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Financial Fragmentation despite Arbitrage

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Financial Fragmentation Despite Arbitrage

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Abstract: If there were no impediments to the flow of capital across space, then interest rates would equalized. We provide evidence to the contrary. We find significant differences in interest rates across the South Indian state of Tamil Nadu, i.e. evidence that financial markets are fragmented. We also find evidence of limited arbitrage across financial markets.

JEL Codes: O16, G21

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1 Introduction

Many economists believe that financial market failures are a cause of underdevelopment and poverty (Aghion and Bolton, 1997; Banerjee and Newman, 1993; King and Levine, 1993; Townsend 1997). There is a growing recent empirical literature documenting these financial market failures in different developing country contexts. For instance, de Mel, Woodruff and Mckenzie (forthcoming) and Paulson,Townsend and Karaivanov (2006) find that finance does not flow to high return entrepreneurs in Sri Lanka and Thailand respectively. Banerjee and Munshi (2004) suggest that finance does not flow across ethnic lines in India.

In this paper we provide some striking evidence of financial market failures across space. We find significant differences in the returns to comparable investments across local financial

[0] We are grateful to the Chit Fund company (in South India) for sharing their data and their time. And to Courtney Asher for research assistance. All errors are our own. Klonner: University of Frankfurt, stefan@klonner.de; Rai: Dept. of Economics, Williams College, Williamstown, MA 01267, arai@williams.edu

markets in the state of Tamil Nadu, India. If finance flowed to its highest use, such differences would not exist. Further, we find that these differences in returns to savings persist despite the presence of specific investors who arbitrage by borrowing when interest rates are low and saving when they are high.

The financial markets we study are organized through bidding Roscas (Rotating Savings and Credit Associations) where interest rates are determined by competitive auction. Roscas are financial institutions in which the accumulated savings are rotated among participants. Since Rosca interest rates are determined by local market conditions – and not set centrally as they would be in a bank with several branches – this dataset provides an ideal opportunity to investigate financial fragmentation. Further, unlike the research summarized by Banerjee 2003 which points to differences in risk-adjusted borrowing interest rates as evidence of financial fragmentation, we use interest rates on local savings. The advantage of doing so is that the savers in the bidding Roscas we study all face the same riskiness regardless of the market in which they save – but adjusting for default risk or other unobservable loan terms with borrowing interest rates is difficult. In sum, the peculiarities of the institutional structure of bidding Roscas are ideally suited to study financial imperfections.[1]

We first look at whether Roscas in a particular town are financially integrated – i.e. are interest rates equalized across these markets, where a "market" is a particular Rosca. We then think of locations as "markets"– and look at whether interest rates are equalized across locations. In both cases we find significant variation – and hence opportunities for arbitrage. The natural question then arises: If there is money to be made because of financial fragmentation, is somebody doing it? We find evidence that specific institutional investors are indeed arbitraging across Roscas in a particular location – and arbitraging across locations. Their arbitrage behavior is not sufficient to equalize interest rates across

[1] Unlike Besley, Coate and Loury (1994) and Baland and Robinson (2002) who provide economic arguments to rationalize informal Roscas, our research does not attempt to justify their existence. The Roscas we study are anonymous and do not rely on internal social enforcement. It is likely that the organized Rosca sector in South India flourishes because it is less regulated than banks.

space, though, and we discuss potential reasons at the end of the paper.

The paper proceeds as follows. In Section 2 we provide background on the non-bank financial institution in South India and on our dataset. In Section 3 we outline some of the testable implications from a simple model. We discuss our preliminary results and ongoing research in Section 4

2 Institutional Background

This study uses data on Rotating Savings and Credit Associations (commonly referred to as Roscas). Roscas match borrowers and savers but do so quite differently from banks. They are common in many parts of the world (Besley et al, 1993). In this section we provide some background on how the Roscas in our study operate. We also describe the sample of Rosca borrowers that we will use in our subsequent empirical analysis.

Rules

Roscas are financial institutions in which the accumulated savings are rotated among participants. Participants in a Rosca meet at regular intervals, contribute into a "pot" and rotate the accumulated contributions. So there are always as many Rosca members as meetings. In random Roscas, the pot is allocated by lottery and in bidding Roscas the pot is allocated by an auction at each meeting. Our study uses data on the latter.

More specifically, the bidding Roscas in our sample work as follows. Each month participants contribute a fixed amount to a pot. They then bid to receive the pot in an oral ascending bid auction where previous winners are not eligible to bid. The highest bidder receives the pot of money less the winning bid and the winning bid is distributed among all the members as an interest dividend. The winning bid can be thought of as the price of capital. Consequently, higher winning bids mean higher interest payments. Over time, the winning bid falls as the duration for which the loan is taken diminishes. In the last month, there is no auction as only one Rosca participant is eligible to receive the pot.

We illustrate the rules with a numerical example:

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

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

The first recipient is a borrower: he receives \$12 and repays \$8 and \$10 in subsequent months, which implies a 30% monthly interest rate. The last recipient is a saver: she saves \$6 for 2 months and \$8 for a month and receives \$20, which implies a 67% monthly rate. The intermediate recipient is partially a saver and partially a borrower.

The Sample

The bidding Roscas we study are large scale and organized commercially by a non-bank financial firm. The data we use is from the internal records of an established Rosca organizer in the southern Indian state of Tamil Nadu.[2] Our sample comprises started after January

[2] Bidding Roscas are a significant source of finance in South India, where they are called chit funds. Deposits in regulated bidding Roscas were 12.5% of bank credit in the state of Tamil Nadu and 25% of bank credit in the state of Kerala in the 1990s, and have been growing rapidly (Eeckhout and Munshi, 2004). There is also a substantial unregulated chit fund sector.

1, 2001 and were completed by December 31, 2005. These Roscas took place in 77 branches of non-bank financial firm.

Our samples comprises 2170 Rosca of different durations and contributions. A common Rosca denomination has 40 participants/months with a Rs. 250 monthly contribution (the total pot is then Rs. $10,000$). There were also Roscas that met for shorter durations (25 or 30 months) or for longer (50 months) and with higher and lower total pot sizes. These different Rosca denominations serve to match borrowers and savers with different investment horizons.

For each Rosca in our sample, we computed the savings interest rate r as the solution to:

$$-m(1+r)^{T-1} + \sum_{i=2}^{T-1}(-m + div_i)(1+r)^i + (Tm - c) = 0$$

where m is the contribution, div_t is the dividend in month t, T is the number of rounds/months/participants, and c is commission to the organizer in each round.

Institutional Investors

In practice, institutional investors operate in all 77 branches and typically take several postions in Roscas in each of the branches. Field interviews with an employee of one such instutional investor gave some insight in to their bidding strategy. These investors bid in Roscas according to a prescribed limit (that is determined by the institutional investor management) and varies by denomination. For instance, we were told that in the first 65% of the rounds of all Roscas the limits are simple fractions of the total pot. For the (40, 2500) denomination, the limit in 2007 was 26 percent of the pot – and was 30 percent of the pot in 2006. The investor aims to match this limit (this fraction) on average across all the Roscas in that particular branch in that particular month. Institutional investors seldom take pots in the last 35 percent of the Rosca – but when they do, the bid limit is based on the dividend earned so far less admin fees less future contributions due (net of future dividends expected).

3 Theory

In this section we illustrate the two main testable implications of the theory:

A. If financial markets are efficient, then interest rates are equalized across locations and across Roscas.

B. If interest rates are not equalized, then an institutional investor would profit by borrowing when the interest rate is low and saving when the interest rate is high.

We consider a stylized economy with N agents. Each agent is endowed with a dollar in the first period. Agents vary in their productivity. Each agent also has an investment opportunity with a fixed investment cost of 2 at date 1 and yield $2p$ at date 2. The productivity p is distributed across individuals according to the cdf F. We assume that the type p is public information. Agents do not discount the future.

We model simple Roscas each with two participants and hence two rounds. There is at auction only at date 1. Each Rosca participant contributes a dollar at date 1 and the auction is for the repayment amount b that is due at date 2. The winner of the auction receives the pot and invests. The organizer keeps a commission of c, and so at date 2, the winner pays $b - 2c$ to the loser of the auction. (In this way, we model how Rosca auctions determine the interest rate but abstract from the specific rules that are used in practice in the Roscas in our sample).

An agent's willingness to pay is determined by equalizing the payoff for winning, $2p - b$ to the payoff from losing $b - 2c$, which gives

$$b^{*} = p + c$$

Since information is public, the lower of the two participants will bid up the higher type to her b^{*}. Essentially, the saver in this Rosca receives all the gains from trade. The payoff in equilibrium of winner and loser is thus equalized to $p^{winner} - c$.

The *efficient allocation* of capital in this economy is if all agents who are more productive that the median, p_m, borrow at date 1 and the others are savers and do not invest. In other words, all $p \geq p_m$ are winners and all others losers. So *efficient matching* in these Roscas is to form pairs of one "high" type (above median) with one low type (below median). Assume that the organizer matches that way.

In what follows we shall consider the special case when there is no commission, i.e. $c = 0$. We will return to the case with commission at the end.

Perfect Credit Markets Suppose there is a perfect credit market on the side with gross interest rate R (borrow 1, repay R): the willingness-to-pay of each participant in a Rosca will be precisely R. This can be proved by contradiction for any distribution F. And the existence of Roscas irrelevant in this case. The implication is that the auction prices (interest rates) should be equalized across Roscas in a particular branch as well as across branches. In other words, there is one price.

Within Branch Arbitrage. Suppose there is a branch made of N agents. Then an (institutional) investor who wishes to arbitrage would join N Roscas. Each Rosca would consist of one investor and one agent. If investor can commit to not bidding higher than his fellow participant, he will win all auctions when paired with a low type at the willingness to pay b^* of the low type and lose all other auctions at the willingness to pay b^* of the corresponding high type. The corresponding profit of investor will be $\frac{n}{2}\left(E[P|P \geq p_m] - E[P|P \leq p_m]\right)$. Note that credit is allocated efficiently but there is no equalization of interest rates within the branch.

Across Branch Arbitrage. Suppose each branch has n_i agents, whose types are distributed as F_i. Assume for simplicity that $n_1 = ... = n_I$. When there is no (institutional) investor then observed winning bids in each branch will have distribution $F_{P_i|P_i \geq p_{m,i}}$, i e F_i conditional on P_i being larger than the branch median. When there is an investor but he is strictly local, winning bids will have distribution F_i, where all prices below $p_{m,i}$ have the investor as winner and all others private participants. (The testable impication is that the investor holds half of all tickets). When the investor participates across branches, he will aggregate all F_i's into the aggregate $F = \frac{1}{I}F_i$ with median p_m, join a group with each agent, win all auctions where the agent has type below p_m and lose all others. Result: auction outcomes distrbution is the same as when the II only acts locally, but there is a difference. Now all pots with a price smaller p_m (not $p_{m,i}$!!!) go to investor and all others to agent. So in some branches - despite the equal participation rate by investor, he will win almost all pots, in others only a few pots. So three testable implications of this very specific model of arbitrage are that (i) the lowest winning bid of agents is equalized across branches, (ii) as is the highest winning bid of the investor across branches, (iii) the value of that winning bid is just p_m. Note that credit is allocated efficiently but there is no equalization of interest rates across branches.

When $c > 0$, there are minor modifications: the investor will not join Roscas with agents whose type is close (above or below) p_m. So his participation rate is less than one half of the total number of tickets and less than one half of tickets in each branch where there are agents with p close to p_m (in branches with agents with values sufficiently different from p_m, he will hold half of the tickets). The implications that continue to hold are (i) and (ii), but not (iii). In particular the highest price paid by investor is lower than lowest price of the private agent. The latter is $p_m + c$.

4 Preliminary Results

We first test if there if financial markets are fragmented or integrated (implication A). As a prelude, figure 1 illustrates the variation in interest rates across the 77 branches in Tamil Nadu. The average interest rate is 0.76 per month with a standard deviation of 0.09 for the 77 branches.

We test for financial integration across branches by the following regression specification in which the interest rate r_{idtj} is regressed on branch and denomination and quarter fixed effects:

$$r_{idtj} = \alpha_i + \gamma_d + \eta_t + u_{idtj},$$

where i indexes branches, d denominations, t the quarter in which a Rosca begins, j Rosca groups of a given denomination, branch and quarter. The table shows F-statistics for the hypotheses $\alpha_1 = ... = \alpha_I, \gamma_1 = ... = \gamma_I, ...$ The result is that for the αs, one clearly rejects the hypothesis of equal branch intercepts, indicating financial fragmentation. A similar test for within branch financial integration yields that the within branch variation is 30 percent higher than across branches.

We next test if there is systematic arbitrage across Roscas and across locations (implication B). We measure the rank (or position) of an investor on a 0 to 1 scale, where 0 represents a receipt of the first pot – and 1 represents the receipt of the last pot. The average rank of the institutional investor is 0.44 which indicates that the investor takes pots before the middle. In all but three of the 77 branches, the institutional investor's rank is below 0.5. Figure 2 illustrates the branches in which the institutional investor takes relatively early pots (i.e. borrows) – and where the investors waits to take later pots. Comparing Figure 1 and 2 suggests that the institutional investor does indeed borrow (i.e. take earlier pots) when interest rates are low and save when interest rates are high. The correlation between the investor's rank and the interest rate is 0.4.

We test this more formally through the regressions of the institutional investor rank and participation on the Rosca interest rates with the appropriate fixed effects included. We find that institutional investors take fewer pots in Roscas within a branch when the interest rate is high – and take later pots if they do (i.e. act as savers) – while they take earlier pots when the interest rate is low. Further, their behavior is remarkably consistent: they follow a clear rule both cross-sectionally in a given quarter in a given branch over groups, and over time in a given branch. In addition, investors arbitrage across branches by taking earlier pots when interest rates are high.

In ongoing research we are investigating why interest rates remain unequal despite the arbitrage by institutional investors. Our simple model suggests that in a perfect information world, arbitrage by a "monopolist" would result in efficient allocations but not the equalization of interest rates – and so suggests one possible explanation. Another possibility is that the commission charged by the organizer limits the possibilities for arbitrage. Finally, since we do not observe the variation in interest rates in the absence of the institutional investors, it is entirely possible that arbitrage reduced the variation but did not close the gap completely because of the transactions costs of arbitraging across Roscas.

References

[1] Besley, T., Coate, S., Loury, G., 1993. The Economics of Rotating Savings and Credit Associations. American Economic Review 83, 792-810.

[2] Aghion, P. and P. Bolton, 1997. A Theory of Trickle-Down Growth and Development. *Review of Economic Studies,* 64(2): 151–172.

[3] Anderson, S. and J. Baland, 2002. The Economics of Roscas and Intrahousehold Resource Allocation, *Quarterly Journal of Economics,* $117(3), 963 - 995$.

[4] Banerjee, A. and A. Newman, 1993, Occupational Choice and the Process of Development. *Journal of Political Economy,* 101: 274–298.

[5] Banerjee, A. and K. Munshi. 2004. How Efficiently is Capital Allocated? Evidence from the Knitted Garment Industry in Tirupur." Review of Economic Studies 71(1):19-42.

[6] Banerjee, A. 2003. "Contracting Constraints, Credit Markets and Economic Development" in Dewatripont, M., L. Hansen and S. Turnovsky eds. Advances in Economic Theory and Econometrics: Theory and Applications, Theory and Applications, Eight World Congress of the Econometric Society, Cambridge University Press, 1-46.

[7] Besley, T., S. Coate and G. Loury. 1994. Rotating Savings and Credit Associations, Credit Markets and Efficiency. *The Review of Economic Studies,* 61(4): 701-719

[8] de Mel, S., Mckenzie, D. and C. Woodruff, Returns to Capital in Microenterprises: Evidence from a Field Experiment. forthcoming, *Quarterly Journal of Economics.*

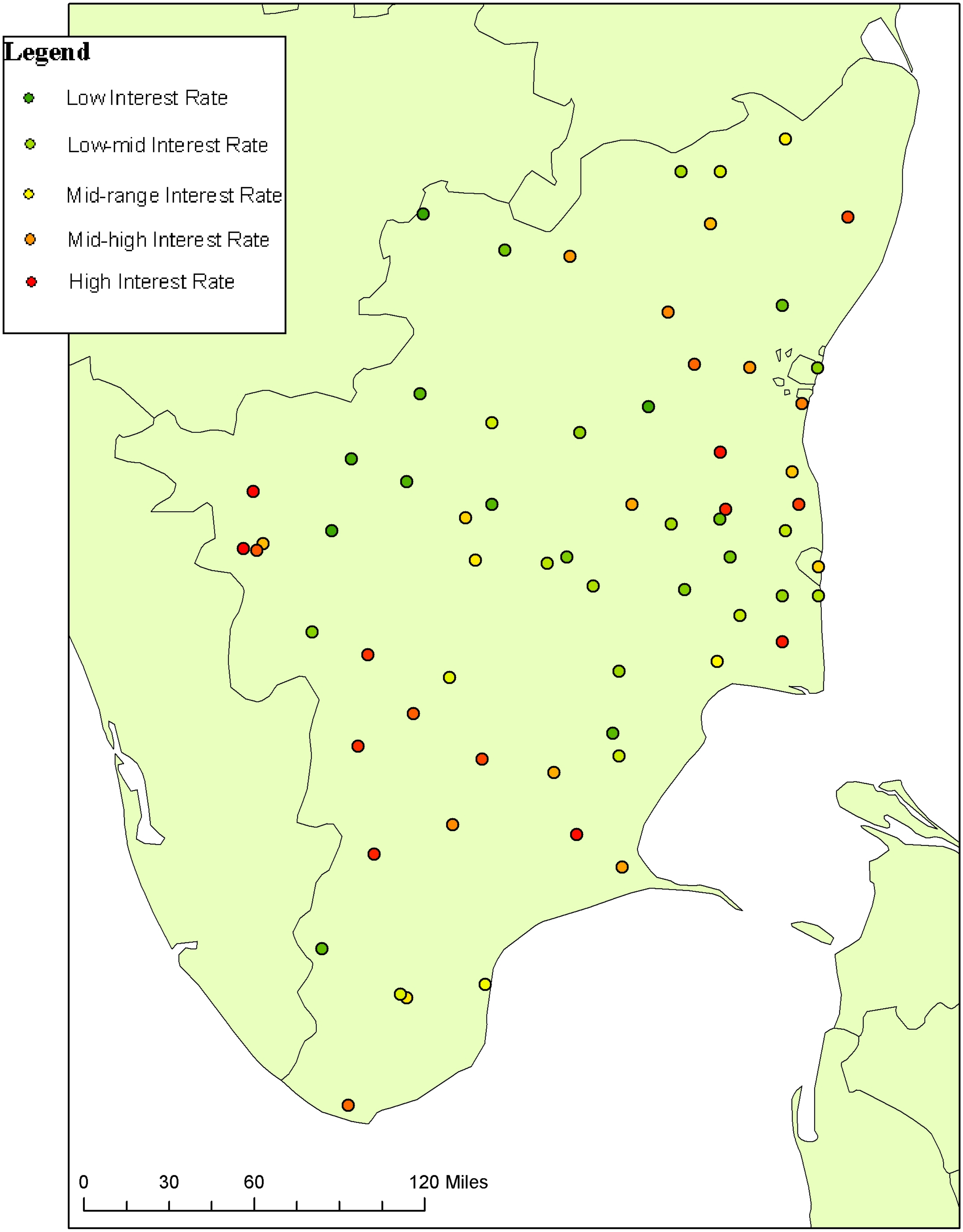
[9] Eeckhout, J. and K. Munshi, 2004. Economic Institutions as Matching Markets. Manuscript, Brown University.

[10] King, R. G, and R. Levine, 1993. Finance and Growth: Schumpeter Might be Right. *Quarterly Journal of Economics,* 108(3): 717–737.

[11] Paulson, Anna L., Robert Townsend and Alex Karaivanov 2006. Distinguishing Limited Liability from Moral Hazard in a Model of Entrepreneurship," Journal of Political Economy Vol. 114. No. 1, pp. 100 -144

[12] Townsend, R. 1997. "Microenterprise and Macropolicy" in Kreps, D. and K. Wallis eds. *Advances in Economics and Econometrics: Theory and Applications, Seventh World Congress of the Econometric Society,* Cambridge University Press, II:160-209.

Interest Rate across Tamil Nadu Branches



Spatial Arbitrage by Institutional Investors