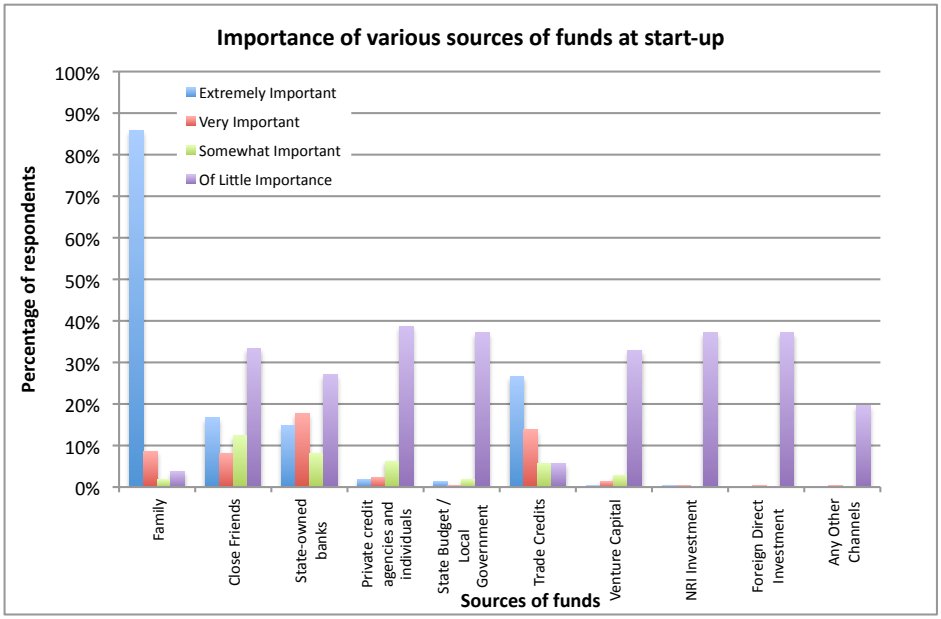

Figure 3: Importance of various sources of funds at start-up

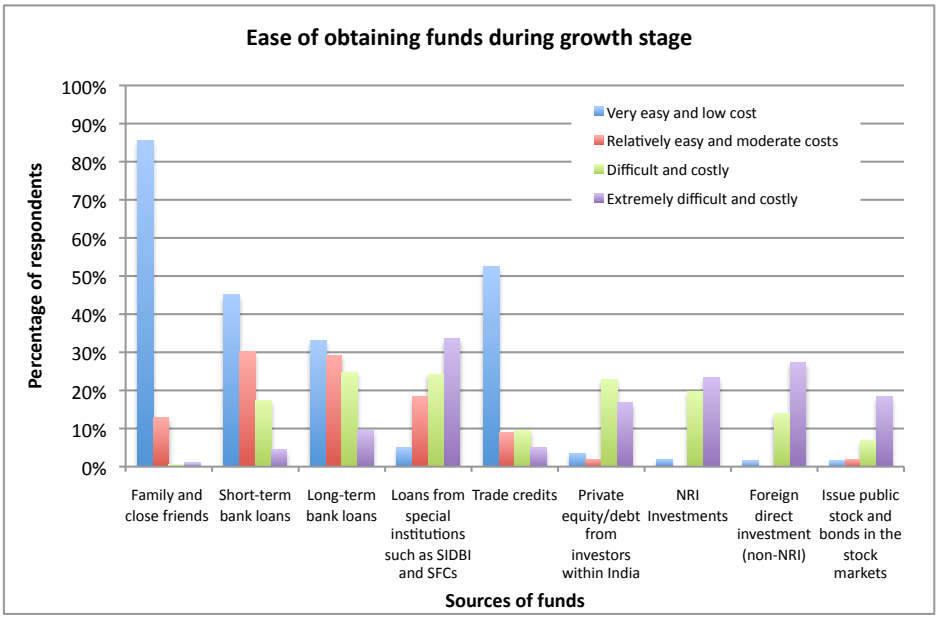

Figure 4: Ease of obtaining funds during growth stage

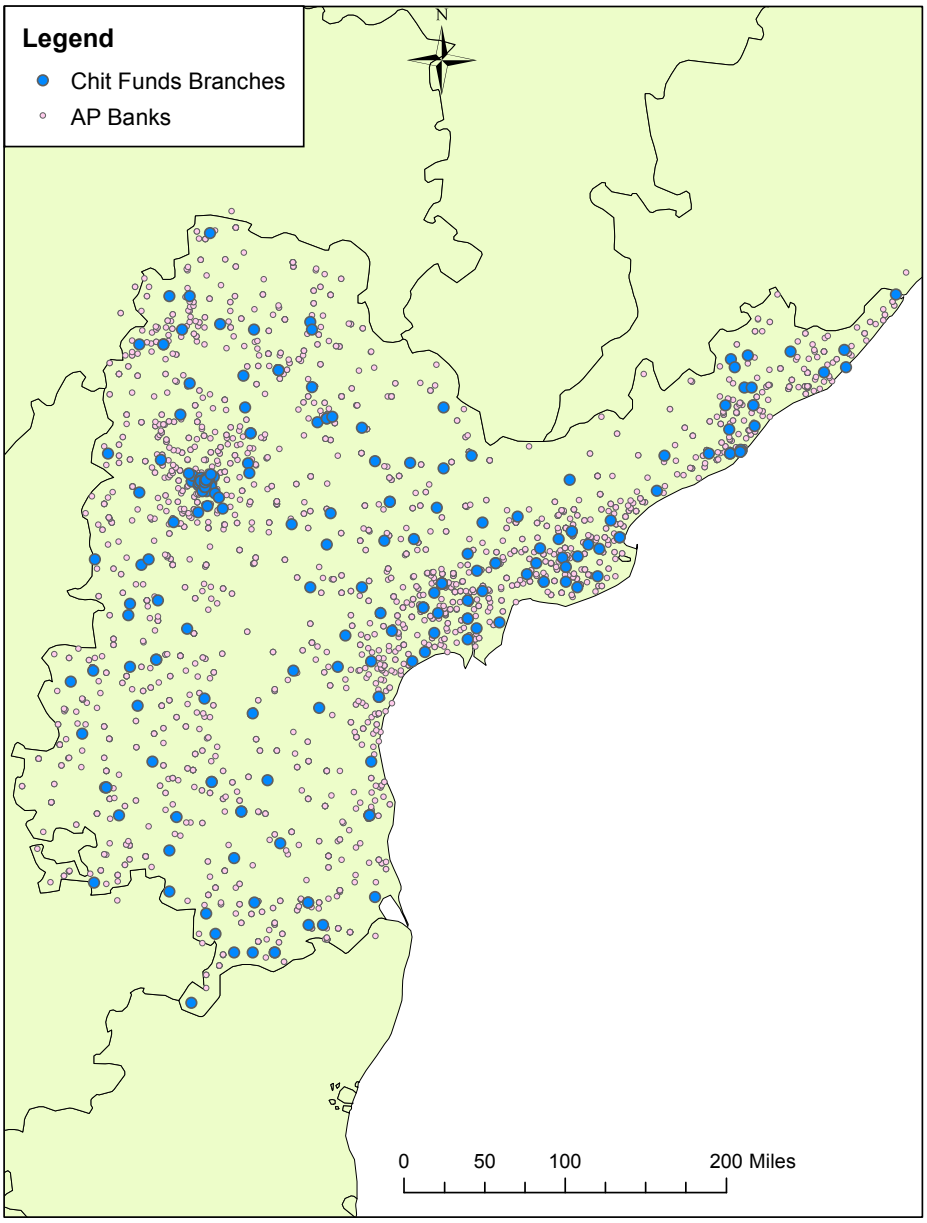

Figure 5: Banks within 20 km of the chit funds branches in Andhra Pradesh

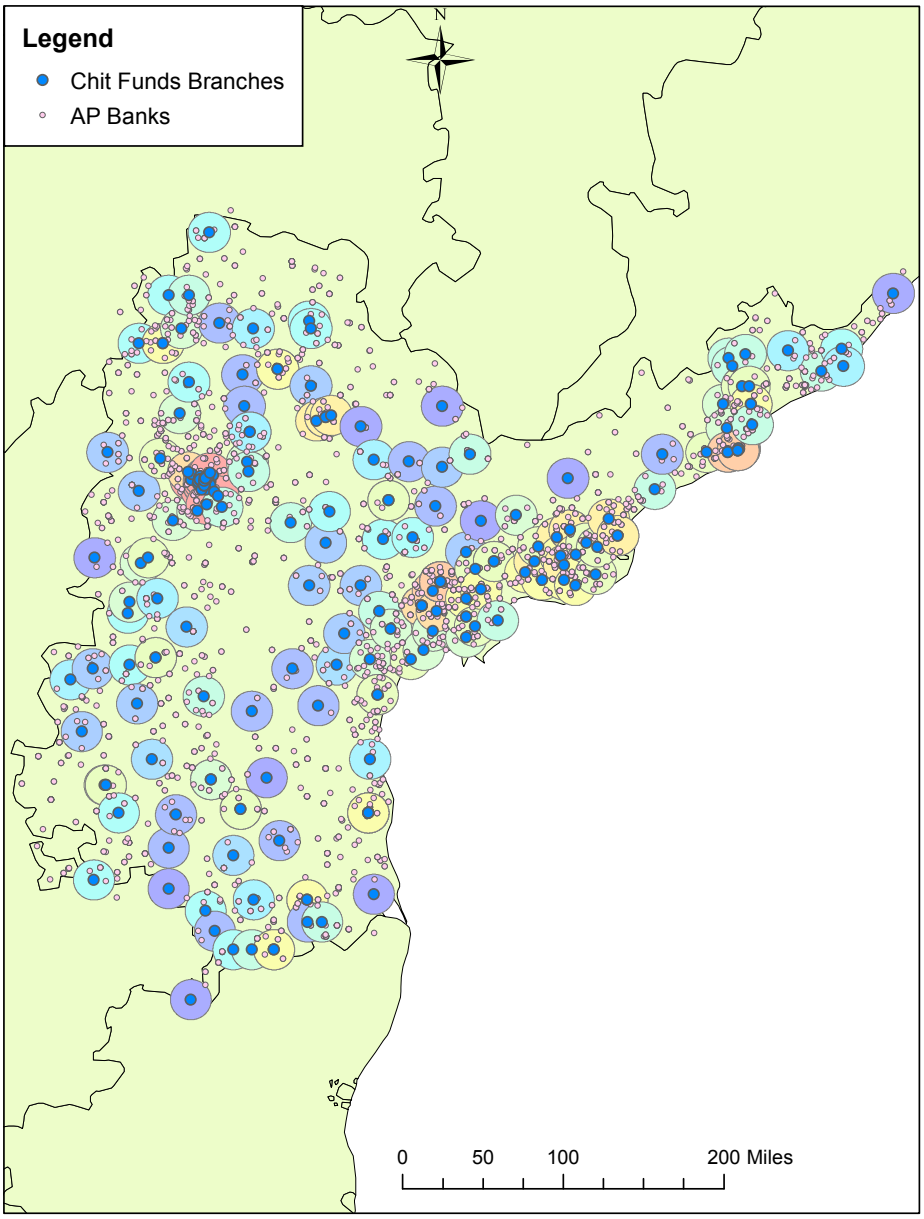

Figure 6: Banks and chit funds branches in Andhra Pradesh

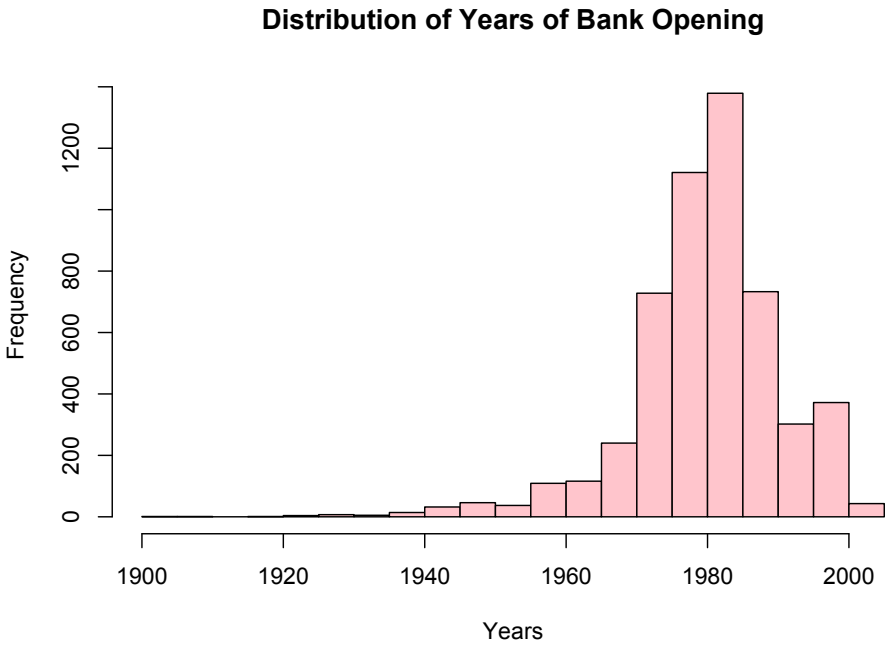

Figure 7: Distribution of years of bank opening in Andhra Pradesh

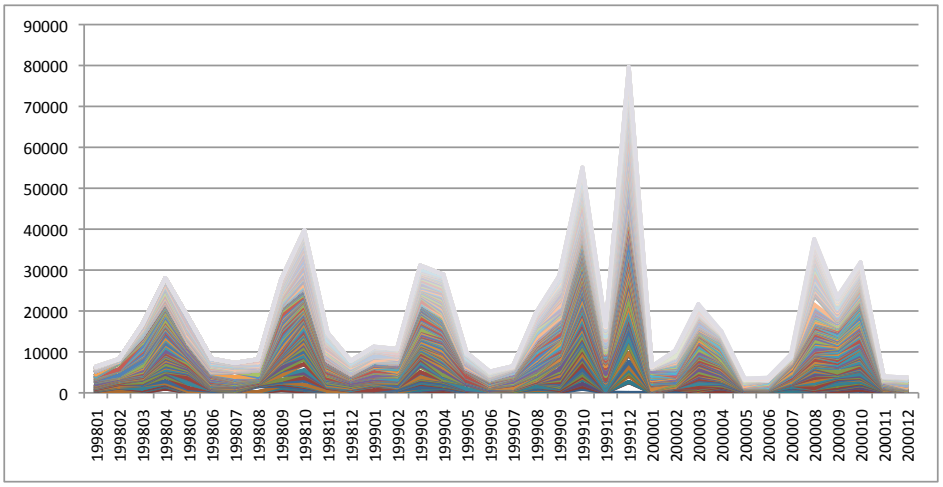

Figure 8: Distribution of ROSCA starting years in Andhra Pradesh