Incentivizing Calculated Risk-Taking

Evidence from a Series of Experiments with Commercial Bank Loan Officers

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Motivation

Question: "Bad bankers or bad incentives?"

- Did performance pay promote excessive risk-taking
- Post-crisis focus on equity based executive compensation
- But non-equity incentives for loan officers and risk-managers may share some of the blame

Regulating bankers' pay in the United States and abroad

- Amendment to *Restoring American Financial Stability Act* (Dodd-Frank)
- Incentive compensation for originators <3% of loan amount
- Predatory lending: illegal to incentivize originator on terms of the loan

Motivation

"If the costs of foolish compensation schemes remained bottled up inside firms, they would not be a cause of public-policy concern [...]. But that is plainly not the case. Most of the world's financial system collapsed after an orgy of irresponsible risk-taking, and the consequences for the real economy have been devastating."

Alan Blinder, Wall Street Journal op-ed
"Crazy Compensation and the Crisis"

This Paper

Framed field experiment with commercial bank loan officers

Loan officers

- Recruited in cooperation with leading Indian commercial banks
- Evaluate *actual* loan applications: risk-assessment and decision
- Performance pay based on decision and loan outcome

Incentive treatments

- Mirror structure of performance contracts in retail lending:
  - (i) *Origination bonus*
  - (ii) *Low-powered incentives*, no penalty for bad loans
  - (iii) *High-powered incentives*, penalty for bad loans
- Vary *incentive power* and *time horizon* of compensation

Contribution

- How does performance pay affect risk-assessment and risk-taking?
- Limited understanding of effect of performance pay in general
  (recent evidence: Lazear 2000, Bandiera et al 2007, 2009, 2011)
- Very limited understanding of incentives within the bank
  (see Hertzberg, Liberti, Paravisini 2011; Fisman, Paravisini and Vig 2011)
  - Perception of credit risk
  - Real effects: lending decisions, risk-taking, allocation of credit
- Heterogeneous response to incentives?
  - How important are fixed characteristics in determining response?
    (age, experience, risk-aversion)
  - Does the optimal contract vary by type?

Theory: Incentives in Lending

Challenges to the design of performance contracts in lending

- Principal-agent problem between the bank and its employees
  - (i) Unobservable effort
  - (ii) Limited liability, loan officer is not residual claimant
  - (iii) Divergent risk-preferences
  - (iv) Divergent time-horizons
  - (v) Multi-tasking (grow loan portfolio, maintain asset quality
- Behavioral biases
  - Overconfidence
  - Time inconsistent preferences
  - May poorly estimate likelihood of low=probability events

Theory: Incentives in Lending

Model

- (i) Firms, (ii) loan officers (iii) bank
- Bank seeks to lend one unit of capital, loan officer screens applications at private cost *e* to learn applicant type
- Firms are either of type θ_G with probability of project success and repayment *p* or type θ_B with probability of success and repayment 0
- Bank's net cost of capital normalized to *0*, interest rate *1+r*
- If bank were to lend to all applicants it would earn $\pi pr + (1 - \pi p)$ which we generally assume to be < 0.

Theory: Incentives in Lending

If loan officer screens, she obtains a negative signal with probability

$$Pr(\sigma_B) = \begin{cases} \gamma & \text{if borrower is type } \theta_B \\ 0 & \text{if borrower is type } \theta_G. \end{cases}$$

so that the posterior that a firm is good, given a *positive* signal is:

$$Pr(\theta_G|\gamma) = \frac{\pi}{\pi + (1-\pi)(1-\gamma)}$$

while a *negative* signal is fully informative.

Theory: Incentives in Lending

Utility

- Utility from approving un-screened:

$$u_{NS} = \pi p w_P + (1 - \pi p) w_D$$

- Utility from screening:

$$u_S = \pi \left[p w_P + (1 - p) w_D \right] + (1 - \pi) \left[\gamma \bar{w} + (1 - \gamma) w_D \right] - e$$

Incentive Compatibility

- Screening is more advantageous than approving un-screened

$$\gamma \left[(1 - \pi)(\bar{w} - w_D) \right] > e$$

- Screening must be more advantageous to simply rejecting

$$\pi p w_P + (\pi\gamma - \pi p - \gamma) w_D - (1 - \gamma) \bar{w} > e$$

Theory: Incentives in Lending

Predictions

- **Prediction 1**: An origination incentive $w=w_P=w_D>0$ as often employed by commercial banks leads to indiscriminate lending, low effort, high defaults.
- **Prediction 2**: With strictly limited liability, such that $w,\ w_R,\ w_P,\ w_D>0$ and a risk-neutral loan officer, there exist parameters, such that the loan officer cannot be induced to screen
- **Prediction 3**: High-powered incentives including a penalty for failure can induce screening effort. (Extreme example: set w_D=-1 and w_P=r)
- **Prediction 4**: If loan officers have a positive discount rate, any performance based incentive will induce less effort if payment is deferred.

Experiment

Small-business lending environment

- Choose setting where loan officer judgment is especially important
- Unsecured small-enterprise loans in an emerging market:
  - Limited credit history
  - High idiosyncratic risk
  - No comprehensive credit bureau coverage
  - Limitations in the use of predictive credit scoring
  - Enforcement of debt contracts difficult (co-signer, collateral)
  - Small ticket size relative to fixed cost of underwriting
  - Lenders use wide variety of incentive structures, optimal model unknown

Experiment

Performance Incentives in Lending

- Public sector bank employees
  - Do not typically use performance pay
  - Penalties for default
  - Career concerns matter
  - Evidence of excessively conservative lending (Banerjee, Cole and Duflo 2009)
- Private sector lenders are different
  - Quarterly performance assessment
  - Loan officer pay is a function of
    - individual portfolio performance
    - client acquisition
    - team lending targets
    - Volume incentives may be up to 50% of bonus

Experiment

Loan officers

- 209 loan officers recruited from leading Indian retail banks
- Includes rookie recruits, senior supervisors and branch managers
- Experimental sessions at two dedicated labs
- Experiment carried out in collaboration with banks but outside regular office hours and without interference of senior staff
- Loan officers receive show-up fee and incentive payments
- Incentive payments calibrated to~ 2x hourly wage of mean participant per session

Experiment

Loan application database

- Data on 1,000 loan applications made by a large commercial lender
- Uncollateralized working capital loans to small enterprises
- Ticket size between US$ 2,500 and US$ 10,000
- Originated in Q1-Q3 2008
- Focus on first-time borrowers

Measuring loan outcomes and profitability

- Matched with 9 months of repayment history from lender's proprietary data (>90% of all defaults occur in this time frame)
- Loans evaluated in the experiment include:
  (i) performing loans, (ii) non-performing loans, (iii) declined loans

Experiment

Incentive Contracts

$$w_{il} = \begin{cases} w_P & \text{if } x_l > 0 \mid approved \\ w_D & \text{if } x_l < 0 \mid approved \\ \bar{w} & \text{if } declined \text{ and } x_l = 0 \end{cases}$$

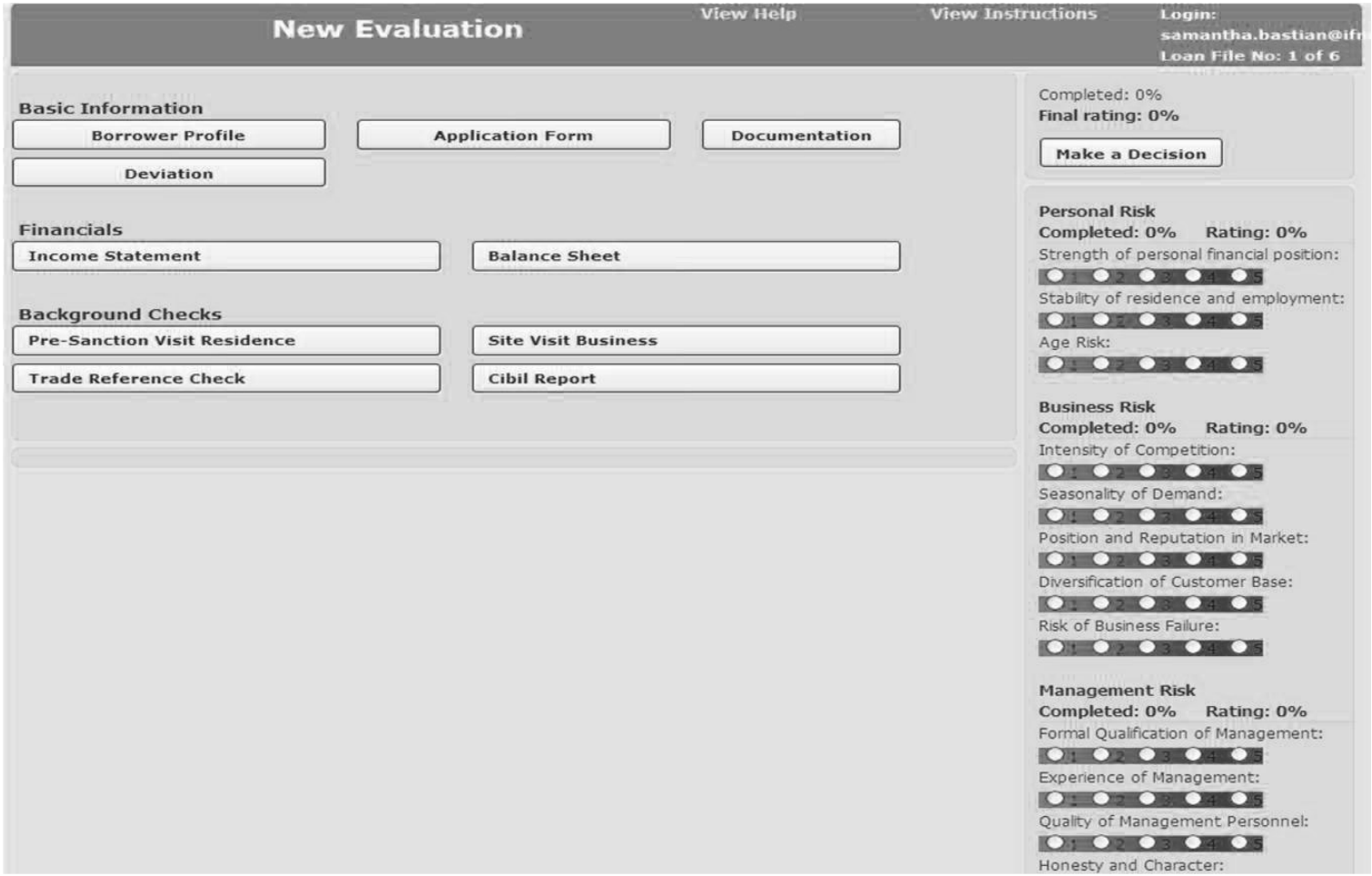
	w_P	w_D	$\overline{w}$
Baseline	20	0	10
Origination bonus	20	20	0
Performance	100	0	0
High-powered	50	-100	0

Experiment

Treatment Design

Baseline N=7,420 [183]			
High-powered incentives N= 2,946 [97]	Origination bonus N=2,548 [87]	Performance bonus low N=1,079 [68]	Performance bonus high N=682 [61]

Experiment



Loan evaluation, main screen

Summary Statistics

Loan officers

	Demographics								
	N	Mean	Median	StDev	Min	Max	10%	25%	75%	90%
Male	206	0.89	1.00	[0.31]	0.00	1.00	0.00	1.00	1.00	1.00
Age	206	38.62	36	[10.88]	23	64	25	30	48	54
Education [Master's Degree]	186	0.34	0.00	[0.47]	0.00	1.00	0.00	0.00	1.00	1.00
Experience [Years]	206	13.77	11	[11.44]	0.00	40	1.00	3.00	25	31
Rank [1 Low - 5 High]	206	1.97	2.00	[1.00]	1.00	5.00	1.00	1.00	3.00	3.00
Branch Manager Experience	206	0.36	0.00	[0.48]	0.00	1.00	0.00	0.00	1.00	1.00
Business Experience	206	0.47	0.00	[0.50]	0.00	1.00	0.00	0.00	1.00	1.00

- Highly experienced > 10 years in bank
- High level of education > 30% has master's degree
- Representative of typical Indian bank's demographic profile

Summary Statistics

Loans

	Panel A All Loans			Panel B Performing Loans			Panel C Non-Performing and Declined Loans			Difference in means B - C	
	Mean	Median	StdDev	Mean	Median	StdDev	Mean	Median	StdDev	Diff	$p > \|t\|$
Loan Amount	6,009	6,383	[2,627]	5,987	6,383	[2,613]	6,147	6,383	[2,722]	-160	[0.58]
Monthly Installment	420	208	[855]	413	208	[878]	476	205	[620]	-63	[0.58]
Loan Tenure	32.64	36.00	[9.04]	31.80	36.00	[7.57]	37.90	36.00	[14.35]	-6.10***	[0.00]
Years in Business	11.27	9.00	[7.99]	11.64	9.00	[8.35]	9.50	8.00	[5.80]	2.14**	[0.02]
Total Income	11,680	6,383	[18,621]	12,126	6,383	[19,257]	7,850	5,309	[11,224]	4,276*	[0.07]
Personal Expenses	283	223	[304]	285	223	[317]	270	231	[209]	15	[0.66]
Business Expenses	9,818	5,191	[17,438]	10,529	5,559	[18,354]	5,368	3,514	[8,771]	5,161***	[0.01]
Gross Profit	13,365	6,926	[37,257]	11,111	6,910	[14,010]	23,979	7,967	[83,569]	-12,868**	[0.03]
Total Debt Burden	6,776	0	[31,572]	6,820	0	[33,425]	6,504	955	[15,887]	316	[0.93]
Total Monthly Debt Services	227	0	[733]	226	0	[777]	234	112	[358]	-8.00	[0.92]
Credit Report, Amount	2.94	1.00	[5.46]	2.97	1.00	[5.66]	2.80	1.00	[4.30]	0.17	[0.79]
Credit Report, Accts Overdue	0.20	0.00	[0.40]	0.18	0.00	[0.38]	0.32	0.00	[0.47]	-0.14**	[0.04]
EBIT	1,844	1,007	[6,523]	1,904	991	[7,002]	1,467	1,074	[1,388]	437	[0.55]
Total Liabilites/Net Income	0.02	0.01	[0.04]	0.02	0.01	[0.04]	0.03	0.01	[0.09]	-0.01*	[0.05]
Total Debt/Net Income	0.37	0.00	[1.50]	0.34	0.00	[1.41]	0.66	0.00	[2.12]	-0.32	[0.10]
Total Liabilities/Total Sales	0.04	0.02	[0.05]	0.03	0.02	[0.05]	0.06	0.03	[0.07]	-0.03***	[0.00]

- Hard information is noisy signal but good and bad loans *do* look different ex-ante
- Performing loans have lower ratio liabilities/sales ratio, higher business expenses, longer business experience

Summary Statistics

Lending Decisions

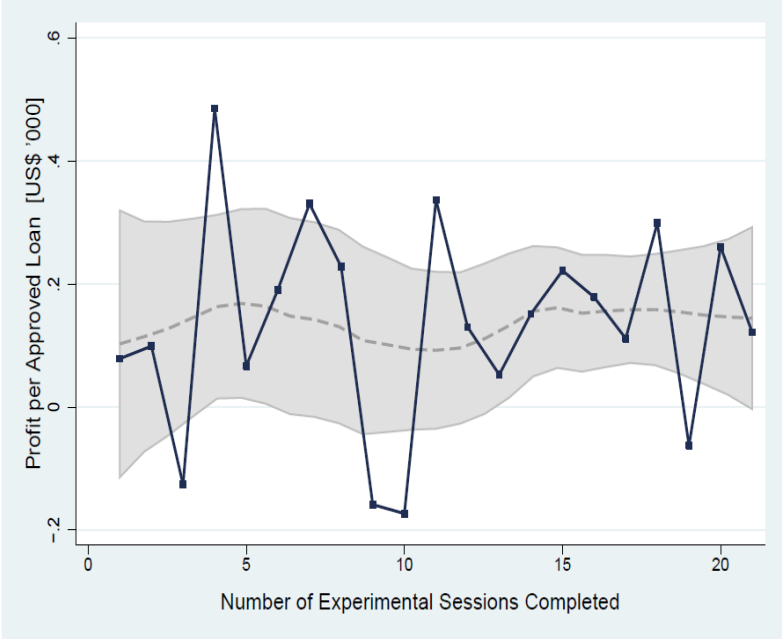
Lending decisions correct, %

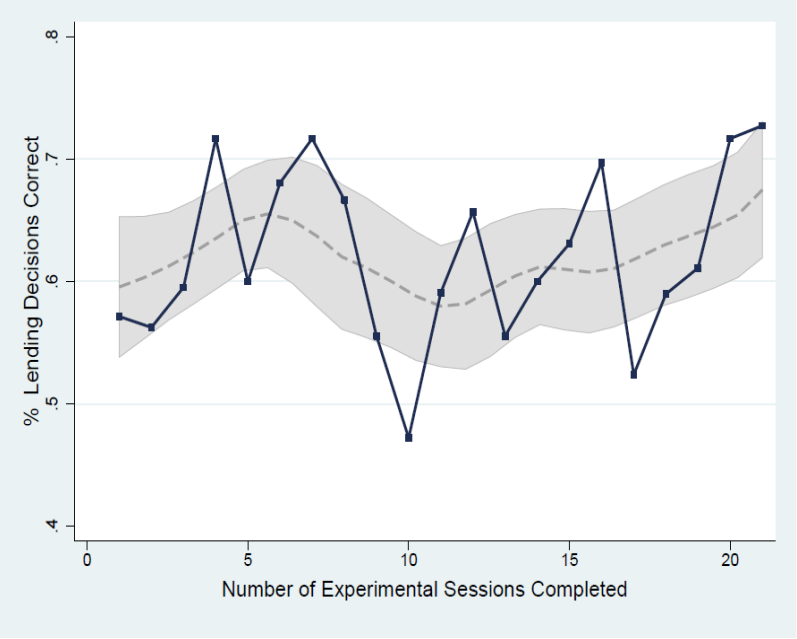
	Loan Type		
	Performing	Non-Performing	Declined by Bank
Baseline	.770	.302	.516
	(.032)	(.031)	(.025)
High-Powered	.735	.402	.491
	(.068)	(.096)	(.058)
Origination	.847	.259	.328
	(.052)	(.060)	(.057)
Performance bonus low	.851	.172	.413
	(.070)	(.072)	(.060)
Performance bonus high	.900	.145	.403
	(.069)	(.069)	(.066)
Sample average	.797	.262	.454
	(.004)	(.008)	(.010)

- Lending decisions are (expectedly) difficult
- But significant variation by incentive scheme
- Non-performing 23% more likely to be identified under high-powered incentives

Summary Statistics

Learning effects?





- Highly experienced participant pool
- No evidence of distortionary learning effects
- Productivity does not change with number of completed experimental sessions

Results

Treatment effect regressions

$$y_{il} = \sum_{k=1}^{K-1} \beta_k T_{ilk} + \theta_i + \theta_l + \zeta' \mathbf{R}_{il} + \xi' \mathbf{X}_{il} + \varepsilon_{il}$$

- Omitted category: [low-powered] *Baseline* incentive
- Loan fixed effects θ_l
- Loan officer fixed effects θ_i
- Matrix of randomization conditions **R**
- Matrix of additional controls **X**
- Stochastic error term, clustered by loan officer-session ε_{il}

Results

[1] Does performance pay affect screening effort?

	Log Evaluation Time		Number of Loan File Sections Reviewed		Information Credits Used	
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline [omitted] $[20, 0, 10]$						
High-powered $[50, -100, 0]$	−.042 (.036)	−.042 (.033)	.385* (.230)	.408*** (.144)	.933** (.425)	.767*** (.252)
Origination bonus $[20, 20, 0]$	−.059* (.029)	−.047 (.029)	−.153 (.216)	.017 (.153)	−.346 (.408)	−.166 (.205)
Performance bonus low $[50, 0, 0]$	−.142** (.064)	−.097* (.051)	.058 (.286)	−.134 (.212)	−.076 (.247)	−.077 (.165)
Performance bonus high $[100, 0, 0]$	−.079 (.081)	−.091* (.051)	−.059 (.438)	.019 (.243)	.060 (.322)	.099 (.228)
Loan officer fixed effects	No	Yes	No	Yes	No	Yes
Loan fixed effects	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	No	Yes	No	Yes	No
Observations	11,492	13,121	12,802	14,675	7,572	8,688
R^2	.455	.535	.512	.698	.324	.695

- Effort increases under high-powered, decreases under origination incentives
- High-powered incentives increase costly screening effort by 4 – 14% over baseline

Results

[2] Risk-assessment: what's in a risk-rating?

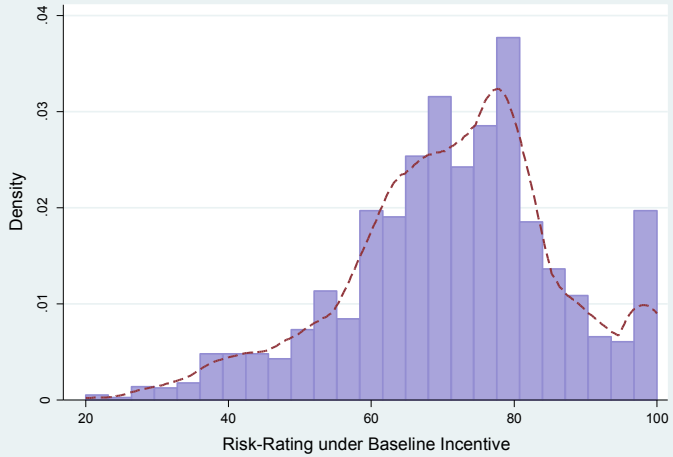
	Approved	Perform	Profit per approved loan	Profit per screened loan
	(1)	(2)	(3)	(4)
Risk-rating	.374***	.112***	.199***	.151***
	(.009)	(.006)	(.043)	(.013)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Loan fixed effects	Yes	Yes	Yes	Yes
Lab fixed effects	Yes	Yes	Yes	Yes
Week fixed effects	Yes	Yes	Yes	Yes
Observations	14,675	14,675	9,357	13,084
R^2	.440	.008	.008	.008

- Incentive schemes are not tied to internal risk-ratings
- But, risk-ratings strong predictor of lending decision, loan performance

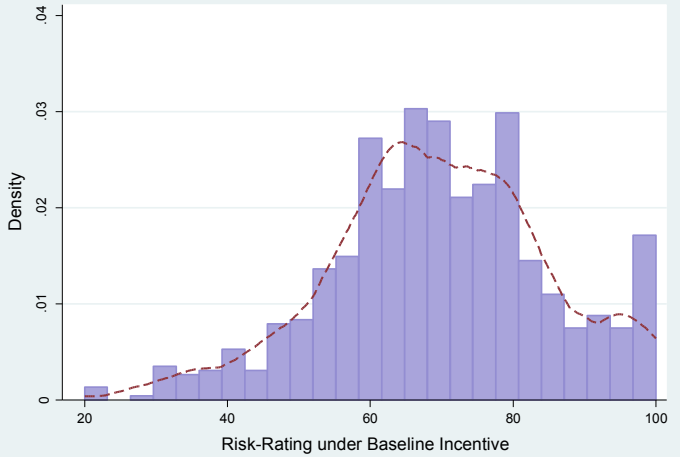
Results

[2] Risk-assessment

(a) Performing loans



(b) Non-performing loans



	Performing Loans	Non-Performing Loans	Loans Declined by Bank	Sample Average
Baseline risk-rating [Mean]	71.62 (1.07)	67.19*** (1.02)	62.99*** (.816)	66.14 (.492)
Baseline risk-rating [Median]	72.00 (1.22)	67.00** (1.13)	63.00*** (1.53)	72.00 (1.64)

Results

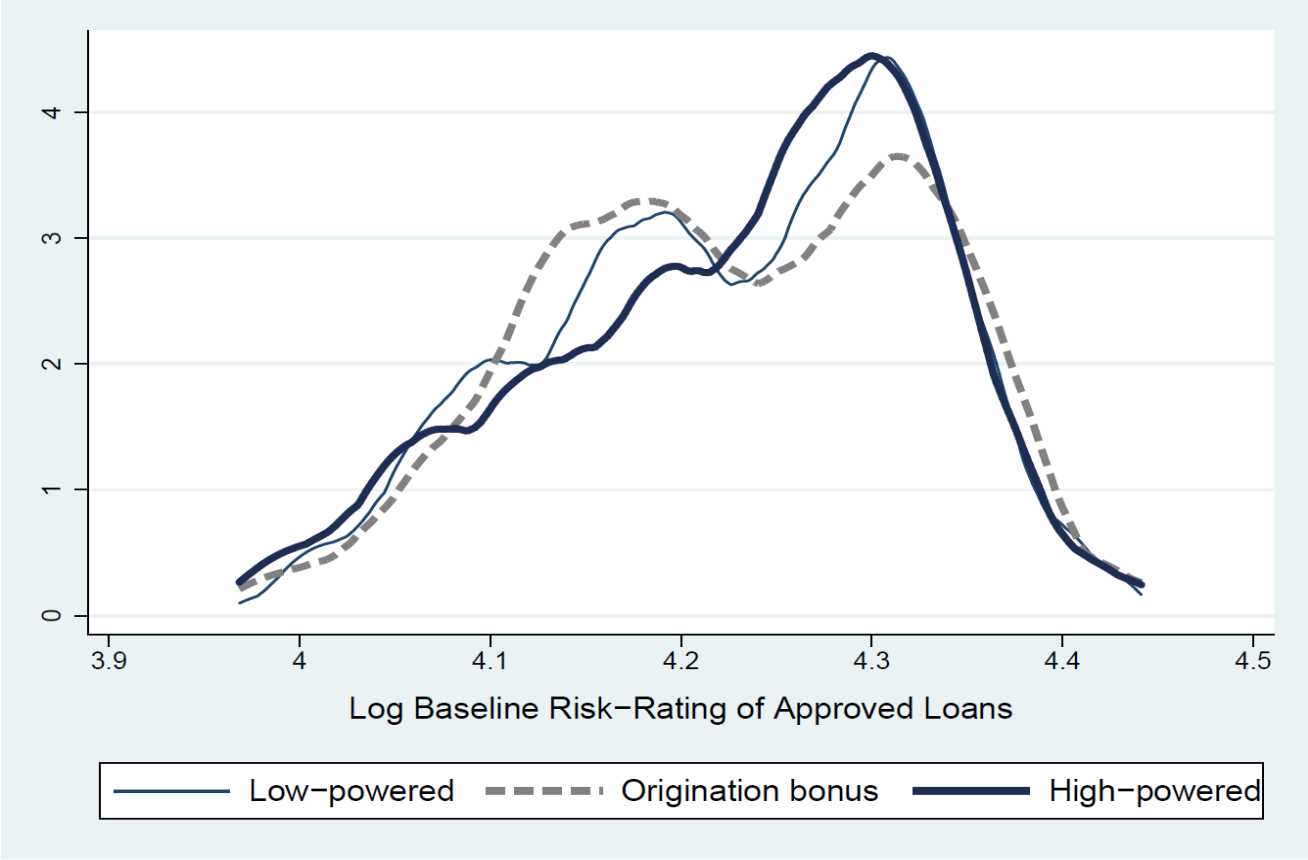
[2] Risk-assessment

	Overall Rating		Personal and Management Risk		Business and Financial Risk	
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline [omitted] $[20, 0, 10]$						
High-powered $[50, -100, 0]$	.036 (.090)	.007 (.039)	−.003 (.087)	−.010 (.041)	.052 (.090)	.018 (.040)
Origination bonus $[20, 20, 0]$	.159** (.077)	.005 (.040)	.129* (.074)	−.027 (.042)	.170** (.078)	.011 (.040)
Performance bonus low $[50, 0, 0]$	.042 (.104)	.157*** (.059)	.009 (.115)	.116 (.071)	.048 (.102)	.141** (.056)
Performance bonus high $[100, 0, 0]$	.244** (.109)	.297*** (.055)	.271** (.120)	.284*** (.067)	.230** (.107)	.270*** (.054)
Loan officer fixed effects	No	Yes	No	Yes	No	Yes
Loan fixed effects	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	No	Yes	No	Yes	No
Observations	14,675	14,675	14,675	14,675	14,675	14,675
R^2	.132	.615	.101	.559	.140	.618

- Loan officers inflate internal risk-ratings in proportion to volume incentive
- No inflation of risk-ratings under high-powered incentives

Results

[3] Risk-taking



- Kolmogorov-Smirnof Tests: Baseline vs High-powered (p=.0174)
  High-powered vs Origination bonus (p=.0052)

Results

[3] Risk-taking

	Overall Rating		Personal and Management Risk		Business and Financial Risk	
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline [omitted] $[20, 0, 10]$						
High-powered $[50, -100, 0]$	−.153*** (.039)	−.151*** (.039)	−.042 (.030)	−.042 (.029)	−.161*** (.040)	−.155*** (.040)
Origination bonus $[20, 20, 0]$	−.044* (.026)	−.030 (.026)	.001 (.024)	.009 (.24)	−.047* (.025)	−.030 (.026)
Performance bonus low $[50, 0, 0]$	−.053 (.046)	-.035 (.050)	−.037 (.039)	−.028 (.042)	−.052 (.041)	−.042 (.047)
Performance bonus high $[100, 0, 0]$	−.040 (.049)	.005 (.055)	−.019 (.042)	.020 (.048)	−.064 (.044)	−.043 (.049)
Loan officer fixed effects	No	Yes	No	Yes	No	Yes
Loan fixed effects	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	No	Yes	No	Yes	No
Observations	9,547	9,547	9,402	9,402	9,552	9,552
R^2	.005	.010	.006	.010	.005	.009

- High-powered incentives cause loan officers to approve loans that seem less risky ex-ante (higher mean, lower dispersion of risk-ratings under baseline)

Results

[4] Performance and profitability

	Approved		Profit per Approved Loan		Profit per Screened Loan	
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline [omitted] $[20, 0, 10]$						
High-powered $[50, -100, 0]$	−.038*	−.007	.102*	.185**	.095*	.117**
	(.022)	(.021)	(.055)	(.079)	(.055)	(.052)
Origination bonus $[20, 20, 0]$	.077***	.075***	−.054	-0.054	−.059	−.010
	(.020)	(.018)	(.052)	(.070)	(.050)	(.050)
Performance bonus low $[50, 0, 0]$	.095***	.137***	−.169	-.052	−.127	-.012
	(.032)	(.032)	(.111)	(.098)	(.079)	(.070)
Performance bonus high $[100, 0, 0]$	.128***	.156***	−.299**	−.266**	−.210**	−.173**
	(.040)	(.033)	(.132)	(.107)	(.099)	(.080)
Loan officer fixed effects	No	Yes	No	Yes	No	Yes
Loan fixed effects	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	No	Yes	No	Yes	No
Observations	12,802	14,675	8,078	9,357	11,374	13,084
R^2	.051	.157	.667	.782	.478	.522

- **High-powered incentives:** Profit per originated loan increases by 3% of median loan size, while number of originated loans remains approximately constant
- **Origination bonus:** Loans originated increase by 16%, net profit per originated loan decreases by 5% of median loan size

Results

[5] Deferred compensation

	Effort						Lending and Profit			
	Log Evaluation Time		Number of Loan File Sections Reviewed		Information Credits Used		Approved		Profit per Approved Loan	
Baseline [omitted] $[20, 0, 10]$, credit										
Low-powered $[20, 0, 10]$, *deferred*	−.023 (.035)	−.036 (.030)	−.221 (.136)	−.148** (.075)	−.641* (.357)	−.275 (.193)	−.012 (.020)	.034 (.020)	−.055 (.056)	−.069 (.053)
High-powered $[50, -100, 0]$, *credit*	.04 (.039)	.006 (.033)	.265* (.159)	.185* (.097)	.933** (.425)	.662*** (.249)	−.062** (.020)	−.061** (.020)	.119** (.053)	.129** (.052)
High-powered $[50, -100, 0]$, *deferred*	−.049 (.045)	−.037 (.038)	−.092 (.202)	−.048 (.119)	−.227 (.510)	−.093 (.276)	−.04 (.030)	−.02 (.030)	.032 (0.076)	.027 (0.071)
Origination bonus $[20, 20, 0]$, *credit*	−0.006 (.035)	−0.005 (.031)	−.251* (.150)	−0.123 (.078)	−0.346 (.408)	−0.152 (.198)	.11*** (.020)	.09*** (.090)	−.121** (.055)	−.098* (.052)
Origination bonus $[20, 20, 0]$, *deferred*	−.003 (.036)	−.015 (.031)	−.089 (.143)	−.180** (.084)	−.291 (.386)	−.429** (.214)	.07*** (.020)	.09*** (0.020)	.045 (0.055)	.05 (0.050)
Loan officer fixed effects		Yes		Yes		Yes		Yes		Yes
Loan fixed effects		Yes		Yes		Yes		Yes		Yes
Test: *immediate=deferred*										
High-powered, p-value	[.060]	[.281]	[.103]	[.094]	[.032]	[.021]	[.591]	[.103]	[.229]	[.143]
Origination bonus, p-value	[.936]	[.772]	[.287]	[.492]	[.893]	[.182]	[.032]	[.891]	[.004]	[.005]
Observations	6,839	7,377	7,572	8,184	7,572	8,184	7,572	8,688	6,727	7,260
R^2	.443	.527	.367	.69	.324	.694	.052	.154	.476	.476

- **Deferring performance pay** (by 30 days) weakens high-powered incentives effect on effort but not on loan performance
- Deferred compensation attenuates negative effect of volume incentives strong effect on loan-level profit

Results

[6] Shared liability

	Effort						Lending and Profit			
	Log Evaluation Time		Number of Loan File Sections Reviewed		Information Credits Used		Approved		Profit per Approved Loan	
Baseline [omitted] $[20, 0, 10]$, credit										
High-powered $[50, -100, 0]$, credit	.041	.006	.265*	.185*	.933**	.662***	−.06**	−.06***	.119**	.129**
	(.039)	(.033)	(.159)	(.097)	(.425)	(.249)	(.021)	(.023)	(.053)	(.052)
High-powered $[50, -100, 0]$ credit+endow	.150***	.088***	.641***	.358***	2.244***	1.233***	−.073***	−.074***	.054	0.05
	(.036)	(.029)	(.149)	(.084)	(.413)	(.217)	(.023)	(.021)	(.053)	(.052)
Loan officer effects		Yes		Yes		Yes		Yes		Yes
Loan fixed effects		Yes		Yes		Yes		Yes		Yes
Test: *individual=shared*										
High-powered p-value	[.031]	[.049]	[.071]	[.166]	[.021]	[.075]	[.732]	[.611]	[.363]	[.305]
Observations	6,839	7,377	7,572	8,184	7,572	8,184	7,572	8,688	6,727	7,260
R^2	.443	.527	.367	.69	.324	.694	.052	.154	.476	.476

- **Shared liability** induces greater screening effort
- But does not improve quality of lending decisions over high-powered incentives

Conclusion

- In a sample of highly experienced commercial bank loan officers, performance incentives strongly affect:
  - Screening effort
  - Subjective risk-assessment
  - Actual risk-taking
  - Profitability of originated loans
- High-powered incentives increase probability that bad loan is detected by 11% and profits per originated loan by up to 3% of median loan size
- Origination incentives increase lending by 16%, reduce profit per loan by 5% of the median loan size
- Cognitive consonance: origination incentives bias risk-assessment
- Time discounting is an important wedge: Deferred compensation reduces incentive power; stronger effect on effort than accuracy of decisions

Future Research

- How do incentives affect the use and transmission of soft information?
- Performance pay as a screening device –are private and public sector bankers different ex-ante or do they become 'socialized' into the risk-taking culture of the organization.
- Which borrower characteristics matter in the allocation of credit. (tweak loan file characteristics). Can performance pay be used to mitigate biases in credit allocation?
- Talent or paycheck? What component of loan officer performance can be explained by (inherent) talent, to what extent can performance be affected by performance incentives?