Free Riding in Teams

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Motivation

- Team production (output due to the efforts of two or more workers), characterizes economic activity of various hues:
  - work done in most white-collar jobs,
  - some blue-collar jobs,
  - by the Cabinet in a Government and
  - by committees.

- Potential for free-riding behavior by team members
  - when it is difficult to observe & verify team members' contributions.

- Free-riding forms the central tenet of economic theories of the firm (Alchian and Demsetz, 1972; Hölmstrom, 1982)

Motivation

- Theories posit various mechanisms to reduce free-riding:
  - Monitoring and supervision (Alchian and Demsetz, 1972; Jensen and Meckling, 1976),
  - Budget breakers (Hölmstrom, 1982),
  - Peer monitoring (Kandel and Lazear, 1992; Carpenter and Matthews, 2009),
  - Relational contracts (Rayo, 2007) and
  - Verifiable signals (Hölmstrom, 1979; Hertzberg et al., 2010)

- Start from the premise that free-riding in teams is pervasive.

- Yet, evidence of free-riding is scarce.

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Motivation

- Free-riding may not manifest in teams:
  - Employees may be intrinsically motivated (Prendergast, 2007)
  - All work is not distasteful (Pfeer, 1996; Kreps, 1997; Baron and Kreps, 1999)

- If free-riding does not exist, theoretical mechanisms to overcome it maybe akin to "shooting flies with a cannon".
- Ultimately, the question is an empirical one:
  - Does free-riding actually occur in teams?

- In this study, we utilize data on agricultural loans from an Indian bank to study this question.
- We find free-riding in teams reduces output by at least 10%.

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The Empirical Challenge

- Several confounding factors hobble empirical tests.

- Members of a team may interact frequently
  - they may be encouraged to monitor and motivate each other.
  - team members may cooperate with or even train each other (Hamilton et al. 2003).

- Such "peer effects" may reduce or eliminate the effect of free-riding (Kandel and Lazear, 1992; Marks et al. 2013).

- If verifiable signals of effort are available, team members avoid free-riding (Hölmstrom, 1979; Hertzberg et al. 2010).

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The Empirical Challenge

- Free-riding can be identified only when peers cannot influence each other.

- Same job done by a team in some cases and by an individual in other cases.
  - Variation should be exogenous to team and individual characteristics.

- Setting for team production should be such that it is difficult to observe and verify the contribution of each team member.

- A non-trivial challenge to find such a setting.

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Our Clean Empirical Setting

- Banks follow a policy of mandatory rotation
  - Once the loan officer has completed three years in a branch
  - Choice of team versus individual production unrelated to loan officer characteristic or loan performance.

- Inputs of each loan officer are sequential and not simultaneous

- So, job rotation removes the effect of other confounding factors in team production:
  - No inter-personal interactions => no peer effects or social pressure.
  - Incumbent and replacement cannot cooperate with each other.
  - They cannot monitor, motivate or train each other.

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Our Clean Empirical Setting

- Unlike corporate loans, agricultural crop loans are zero-coupon loans that don't require interim payments.
  - In corporate loans, incoming loan officer can use documentation or interim coupon payments to ferret out free-riding.
  - In agricultural crop loans in India, illiterate, small farmers
    - don't document activates,
    - don't posses any financial reports
    - don't pay taxes
    - do not own a checking or savings account with the bank
  - Loan officer's interactions with his borrowers are only through the loan account and transactions related to the same
  - Soft information based lending that utilizes
    - Loan officer's geographical proximity to the borrower
    - Local informal networks
  - No verifiable information to disentangle relative contributions of loan officers.

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Our Clean Empirical Setting

- Use job rotation on agricultural loans provided by a bank.
- Verifiable measure of output : loan performance.

Data

- Unique loan account level information from a Government owned Bank in India.
  - Bank has a pan India presence and operates more than 1000 branches.
- Bank provided data for 14 branches in
  - four districts in Andhra Pradesh, two in Karnataka and three in Maharashtra.
- October 2005 - May 2012.
- 43,000 loans availed by more than 15,000 agricultural borrowers.
- Loans issued by 44 different loan officers.
  - Identity of loan officer who lent a particular loan
  - Tenure of loan officer in a branch.
- All crop loans have a one-year maturity.

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Dependent Variable

- We define default as the borrower not repaying the loan by the due date of repayment.

- Follow RBI's guidelines for Asset Classification, Provisioning and Other Related Matters
  - Loan is in default if it has not been repaid by due date of repayment.
  - Results robust to loan becoming NPA

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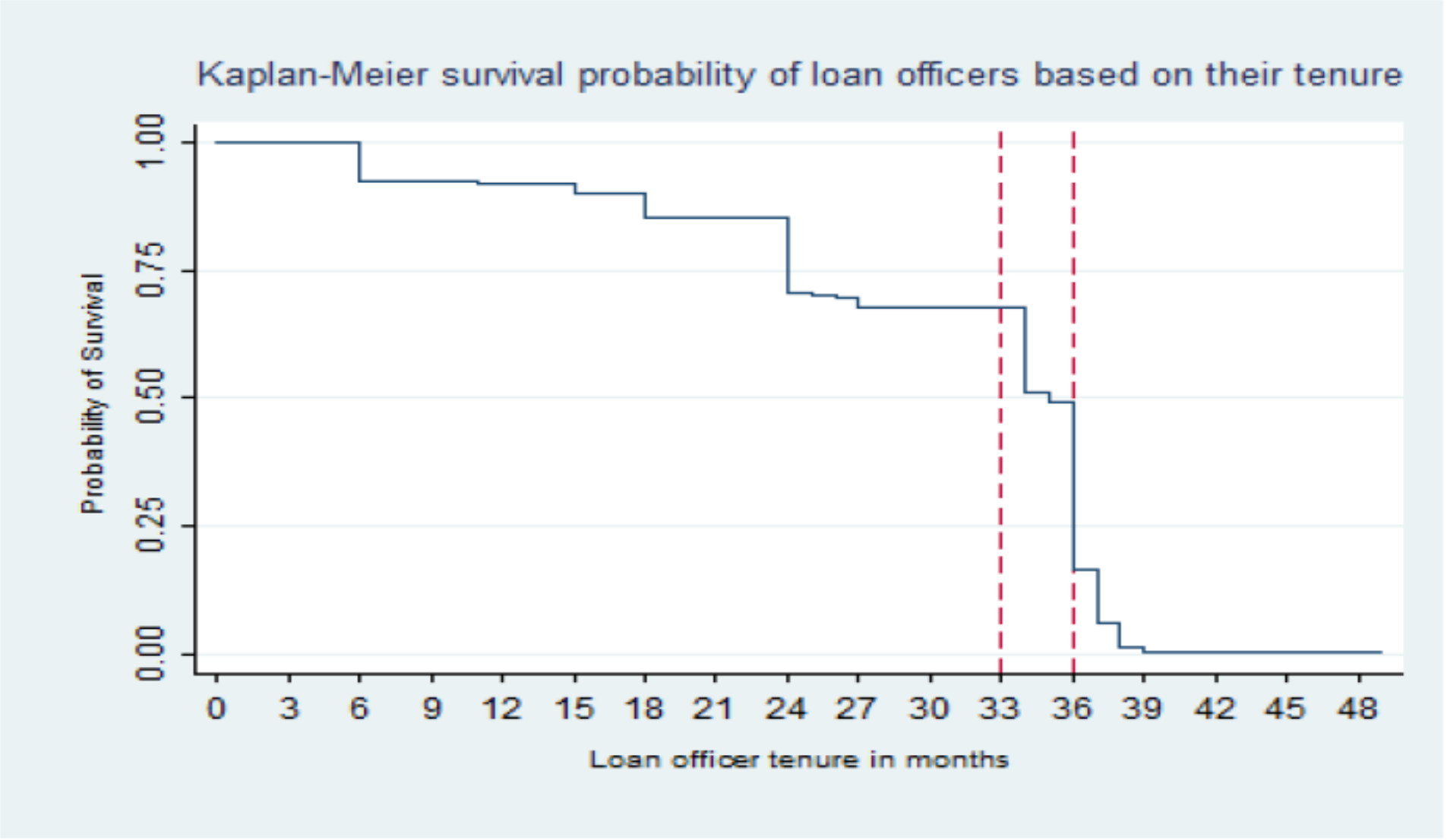
Figure 1: Kaplan-Meier survival curve with Loan Officer Tenure in Months



Note: The graph shows Kaplan-Meier survival curve (also known as the Kaplan-Meier product limit estimate) against loan officers tenure (in months). The discontinuity in the graph occurs at 12_th quarter which illustrates that the average loan officer gets transferred between 33 and 36 months.

Empirical Framework

- $Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_b + \beta_k * Dummy(month \geq k) + \varepsilon_{ijkt}$

  - Y equals 1 if loan *j* issued to borrower *b* by officer *i* in time *t* defaults and 0 otherwise.
  - *Dummy (month ≥ k)* is a dummy that takes the value of 1 for loans originated in or after month *k* and 0 otherwise
  - *k* denotes the number of months of service of an officer in a branch
  - β_i denotes officer fixed effects.
  - β_t denotes fixed effects for each calendar month.
  - β_b denotes borrower fixed effects.

$$\beta_k = (\overline{Y}_{\text{Loans issued in or after month } k} - \overline{Y}_{\text{Loans issued earlier}})\Big|_{\text{loan officers moving on scheduled rotation}}$$

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Likelihood of job rotation

- All agricultural crop loans have a *maturity of 12 months*.

- Scheduled rotation after 36 months
  - Loans originated before the 24th month of a loan officer's tenure unlikely to be affected by rotation.

- Actual tenure varies between 33 to 39 months
  - Loans originated till the 26th month of a loan officer's tenure unlikely to be affected by rotation (26+12<39).
  - After the 27th month, the probability of a loan being affected by rotation is extremely high [(27+x)+12 > 39].
  - Loans affected by rotation allocated exogenously.
  - Probability increasing with loan officer tenure (after 27th month).

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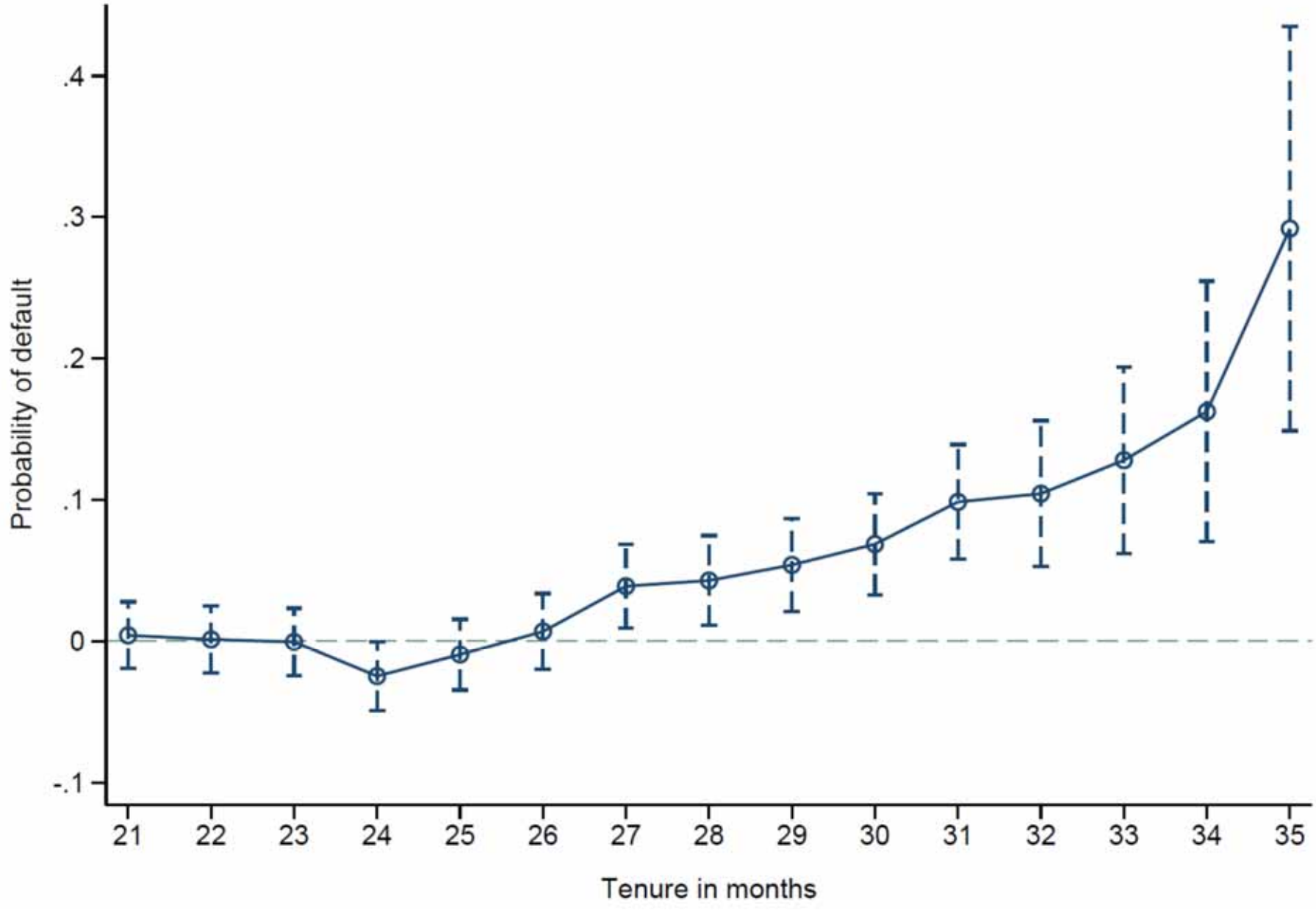
Figure 2: Loan Default rates based on loan officer tenure



Evidence consistent with free-riding

- Monotonic increase in probability of default after 27th month

- Consider loans originated in the 29th month and 31st month.
- Any loan originated after 27th month => probability of rotation ≈ 1
- Difference cannot stem from the probability of rotation, which affects quality of effort in screening

- Expected tenure is 36 months
- For loans originated in the 29th (31st) month, incoming officer is expected to monitor the loan for five (seven) months.
- Higher prob of default for loans originated in 31st month
  - Has to stem from free-riding in monitoring effort for 7 instead of 5 months.

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Empirical Framework

- Tests exploiting discontinuity due to actual month of rotation:
  - $$Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_k * Before\_Rotation\_k + \beta \cdot X_{ij} + \varepsilon_{ijkt}$$
  - *Before_Rotation_k* is a dummy that takes the value of 1 for loans originated within k days before actual rotation and 0 otherwise.

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Table 4: Effect of Mandatory Loan Officer Rotation on Loan Default

$$Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_1 * Tenureend_{it} + \beta X + \varepsilon_{ijmt}$$

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable			Dummy For Default			
Last Six Months	0.100***	0.114***				
	[7.745]	[5.622]				
Last Three Months			0.174***	0.143***		
			[8.469]	[4.270]		
Last One Month					0.215***	0.319***
					[4.255]	[4.373]
Loan Size	0.017***	0.121***	0.016***	0.120***	0.017***	0.121***
	[6.066]	[15.774]	[5.914]	[15.564]	[6.093]	[15.638]
Current Tenure	-0.006***	-0.005***	-0.005***	-0.003***	-0.004***	-0.003***
	[-12.331]	[-6.021]	[-11.737]	[-4.649]	[-10.412]	[-4.383]
Officer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Calender Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Fixed Effects	No	Yes	No	Yes	No	Yes
Officer X Calender Month Fixed Effects	Yes	No	Yes	No	Yes	No
Observations	29,353	29,353	29,353	29,353	29,353	29,353
Number of Borrowers	15,489	15,489	15,489	15,489	15,489	15,489
Adjusted R-squared	0.229	0.548	0.229	0.547	0.228	0.547

Table 5: Effect of Mandatory Loan Officer Rotation on Loan Default Using Discontinuity Provided By Actual Rotation

$$Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_1 * Before_{it} + \beta X + \varepsilon_{ijmt}$$

Dependent Variable	Dummy for default			
Interval	15 days	30 Days	45 Days	60 Days
Before Rotation	0.134***	0.510***	0.303***	0.282***
	[3.019]	[2.858]	[8.147]	[8.124]
Loan Size	0.008	0.012	0.020**	0.020**
	[0.457]	[0.946]	[1.965]	[2.260]
Officer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	886	1,771	2,586	3,256
Number of Borrowers	879	1,736	2,507	3,135
Adjusted R-squared	0.163	0.172	0.185	0.180

What about prior default?

- Prior default is the only piece of verifiable information
- If loan officer lends to borrowers that have already defaulted, this is a verifiable signal that can be used against him

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Table 7: Mandatory Loan Officer Rotation And Borrower Credit History

$$Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_1 * Tenureend_{it} + \beta X + \varepsilon_{ijmt}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable				Dummy For Lag Default				
Last Six Months	-0.069***	-0.081***						
	[-3.323]	[-2.616]						
Last Three Months			-0.002	-0.062				
			[-0.045]	[-1.268]				
Last One Month					-0.273***	-0.218**		
					[-4.438]	[-2.125]		
Straddle							-0.051***	-0.111***
							[-3.686]	[-4.492]
Loan Size	-0.068	-0.067	-0.068	-0.055	-0.059	-0.063	-0.069	-0.069***
	[-1.318]	[-1.310]	[-1.318]	[-1.302]	[-1.292]	[-1.317]	[-1.320]	[-1.320]
Current Tenure	-0.024***	-0.041***	-0.024***	-0.041***	-0.023***	-0.041***	-0.023***	-0.040***
	[-5.718]	[-2.917]	[-5.656]	[-2.854]	[-5.425]	[-2.845]	[-5.478]	[-2.833]
Officer Fixed Effects	0.005***	0.003***	0.004***	0.002**	0.005***	0.002**	0.006***	0.005***
Calender Month Fixed Effects	[7.967]	[2.628]	[7.219]	[1.976]	[8.271]	[2.123]	[7.865]	[3.929]
Borrower Fixed Effects	0.350***	0.819***	0.367***	0.785***	0.345***	0.781***	0.331***	0.750***
Officer X Calender Month Fixed Effects	[5.672]	[5.506]	[5.949]	[5.235]	[5.606]	[5.217]	[5.269]	[5.126]
Observations	14,242	14,242	14,242	14,242	14,242	14,242	14,242	14,242
Number of Borrowers	7,554	7,554	7,554	7,554	7,554	7,554	7,554	7,554
Adjusted R-squared	0.245	0.575	0.244	0.575	0.246	0.575	0.245	0.577

What about loan size?

- Loan size is decided only at the time of origination
- No role of replacement loan officer in deciding this
- Should not get affected by free-riding

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Table 8: Effect of Mandatory Loan Officer Rotation on Quantity Of Loans

$$Y_{imt} = \beta_0 + \beta_i + \beta_t + \beta_1 * Tenureend_{it} + \beta X + \varepsilon_{ijmt}$$

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Loan Amount			Number Of Loans		
Last Six Months	0.22			-3.629		
	[0.513]			[-0.615]		
Last Three Months		0.27			-5.961	
		[0.458]			[-0.694]	
Last One Month			-2.65			-9.840
			[-2.621]			[-0.582]
Officer Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	612	612	612	612	612	612
Adjusted R-squared	0.192	0.172	0.193	0.221	0.112	0.123

Are these results because our data is from a Government-owned bank?

- Time-invariant features such as incentive structures prevailing in government-owned banks cannot explain our results.

- Loan officer only wants to meet a minimum quota of agricultural lending?
  - Picks out the best available projects first and then lends to the marginal projects as his/her term expires.

- But, all agricultural crop loans of exactly one-year maturity.
  - So, loan officer has to lend to meet a fresh quota in every year of his tenure.
  - Loan officer cannot inter-temporally substitute loan quality across his tenure.

- Also, results using prior default identical to those in Hertzberg et al. (2010)

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What about complementarity between screening and monitoring?

- Screening and monitoring are complementary activities
- Job rotation disrupts such complemantarity
- Could the higher default be due to this?

- Look at loans that were expected to be affected by rotation but were actually not affected
  - Actually not affected by JR=> not affected by complementarity
- Compare to loans that were not expected to be affected by rotation

- If free-riding leads to our results, we should expect results for this sample as well

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Table 10: Job Rotation And Destruction Of Complementarity

$$Y_{ijmt} = \beta_0 + \beta_i + \beta_t + \beta_1 * Treatment_Loan_{it} + \beta X + \varepsilon_{ijmt}$$

	(1)	(2)
Dependent Variable	Default	
Treatment Loans	0.078***	0.066**
	[3.366]	[2.391]
Loan Size	0.020***	0.015***
	[5.892]	[4.072]
Current Tenure	-0.026***	-0.029***
	[-54.640]	[-48.275]
Officer Fixed Effect	Yes	Yes
Month Fixed Effect	Yes	Yes
Officer X Month Fixed Effect	Yes	Yes
Observations	10,861	10,861
R-squared	0.325	0.394
Number of Borrowers	6,707	6,707

What about destruction of lending relationship?

- Can destruction of relationship between loan officer and borrower account for our results?

- Distinguish between
  - loans originated by the same officer versus
  - loans originated by different officers

- If results due to destruction of relationship, effect should be greater for loans originated by the same officer

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Table 11: Relationship Banking Versus Mandatory Loan Officer Rotation

$$Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_1 \cdot Tenurend_{it} + \beta_2 \cdot Sameofficer_{it} + \beta_3 \cdot Tenurend_{it} * Sameofficer_{it} + \beta_4 \cdot X + \varepsilon_{ijtk}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Dummy For Default							
Last Six Months	0.060*	0.047						
	[1.923]	[0.674]						
Last Three Months			0.208**	0.655***				
			[2.498]	[2.859]				
Last One Month					0.344**	0.749*		
					[1.967]	[1.720]		
Stradle							0.419***	0.678***
							[14.688]	[8.518]
Sameofficer	-0.017	0.320***	-0.010	0.321***	-0.012	0.320***	-0.020*	0.348***
	[-1.411]	[13.838]	[-0.883]	[14.575]	[-1.071]	[14.488]	[-1.737]	[15.703]
Sameofficer X Last Six	0.076***	0.018						
	[2.779]	[0.264]						
Sameofficer X Last Three			0.053	-0.497**				
			[0.627]	[-2.108]				
Sameofficer X Last One					0.048	-0.267		
					[0.260]	[-0.599]		
Sameofficer X Stradle							0.064**	-0.187**
							[2.258]	[-2.315]
Loan Size	0.007	0.076***	0.005	0.077***	0.005	0.076***	0.000	0.070***
	[1.593]	[5.508]	[1.073]	[5.499]	[1.110]	[5.462]	[0.024]	[5.737]
Current Tenure	-0.012***	-0.022***	-0.011***	-0.022***	-0.011***	-0.022***	-0.023***	-0.035***
	[-15.580]	[-15.253]	[-16.915]	[-16.690]	[-16.279]	[-16.711]	[-31.558]	[-25.513]
Officer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Calender Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Officer X Calender Month Fixed Effects	Yes	No	Yes	No	Yes	No	Yes	No
Observations	14,242	14,242	14,242	14,242	14,242	14,242	14,242	14,242
Number of Borrowers	7,554	7,554	7,554	7,554	7,554	7,554	7,554	7,554
Adjusted R-squared	0.265	0.610	0.266	0.611	0.265	0.613	0.331	0.613

What about borrower moral hazard?

- For borrower moral hazard, borrowers should know when a loan officer is expected to be transferred out of the branch.
- Borrowers having a relationship with the loan officer more likely to know this.
- Our results are no different for loans to borrowers with a prior relationship and borrowers with no prior relationship
- So borrower moral hazard is unlikely to explain our results.

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What about loss of learning?

- Disruption in the officer's learning due to rotation?
- Examine effect of job rotation on loans that are affected by *unscheduled* rotation
- Loans originated by such loan officers are not expect to be affected by rotation.
- But, they are affected by disruption in officer's learning.
- We should find loan performance to deteriorate following unscheduled job rotation as well.

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Table 12: Comparison Between Scheduled And Unscheduled Rotation

$$Y_{ijbt} = \beta_0 + \beta_i + \beta_t + \beta_1 \cdot Tenurend_{it} + \beta_2 \cdot Shceduled\_Rotation_{it} + \beta_3 \cdot Tenurend_{it} * Shceduled\_Rotation_{it} + \beta_4 \cdot X + \varepsilon_{ijtk}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable					Default			
Straddle	0.316***	0.291***						
	[15.402]	[19.309]						
Scheduled X Straddle	0.243***	0.259***						
	[10.989]	[16.306]						
Last_Six			-0.133***	-0.277***				
			[-7.713]	[-19.335]				
Scheduled X Last Six			0.380***	0.504***				
			[20.425]	[30.518]				
Last_Three					0.019	-0.195***		
					[0.649]	[-5.906]		
Scheduled X Last Three					0.256***	0.475***		
					[7.814]	[13.177]		
Last_One							0.095***	-0.078***
							[3.014]	[-2.733]
Scheduled X Last One							0.293***	0.490***
							[5.740]	[11.212]
Scheduled Tenure	1.033***	0.239***	0.712*	-0.002	0.685*	-0.011	0.671*	-0.026
	[4.987]	[6.166]	[1.937]	[-0.053]	[1.843]	[-0.307]	[1.852]	[-0.747]
Loan Size	0.099***	0.015***	0.122***	0.021***	0.112***	0.018***	0.113***	0.019***
	[19.235]	[7.025]	[21.406]	[9.239]	[19.278]	[7.943]	[19.652]	[8.219]
Current Tenure	-0.001***	-0.001***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	[-45.812]	[-62.310]	[-21.800]	[-26.861]	[-22.467]	[-30.884]	[-21.124]	[-29.257]
Officer Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Calender Month Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Officer X Month Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES
Borrower Fixed Effects	YES	NO	YES	NO	YES	NO	YES	NO
Observations	43,769	43,769	43,769	43,769	43,769	43,769	43,769	43,769
R-squared	0.612	0.585	0.563	0.623	0.555	0.643	0.552	0.512
Adjusted R-squared	0.73	0.43	0.69	0.41	0.74	0.39	0.68	0.44

Summary

- Consistent with concerns expressed by earlier theories of the firm, free-riding in teams is indeed an important problem.

- Free-riding in teams manifests primarily when
  - Individual contributions made by the team members cannot be verified by the principal
  - Peer effects are absent

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Table 3: SUMMARY STATISTICS

Our sample comprise of 43,771 agricultural crop loans issued by 44 loan officers over the time period October 2005 to May 2011.

Variables	No. of Obs.	Mean	Median	Standard Deviation
Loan Officer Tenure (Days)	44	918.02	1064.00	288.11
Probability of Default	43,771	0.63	1.00	0.48
Probability of Delinquency(NPA)	43,771	0.27	0.00	0.45
Days Loan is Outstanding	43,771	605.64	515.00	466.73
Loan Amount (INR)	43,771	57881.01	30000.00	61578.12
Rainfall (cm)	43,771	10.00	9.39	3.78
Area of Rice Production ('0000 Hectares)	43,771	3557.65	3978.00	1152.52
Agricultural NPA (INR billions)	43,771	95.4	71.5	43.5
Yield of Food Grains (Kg/Hectares)	43,771	1803.36	1798.00	90.32
Direct Agricultural Lending (INR billions)	43,771	7429.0	6097.7	4664.8
Indirect Agricultural Lending (INR billions)	43,771	855.0	480.6	717.1
Total Deposits (INR billions)	43,771	69877.0	69670.0	44024.0
Literacy Rate (in percentage)	43,771	55.94	54.90	6.33
Inflation (Consumer Price Index)	43,771	145.36	134.75	26.98

Location of Bank Branches

S.no	Name Of the Branch	District	State
1	Paloncha	Kothagudem	Andhra Pradesh
2	Bhadrachalam Road	Kothagudem	Andhra Pradesh
3	Mahabubnagar	Mahabub Nagar	Andhra Pradesh
4	Sattupalli	Khammam	Andhra Pradesh
5	VM Banjara	Khammam	Andhra Pradesh
6	Zaheerabad	Medak	Andhra Pradesh
7	Kohir	Medak	Andhra Pradesh
8	Medak	Medak	Andhra Pradesh
9	Peddapally	Karim Nagar	Andhra Pradesh
10	Sindhanur	Raichur	Karnataka
11	Gangavathi	Koppal	Karnataka
12	Parbhani	Parbhani	Maharashtra
13	Nanded	Nanded	Maharashtra
14	Ramtirth	Nanded	Maharashtra