Economic Institutions as Matching Markets

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Stanford

Eluding Regulation: The Response of Financial Institutions in India

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Motivation

The issue: Regulation

- Often benefits special interest groups
- Individuals respond by "voting with their feet"
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- Special setting in which response to regulation can be observed
- Financial intermediation, Chit Funds in Chennai (Madras)

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Starting point: nationalization of Indian banking in 1970

- Below-market interest rates and credit is rationed
- The cost: mainly borne by small investors and households
- Benefits money lenders, landowners (see Rajan and Zingales)

Chit funds: Traditional Micro Finance

- Small, rural, community-based (Grameen, Rosca)
- Allow individuals to elude the regulation
- Savings scheme with randomly selected winner
- Besley e.a.: gains from trade if complementarity, indivisibility

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Chit funds: Commercial Chit Funds

- Develop into commercial chit funds: large, urban, auctions
- Rather: financial intermediary for borrowers and lenders
- Operated by a company: fee and collateral
- They (imperfectly) replicate the market
- Default rates are very low
- Commercial chit funds become very big: 25% of bank deposits in Tamil Nadu, Kerala (1993).

Regulation: Chit Fund Act

- Compete with banking system; banks lobby for regulation
- The Reserve Bank India (RBI) passed the 1982 Chit fund act
- Bids capped: After appeal, upheld in 1993 by Supreme Court
- We evaluate the response to this regulation: voting with feet

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Data

- All auctions in largest Chit Fund company, based in Chennai
- Information on bids, income
- Identification of "corporate" and "private" subscribers

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Main findings

- we measure how the composition changes to new equilibrium
- equilibrating force: proportion of borrowers and lenders
- remarkable, given the absence of participation prices
- adjustment takes 1 year
- calculate implicit interest rate, a measure of welfare effects

Scope of the Paper

Applied Theory: provide a simple theory that is consistent with the observed institutional response to regulation;

Limitations of the analysis:

1. the model is highly stylized; in particular, the allocation procedure (auction) within the chit fund is simplified

2. empirically, we do not provide a structural analysis of the bidding (plans for future); build a theoretical framework that is consistent with the empirically observed institutional response

A Simple Model of Chit Funds

Two types $\overline{\gamma}, \underline{\gamma}$ with investment opportunities of value $1 + \gamma$

Time t is discrete; discount factor δ

Chit fund $\langle N, v, p \rangle$ (duration, contribution, proportion high types)

Allocation of funds based on second price sealed bid auction; only "losers" bid; proceeds of bid distributed among losers

Two stages:

Stage 1 - endogenous matching into different chit funds $\langle N, p, v \rangle$ (determines # high types p)

Stage 2 - funds are allocated in each period, given p

Stage 2: Bidding

High type's payoff for $t \leq pN$

$$\begin{aligned}\overline{V}_t &= \frac{1}{pN-t+1}\left(\overline{V}_N - \bar{b}_t\right) \\ &\quad + \left(1 - \frac{1}{pN-t+1}\right)\left(\delta\overline{V}_{t+1} + \frac{1}{N-t}\bar{b}_t\right)\end{aligned}$$

$\overline{V}_N = Nv\left(1+\overline{\gamma}\right)$ and $\bar{b}_t = \frac{N-t}{N-t+1}\overline{V}_N\left(1-\delta\overline{V}_{t+1}\right)$

$$\overline{V}_t = \overline{V}_N - \bar{b}_t = \delta\overline{V}_{t+1} + \frac{1}{N-t}\bar{b}_t.$$

Low type's payoff

$$\underline{V}_t = \delta\underline{V}_{t+1} + \frac{1}{N-t}\bar{b}_t.$$

$$\triangle V_t = \delta \triangle V_{t+1} \longrightarrow \triangle V_1 = \delta^{pN-1} \triangle V_{pN}.$$

For $t = pN$, high type wins for sure

$$\overline{V}_t = \overline{V}_N - \underline{b}_t$$

$$\underline{V}_t = \delta \underline{V}_{t+1} + \frac{1}{N-t}\overline{b}_t = \underline{V}_N - \underline{b}_t$$

$$\underline{b}_t = \frac{N-t}{N-t+1}\left(\underline{V}_N - \delta \underline{V}_{t+1}\right).$$

$$\triangle V_{pN} = \triangle V_N$$

Difference in high and low type's valuation:

$$\triangle V_1 (N, p) = \delta^{pN-1} \triangle V_N$$

where $\triangle V_N = Nv \left[\overline{\gamma} - \underline{\gamma}\right] = Nv \triangle \gamma$.

Properties of Chit fund Payoffs

The normalized continuation payoff of participation in a chit fund $\langle N, p, v \rangle$ is

$$\triangle W(\gamma, N, p) = \triangle V_1(\gamma, N, p)\left[1 + \delta^N + \delta^{2N} + ...\right] = \frac{\delta^{pN-1} N v \triangle \gamma}{1 - \delta^N}.$$

Lemma 1:

$$\frac{d \triangle W(N,p)}{dp} < 0$$

Lemma 2: For sufficiently impatient participants

$$\frac{d \triangle W(N,p)}{dN} < 0.$$

Stage 1: Matching

Given menu of chit funds, indifference between chit funds

$$W\left(\gamma, N_i, p\left(N_i\right)\right) = W\left(\gamma, N_j, p\left(N_j\right)\right), \forall \gamma, \forall i \neq j$$

which implies

$$\triangle W\left(N_i, p\left(N_i\right)\right) = \triangle W\left(N_j, p\left(N_j\right)\right), \forall i \neq j.$$

In addition, the beliefs p_i in each chit fund must be consistent with the initial distribution μ

$$\sum_i n_i p\left(N_i\right) N_i = \mu \sum_i n_i N_i$$

where the measure of groups of type i is n_i and the total measure of participants is n such that $\sum_i n_i N_i = n$.

Proposition 1. (Equilibrium Sorting) Consider any two chit funds i, j with $N_i < N_j$ and sufficiently patient participants. Then the matching equilibrium implies $p(N_i) > p(N_j)$.

The Impact of Regulation and the Change in Composition

Lemma 3: Consider the case in which high bids are constrained, while low bids are not. Then the difference in (normalized) payoffs between high types and low types increases under the constraint, for a fixed p and N.

Proposition 3. The proportion of high types will increase more in the constrained groups than in the unconstrained groups.

Testing the Theory: the Data

The data, from Shriram Chits and Investments Pvt. Ltd

1. *all* winning bids one year before/after 30% cap (Sep 30 1993)

   between October 1, 1992 and September 30, 1994 (we refer to 1993 and 1994 respectively)

   78,000 individuals participated

2. income information for a limited number of subscribers (21,906 subscribers - 25% of the full sample)

3. aggregate break down by groups

A wide range of value-duration combinations is offered: classification of groups (both Nv and v) – Table 1

Table 1: Classification of Groups

Groups divided by:		chit value			monthly contribution		
Chit value/contribution:		Low	Medium	High	Low	Medium	High
		(1)	(2)	(3)	(4)	(5)	(6)
Duration							
20 months		17.42	3.35	5.79	--	23.29	7.02
25 months	SHORT	8.51	8.77	17.38	10.25	--	27.41
30 months		--	49.29	5.79	--	40.85	14.47
40 months		73.87	24.77	18.90	88.93	23.41	13.60
50 months	LONG	0.20	0.90	38.11	0.82	0.24	27.41
60 months		--	12.90	10.67	--	12.20	7.68
100 months		--	--	3.35	--	--	2.41
Total		100.00	100.00	100.00	100.00	100.00	100.00
Total no. of groups		1022	775	328	849	820	456

Note: Chit value is the product of the monthly contribution and the group duration (in months).
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.
Duration: Long >=40 months.

A wide range of value-duration combinations is offered: classification of groups (both Nv and v) – Table 1

Identifying assumption: no change in characteristics of participants. Compare income distributions in 1993-1994 – Table 2

Table 2: Description of Participants

Groups partitioned by:	chit value						monthly contribution					
Chit value/ contribution:	Low		Medium		High		Low		Medium		High	
Year:	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Income Distribution (private subscribers)												
Mean	2.90	2.98	3.66	3.66	4.84	7.59	2.88	2.96	3.60	3.53	4.76	7.05
(standard deviation)	(2.70)	(3.06)	(4.79)	(3.00)	(9.12)	(35.94)	(2.75)	(2.98)	(4.70)	(2.54)	(8.80)	(32.92)
0.10 quantile	1.14	1.12	1.52	1.55	1.86	1.94	1.15	1.10	1.50	1.50	1.87	1.90
0.25 quantile	1.63	1.70	2.23	2.24	2.58	2.71	1.62	1.66	2.20	2.16	2.52	2.66
0.50 quantile	2.47	2.50	3.00	3.03	3.55	3.83	2.44	2.48	3.00	3.00	3.52	3.74
0.75 quantile	3.50	3.50	4.10	4.33	5.00	5.25	3.47	3.46	4.05	4.21	5.00	5.14
0.90 quantile	4.90	5.00	5.79	6.00	7.35	8.00	4.85	5.00	5.68	5.93	7.05	7.90
B. Proportion of corporate subscribers												
	0.17	0.23	0.15	0.20	0.12	0.24	0.17	0.23	0.15	0.20	0.13	0.23

Note: Chit value is the product of the monthly contribution and group duration (in months).
Income is measured in thousands of Rs. per month.
Statistics in Panel A are computed for private subscribers only.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.

A wide range of value-duration combinations is offered: classification of groups (both Nv and v) – Table 1

Identifying assumption: no change in characteristics of participants. Compare income distributions in 1993-1994 – Table 2

Stability of income distribution seems to justify the use of chit value as criterion for classifying the groups

We use the "corporate subscribers" to classify ex ante characteristics of high types (i.e. borrowers). In the data: they win early – Table 3

Table 3: Timing of Winning Bids by Type of Participant

Dependent variable:	Timing					
Chit value/ contribution:	Low		Medium		High	
Year:	1993	1994	1993	1994	1993	1994
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Groups partitioned by chit value						
Corporate subscriber	-0.124	-0.124	-0.105	-0.144	-0.151	-0.118
	(0.005)	(0.006)	(0.007)	(0.006)	(0.010)	(0.008)
Constant	0.535	0.543	0.530	0.543	0.529	0.541
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Number of observations	21,400	14,635	14,300	13,411	7,555	6,750
Panel B: Groups partitioned by contribution						
Corporate subscriber	-0.122	-0.117	-0.114	-0.147	-0.134	-0.126
	(0.005)	(0.006)	(0.007)	(0.006)	(0.009)	(0.007)
Constant	0.534	0.540	0.532	0.544	0.529	0.543
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Number of observations	19,910	12,815	14,330	13,321	9,015	8,660

Note: Timing is measured as the winning month divided by the total duration of the group.
Corporate subscriber equals one if finance company, zero otherwise.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.
The individual subscriber is the unit of observation.
Standard errors in parentheses.

Sorting in 1993

Theory predicts a systematic relationship between p and N. Short duration funds have a higher proportion of "corporate subscribers" (borrowers) – Table 4

Larger coefficient on higher value funds

Table 4: Matching into Groups (1993)

Dependent variable:	Proportion of corporate subscribers					
Groups partitioned by:	chit value			monthly contribution		
Chit value/ contribution:	Low	Medium	High	Low	Medium	High
	(1)	(2)	(3)	(4)	(5)	(6)
A. Duration measured by a binary variable						
Long duration dummy	-0.007	-0.014	-0.098	-0.018	-0.024	-0.063
	(0.008)	(0.009)	(0.014)	(0.012)	(0.010)	(0.011)
Constant	0.179	0.141	0.208	0.190	0.150	0.173
	(0.007)	(0.005)	(0.013)	(0.012)	(0.006)	(0.009)
Number of observations	594	337	161	512	363	217
B. Duration measured as a continuous variable (in years)						
Group duration	-0.004	-0.014	-0.015	-0.016	-0.026	-0.014
	(0.005)	(0.009)	(0.004)	(0.010)	(0.008)	(0.004)
Constant	0.185	0.173	0.191	0.227	0.210	0.185
	(0.017)	(0.024)	(0.018)	(0.031)	(0.020)	(0.014)
Number of observations	594	337	161	512	363	217

Note: Long duration dummy equals one if the group runs for at least 40 months, zero otherwise.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.
Regressions use 1993 data only and the group is the unit of observation.
Standard errors in parentheses.

The Bids Before and After

Normalized bids are higher in long duration groups – Table A3

Table A3: Bids within the Group

Dependent variable:	Normalized bid					
Contribution:	Low		Medium		High	
Duration:	Short	Long	Short	Long	Short	Long
	(1)	(2)	(3)	(4)	(5)	(6)
Period 1	0.275	**0.370**	**0.328**	**0.464**	**0.337**	**0.527**
	(0.004)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
Period 2	0.223	0.312	0.246	**0.368**	0.254	**0.418**
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Period 3	0.156	0.221	0.161	0.275	0.174	0.304
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Period 4	0.097	0.118	0.095	0.181	0.110	0.197
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Period 5	0.063	0.065	0.063	0.077	0.065	0.085
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Period 1 * 1994 dummy	0.003	**-0.077**	**-0.043**	**-0.167**	**-0.046**	**-0.224**
	(0.005)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Period 2 * 1994 dummy	0.020	-0.041	-0.005	**-0.081**	0.003	**-0.123**
	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Period 3 * 1994 dummy	0.003	-0.002	-0.008	-0.016	0.002	-0.031
	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Period 4 * 1994 dummy	-0.009	0.006	-0.008	-0.002	-0.007	-0.009
	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Period 5 * 1994 dummy	-0.010	-0.009	-0.010	-0.009	-0.009	-0.014
	(0.004)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)
Number of observations	2088	29788	13344	13487	5522	11697

Note: Normalized bid is measured as the bid amount divided by the chit value.
Short duration groups last for less than 40 months, Long duration groups last for 40 months or more.
Each group is divided into 5 equal periods: Period 1- Period 5, covering its entire duration in sequence.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>=1000.
Bold face coefficients highlight bids greater than 0.3 in Rows 1-5 and the change in those bids in Rows 6-10.
Standard errors in parentheses.

The Bids Before and After

Normalized bids are higher in long duration groups – Table A3

The 30% cap in 1994 forces the highest bids down

See also the nonparametric kernel estimates of the bid regression – Figures 1-3

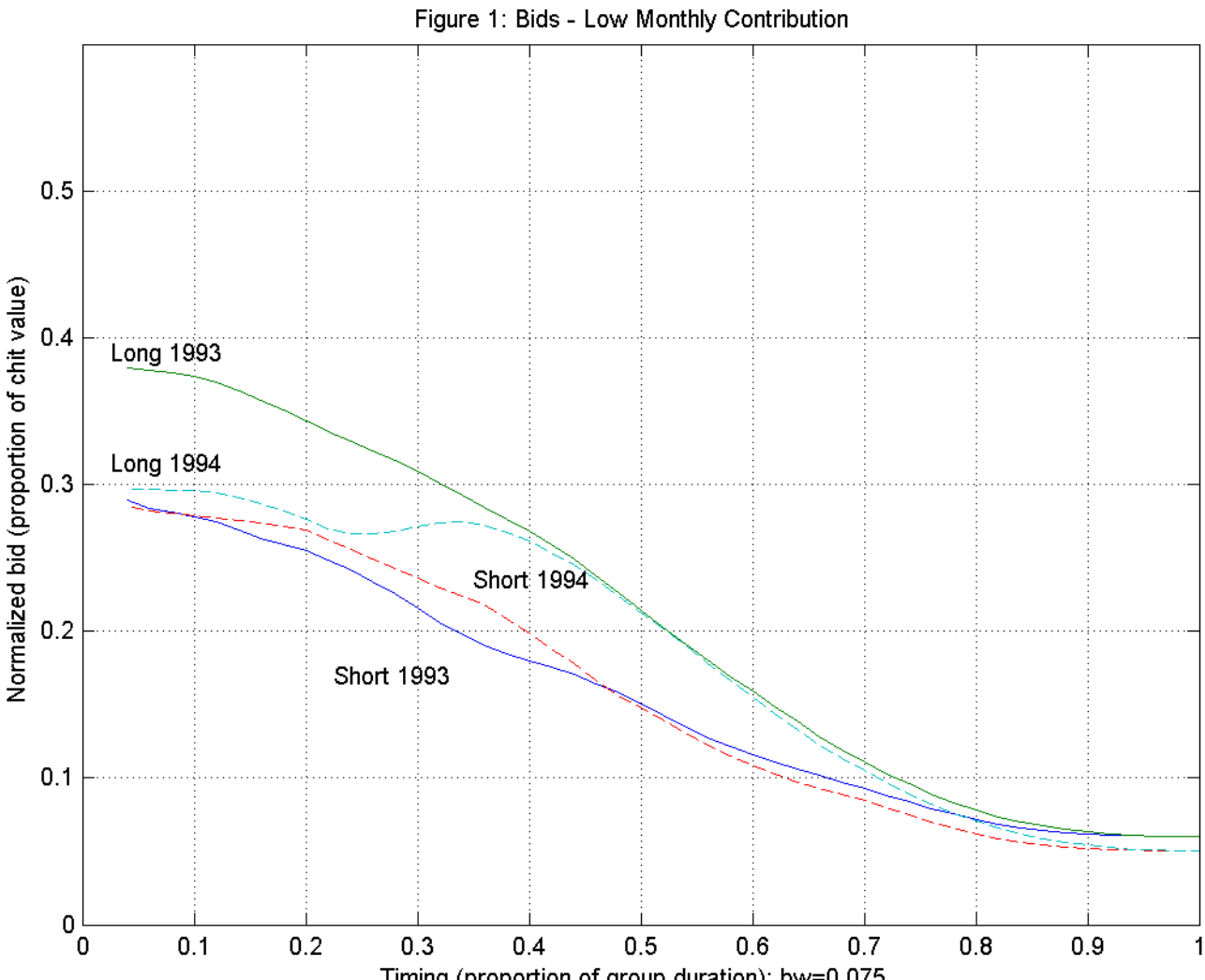
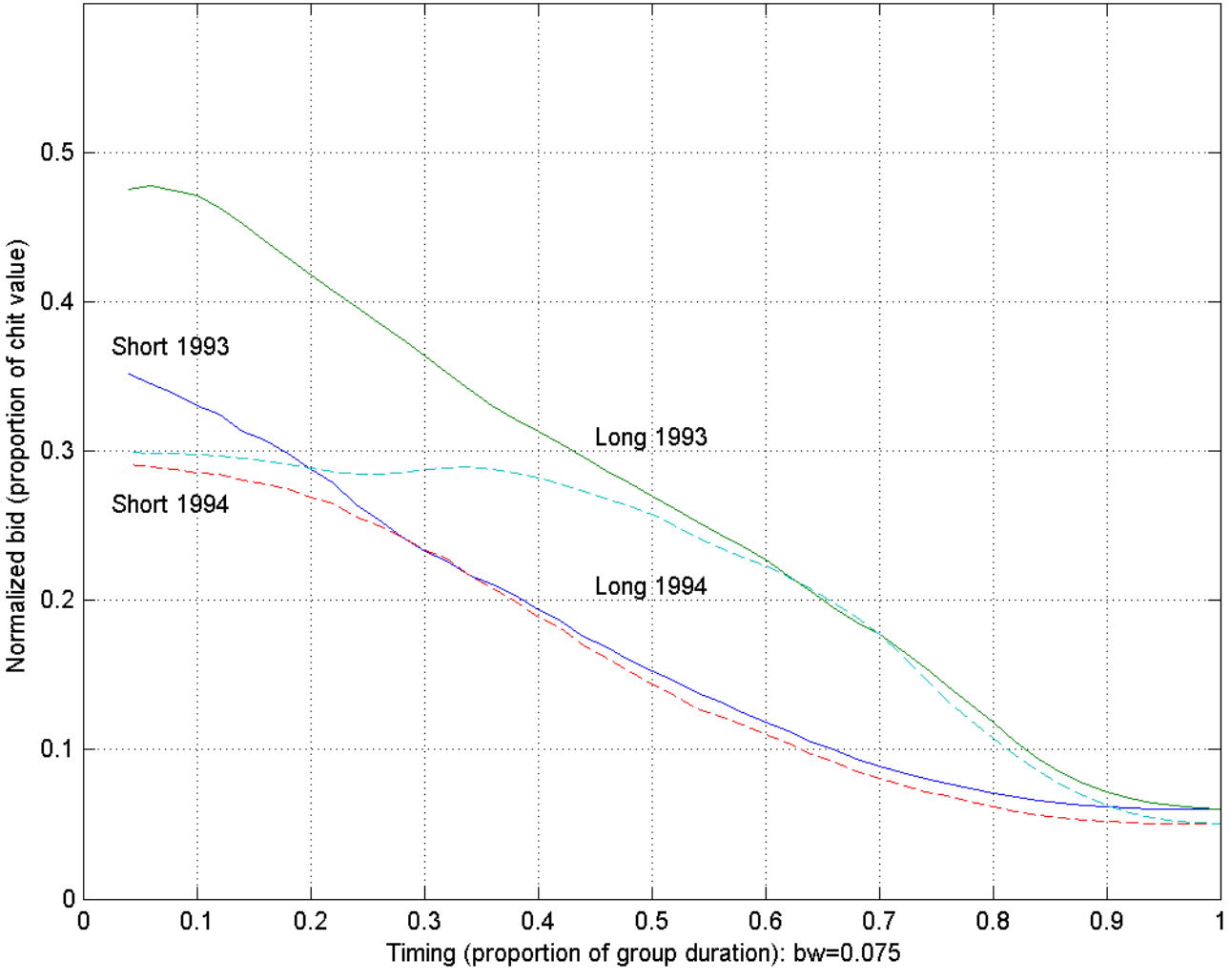


Figure 1: Bids - Low Monthly Contribution
Normalized bid (proportion of chit value)
0
0.1
0.2
0.3
0.4
0.5
Long 1993
Long 1994
Short 1994
Short 1993
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Timing (proportion of group duration): bw=0.075

Figure 2: Bids - Medium Monthly Contribution



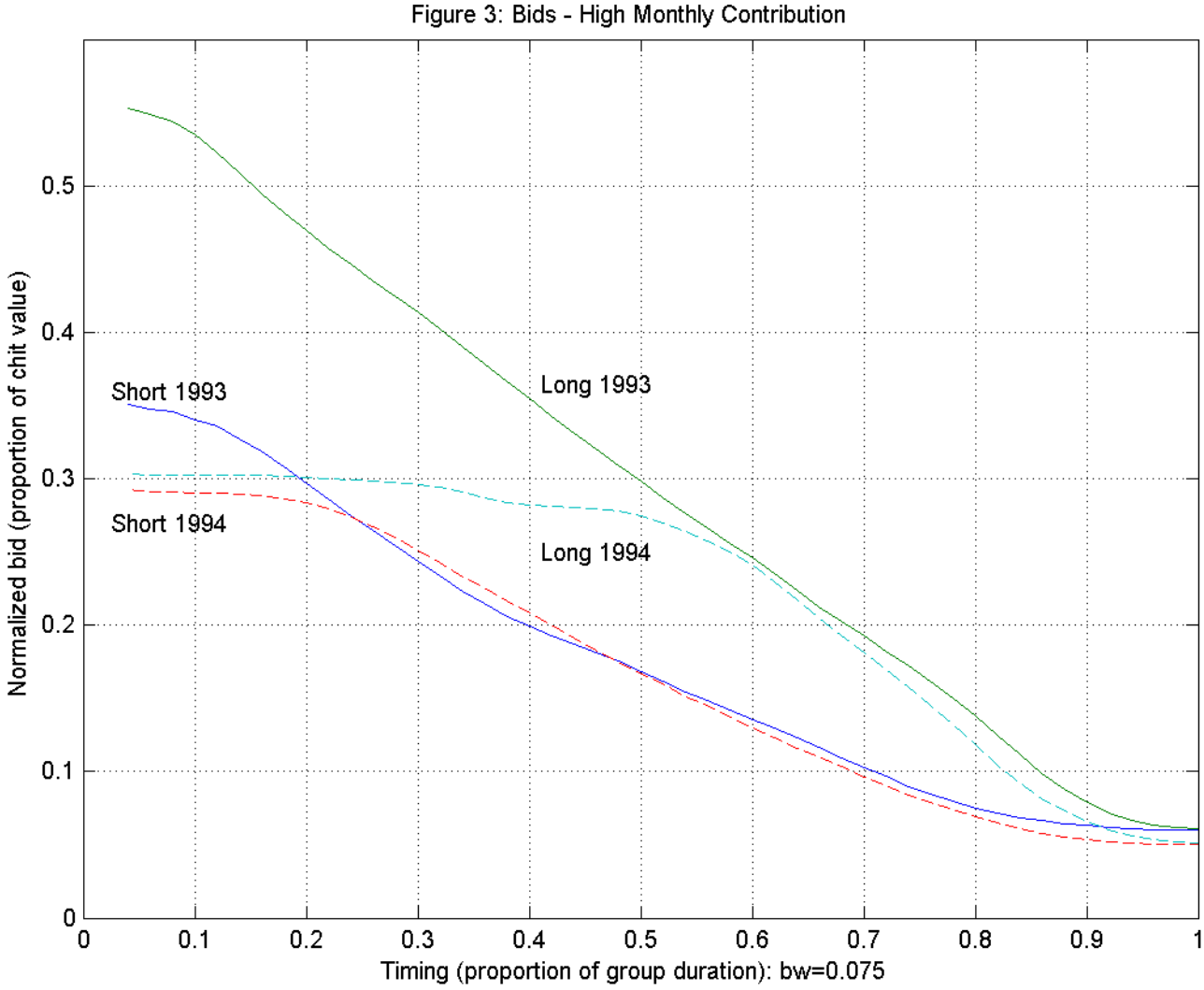


Figure 3: Bids - High Monthly Contribution
Normalized bid (proportion of chit value)
0
0.1
0.2
0.3
0.4
0.5
Short 1993
Short 1994
Long 1993
Long 1994
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Timing (proportion of group duration): bw=0.075

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Theory predicts that the constrained groups (here, the long duration funds) will experience a higher increase in p: 1994 - duration dummy must be positive – Table 5

Table 5: Matching into Groups (from 1993 to 1994)

Dependent variable:	Proportion of corporate subscribers					
Groups partitioned by:	chit value			monthly contribution		
Chit value/contribution:	Low	Medium	High	Low	Medium	High
	(1)	(2)	(3)	(4)	(5)	(6)
A. Duration measured by a binary variable						
Long duration dummy - 1994 dummy	0.059	0.030	0.088	0.073	0.039	0.086
	(0.013)	(0.015)	(0.024)	(0.019)	(0.016)	(0.019)
Long duration dummy	-0.007	-0.014	-0.098	-0.018	-0.024	-0.063
	(0.009)	(0.010)	(0.018)	(0.013)	(0.011)	(0.014)
1994 dummy	0.004	0.031	0.040	-0.009	0.022	0.042
	(0.011)	(0.008)	(0.020)	(0.018)	(0.008)	(0.014)
Constant	0.179	0.141	0.208	0.190	0.150	0.173
	(0.008)	(0.006)	(0.016)	(0.013)	(0.006)	(0.010)
Number of observations	1,022	675	328	849	720	456
B. Duration measured as a continuous variable (in years)						
Group duration -1994 dummy	0.038	0.007	0.019	0.063	0.021	0.028
	(0.008)	(0.014)	(0.009)	(0.015)	(0.012)	(0.008)
Group duration	-0.004	-0.014	-0.015	-0.016	-0.026	-0.014
	(0.006)	(0.010)	(0.005)	(0.010)	(0.008)	(0.005)
1994 dummy	-0.063	0.020	0.037	-0.147	-0.020	-0.002
	(0.024)	(0.039)	(0.033)	(0.047)	(0.030)	(0.026)
Constant	0.185	0.173	0.191	0.227	0.210	0.185
	(0.017)	(0.027)	(0.022)	(0.033)	(0.021)	(0.017)
Number of observations	1,022	675	328	849	720	456

Note: Long duration dummy equals one if the group runs for at least 40 months, zero otherwise.
1994 dummy equals one if the group commenced in 1994, zero otherwise.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>1000.
The group is the unit of observation.
Standard errors in parentheses.

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Full adjustment to regulation in 1 year – Figure 4,5

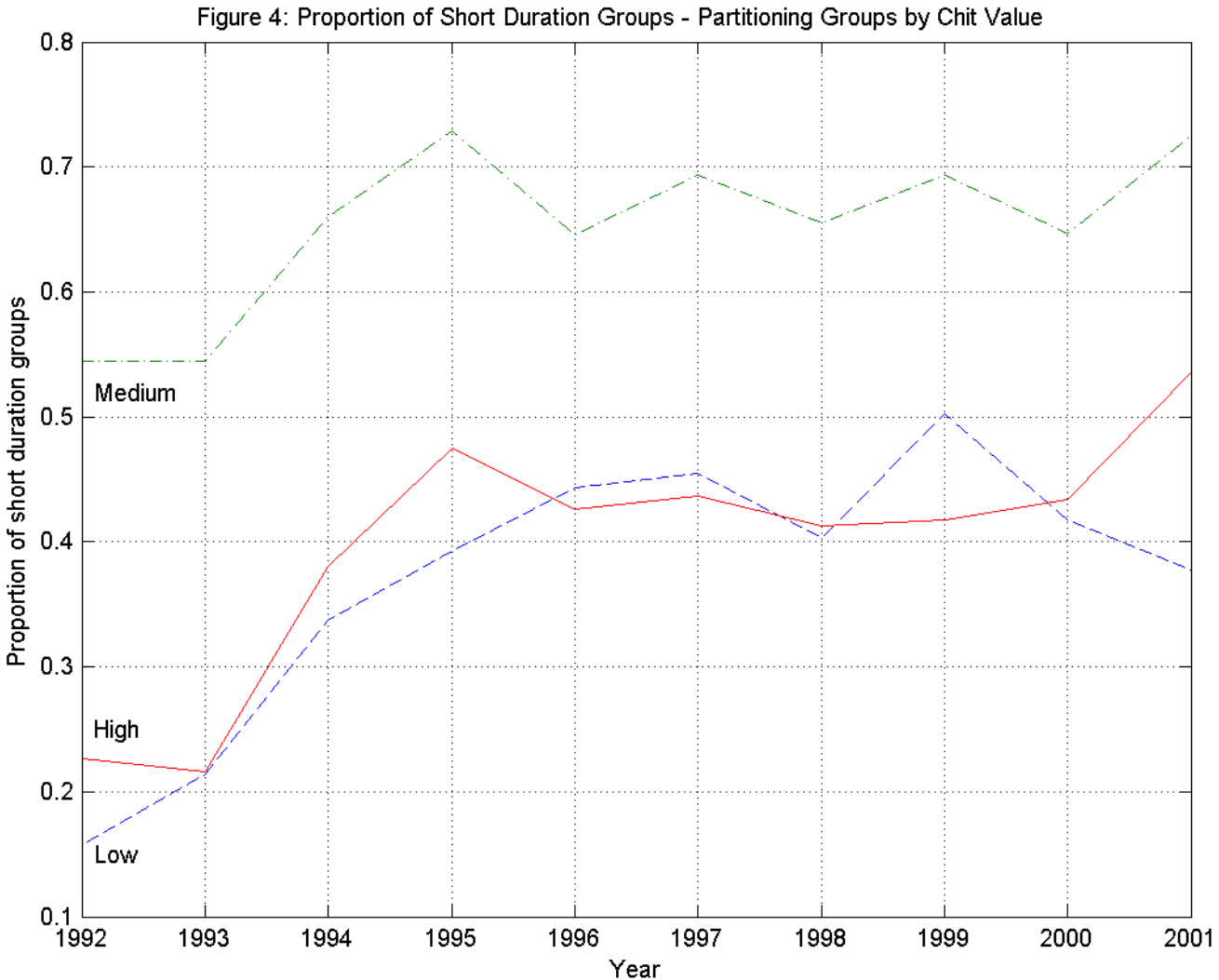
Figure 4: Proportion of Short Duration Groups - Partitioning Groups by Chit Value
Proportion of short duration groups
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Medium
High
Low
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year

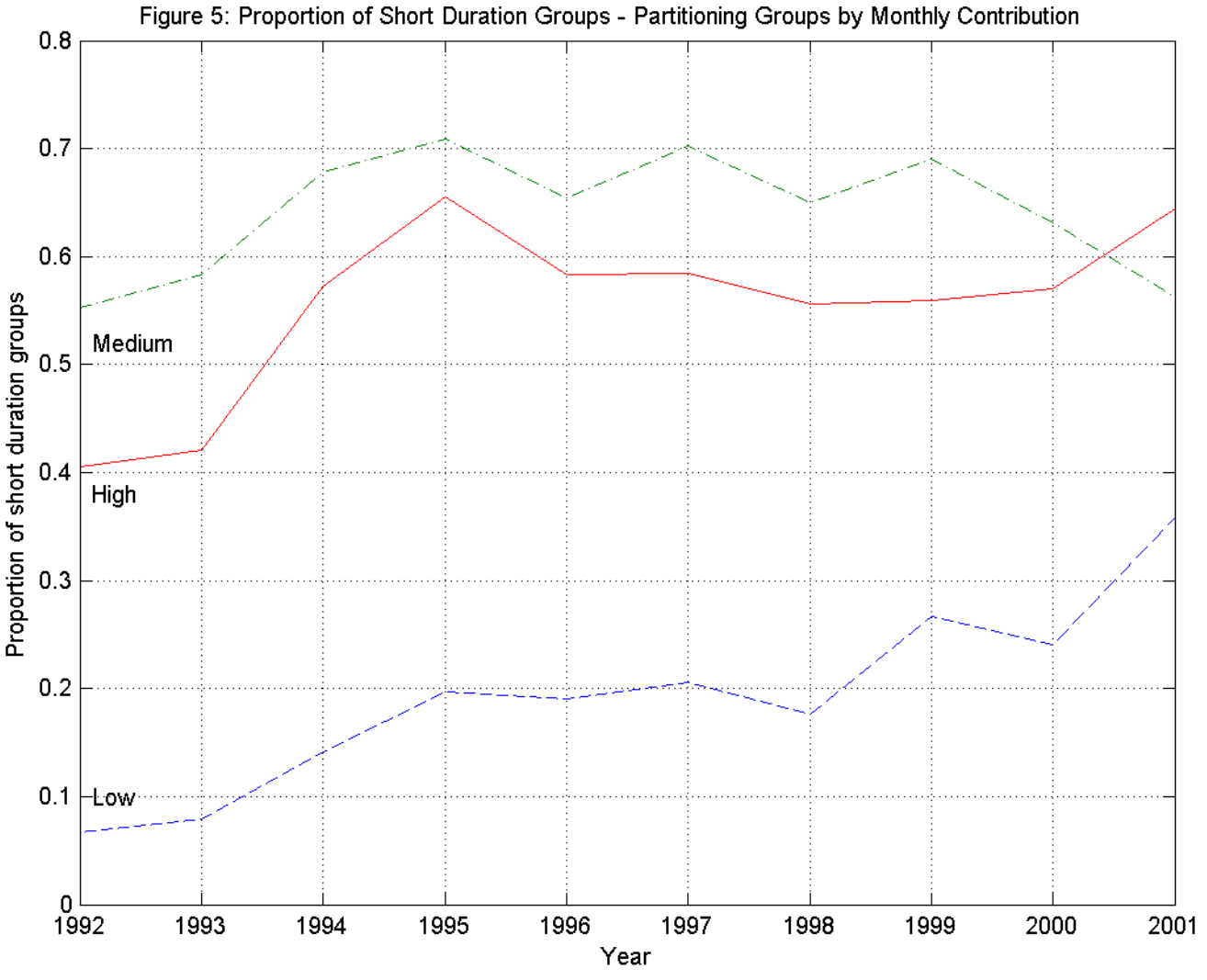
Figure 5: Proportion of Short Duration Groups - Partitioning Groups by Monthly Contribution
Proportion of short duration groups
Year
Medium
High
Low
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001

The Implicit Interest Rate

The net present value of monthly contributions must equal the net present value of funds received:

$$D^{\tau}\left(Nv - b_{\tau}\right) + \sum_{t=0}^{N-1} D^{t}\left(\frac{1}{N}b_{t} - v\right) = 0,$$

where $D = \frac{1}{1+r_m}$ is monthly interest factor, τ is winning period

$$D = \left(\frac{Nv - b_{\tau}}{Nv - b_{\tau'}}\right)^{\frac{1}{\tau'-\tau}}.$$

Converting to an annual interest rate,

$$r = \left(\frac{Nv - b_{\tau'}}{Nv - b_{\tau}}\right)^{\frac{12}{\tau'-\tau}} - 1.$$

Table 7

Table 7: Implicit Interest Rates

Groups partitioned by:	chit value						contribution					
Chit value/contribution:	Low		Medium		High		Low		Medium		High	
Duration:	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Interest rate computed using first and last month												
1993	16.48	14.15	18.92	18.17	24.18	20.88	15.76	14.20	18.33	18.15	20.60	20.88
	(0.36)	(0.12)	(0.32)	(0.63)	(1.02)	(0.56)	(0.38)	(0.12)	(0.28)	(0.64)	(0.69)	(0.56)
1994	17.00	9.95	14.52	8.77	16.58	8.38	16.09	9.95	15.30	8.77	15.88	8.38
	(0.42)	(0.04)	(0.15)	(0.16)	(0.37)	(0.13)	(0.36)	(0.04)	(0.24)	(0.16)	(0.25)	(0.13)
B: Interest rate computed using 0.20*duration and last month												
1993	15.53	14.01	17.71	16.40	20.50	17.94	15.04	14.11	17.04	16.18	18.81	17.94
	(0.44)	(0.12)	(0.32)	(0.56)	(0.97)	(0.49)	(0.72)	(0.12)	(0.32)	(0.57)	(0.53)	(0.49)
1994	16.88	10.80	16.39	9.98	18.98	10.00	17.36	10.80	16.28	9.98	17.97	10.00
	(0.55)	(0.11)	(0.20)	(0.18)	(0.39)	(0.15)	(0.58)	(0.11)	(0.29)	(0.18)	(0.32)	(0.15)

Note: Short duration groups run for less than 40 months, Long duration groups run for at least 40 months.
Chit value: Low if chit value=10000, Medium if chit value 10000-50000, High if chit value>=50000.
Contribution: Low if contribution<500/month, Medium if contribution 500-1000, High if contribution>=1000.
Mean interest rate (in percentage) with standard errors in parentheses.
Interest rates are computed at the group level.

Conclusion

Eluding Regulation, participants "vote with their feet" and we observe the response in the chit funds.

The participation decisions are as predicted by the theory: the proportion of borrowers p increases more in 1994 in the long duration funds (those that have the higher bids).

Even in the absence of market prices, participation decisions induce equilibrium, and there is full adjustment in one year.

Implicit interest rate calculations indicate that these institutions capture substantial gains from trade, and those gains are affected by the new regulation.