

Nonlinear incentives and mortgage officers' decisions



Kostas Tzioumis

Office of the Comptroller of the Currency

Matthew Gee

University of Chicago

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The views expressed in this paper are those of the authors alone and do not necessarily reflect those of the Office of the Comptroller of the Currency or the Department of the Treasury.

Motivation (1)

□ Financial crisis & Incentives

- “[...] Poorly designed compensation policies can create perverse incentives that can ultimately jeopardize the health of the banking organization.” (3/20/2009)

Ben Bernanke, Chairman of the Federal Reserve

- Banks should promote incentive policies that improve the link between compensation and longer-term performance, and discourage imprudent risk-taking behavior.

OCC/OTS/FDIC/FED press release on the “*Guidance on Sound Incentive Compensation Policies*” (Federal Register: 6/25/2010)

Motivation (2)

- **Focus on executive compensation**
- **Sparse evidence for lower-level employees**

Two studies on commercial loan officers:

- Agarwal and Wang (2009) find that loan officers in a US commercial bank dramatically increased their output after the bank changed their incentive package from fixed wage to fixed wage plus commission. However, the quality of these loans was considerably reduced and the bank soon reverted to the previous incentive structure.
- Hertzberg et al. (2010) illustrates that commercial loan officers reduce their optimistic bias when the threat of rotation becomes imminent.

Motivation (3)

- **What is the appropriate incentive design for mortgage officers?**
 - Mortgage officers should be paid based on loan performance (Baker, AER 2000). However, this is impractical.
 - Are mortgage officers salespeople?
 - Banks have characterized mortgage officers as administrators rather than salespeople. The US Dept. of Labor only recently (2010) clarified that mortgage officers are not administrators, but primarily salespeople.
 - Absence of consensus on the second-best contract, and the nature of the job.
 - Banks are using a variety of incentive structures.

Motivation (4)

- **Many banks are using nonlinear incentives**
 - Typically, nonlinear contracts have a performance hurdle (a minimum output during a specific time period).
 - Outcomes from meeting or missing the hurdle are asymmetric.

- **(Agency) Theory**
 - Holmstrom and Milgrom (1987) model - repeated moral hazard with non-linear contracts:
 - Hurdle-type contracts allows the agent to game his effort and impose costs to the principal.
 - Conclusion: Linear contracts are better than nonlinear contracts.

Literature on nonlinear incentives

- Navy-recruiters (Asch, ILLR 1990)
- Sales in manufacturing firms (Oyer, QJE 1998)
- Salespeople in a software vendor (Larkin, HBS, 2007)
- Evidence on effort gaming

But ...

- Rather infrequent assessment of the performance
- No information about the cost on the firm.
- Firm-based rather than individual-based analysis

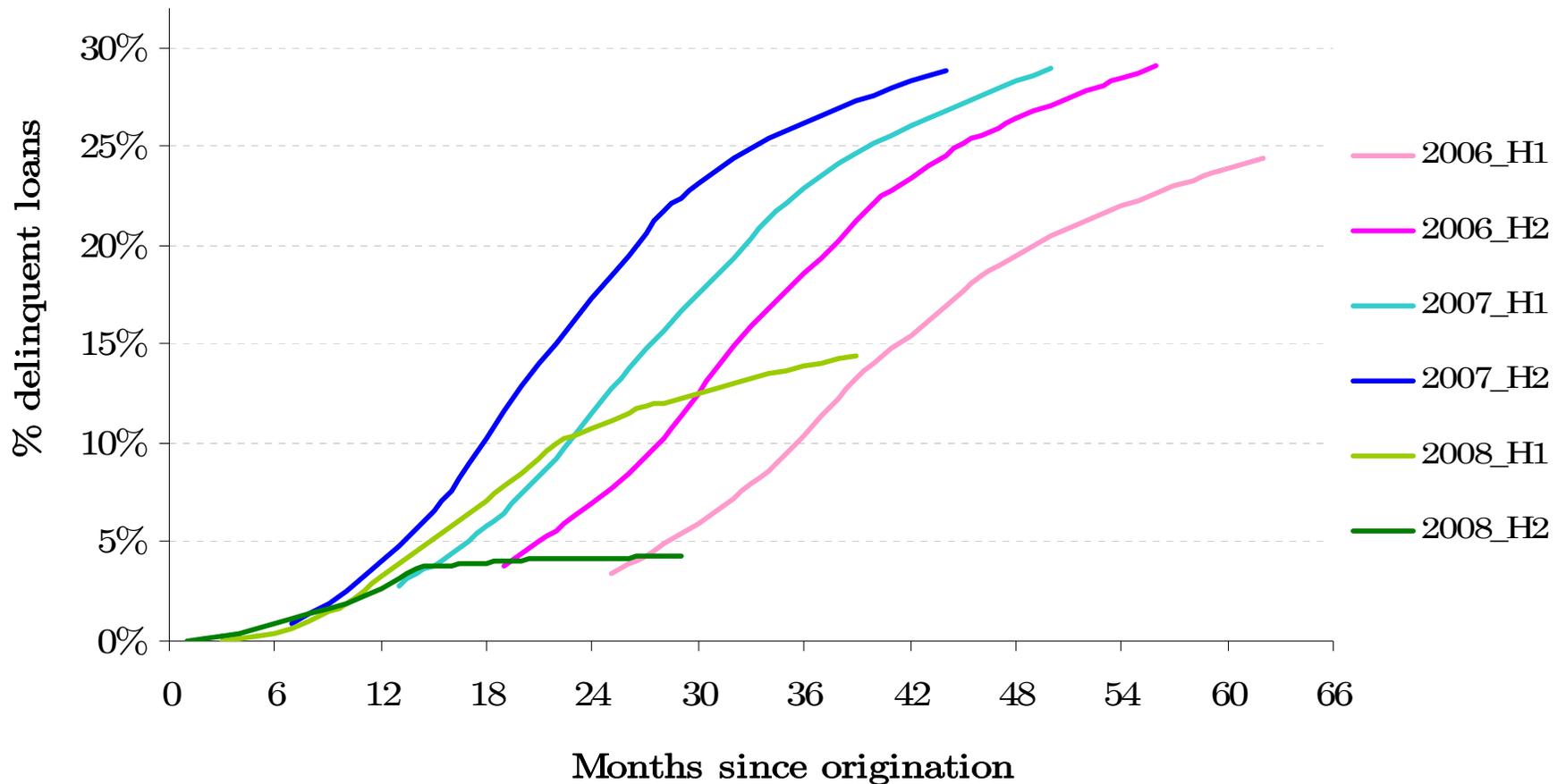
Sample

- ❑ US commercial bank using nonlinear contracts
- ❑ All loans during 2006-2008 period (retail channel)
- ❑ 568,027 applications
- ❑ 437,645 loan originations
- ❑ 87,408 denials, 42,974 approved/not-accepted appls
- ❑ Daily frequency (aggregate activity)

- ❑ Merge HMDA+ and OCC Mtg Metrics (based on ten criteria)
- ❑ 89% matching rate
- ❑ 388,300 portfolio loans (mean performance range: 45 months)
- ❑ Loan performance through March 2011

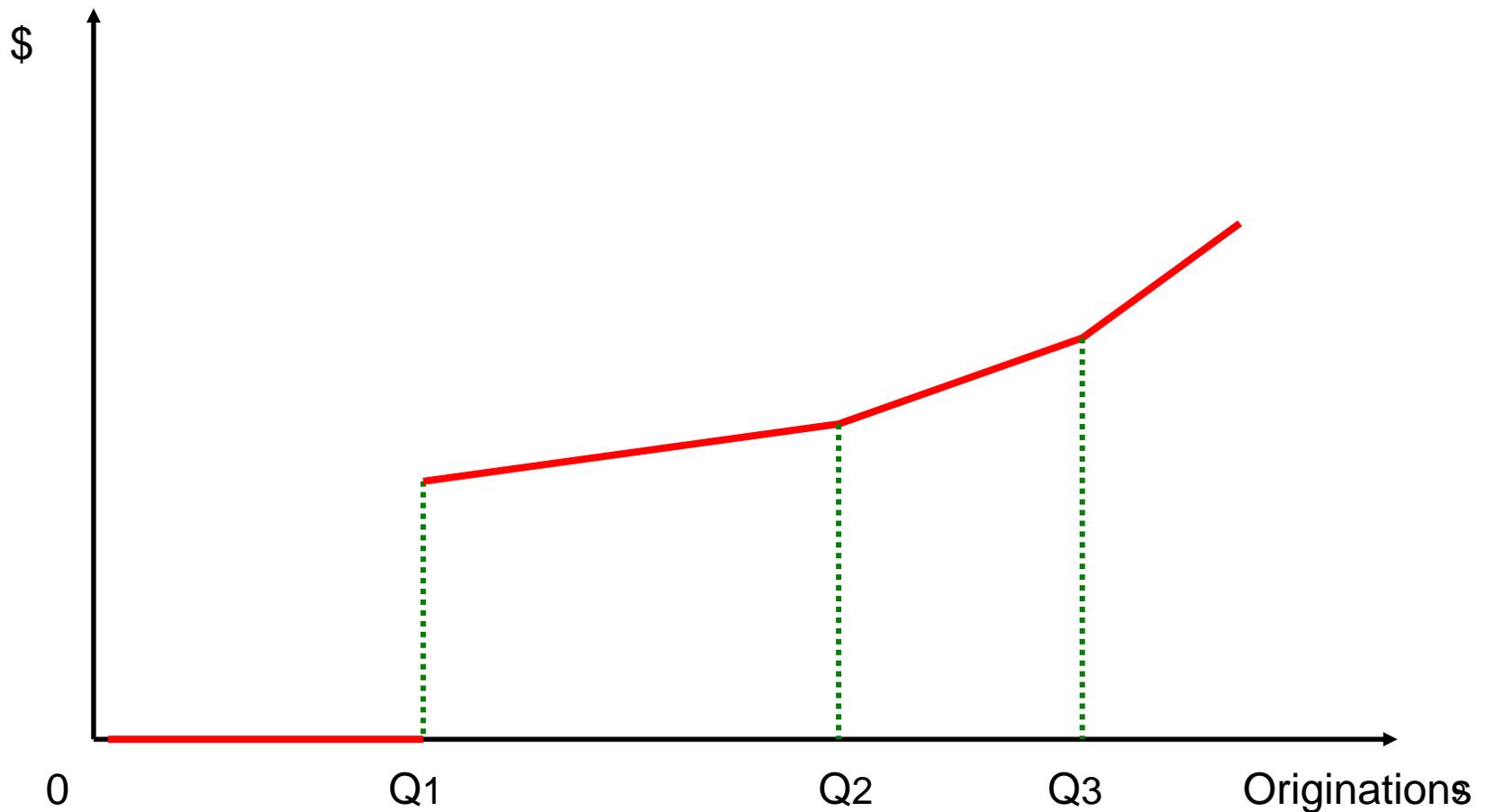
Loan performance

□ Cumulative Delinquency Rates since Loan Origination (by Semi-Year)



Institutional background (1)

- Payoff: Combination of nonlinear & linear incentives



Institutional background (2)

- During the sample period (2006-2008):
 - The number of mortgage officers and the number of branches remained relatively stable.
 - Incentive structures did not change during our sample period

- Decision-making process
 - The bank's retail lending overwhelmingly processed fully documented loan applications
 - By and large, mortgage officers are deciding based on hard information.

Institutional background (3)

□ Nature of the work

- Mortgage officers specialize in household properties, thus spending most of their time in an office.
- Mortgage officers work a 5-day, 40-hour week.
- Limited promotion opportunities

□ Overall

- Any output fluctuation can be attributed to the productivity of the incumbent workforce rather than sorting effects from outflow/inflow of high-productivity officers.
- Mortgage officers seem to operate in a repeated contract setting that is very different from promotion-based incentives (e.g., *up-or-out* models).

Hypotheses

- **Is the output time-dependent?**
 - End-of-month output spike

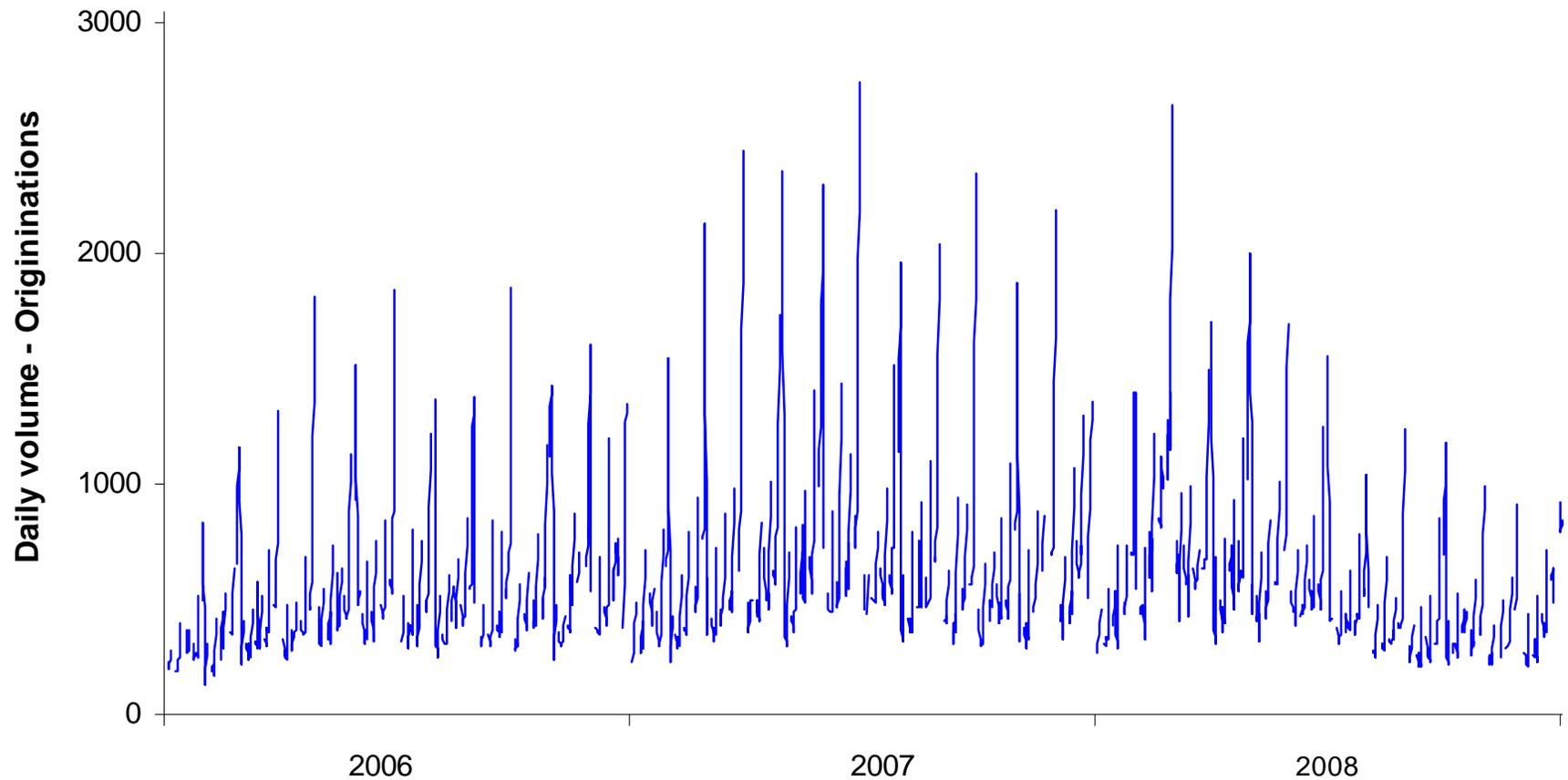
- **Is the EoM spike in originations due to increased effort or due to approving loans that are on the margin?**
 - Speed in processing applications
 - Loan/Applicant creditworthiness across time
 - Pricing variations across time

- **Cost to the firm (loan performance)**
 - Delinquency rate (we define delinquency using the standard definition of 60+ days past due on payment)

Results (1)

Is the output time-dependent?

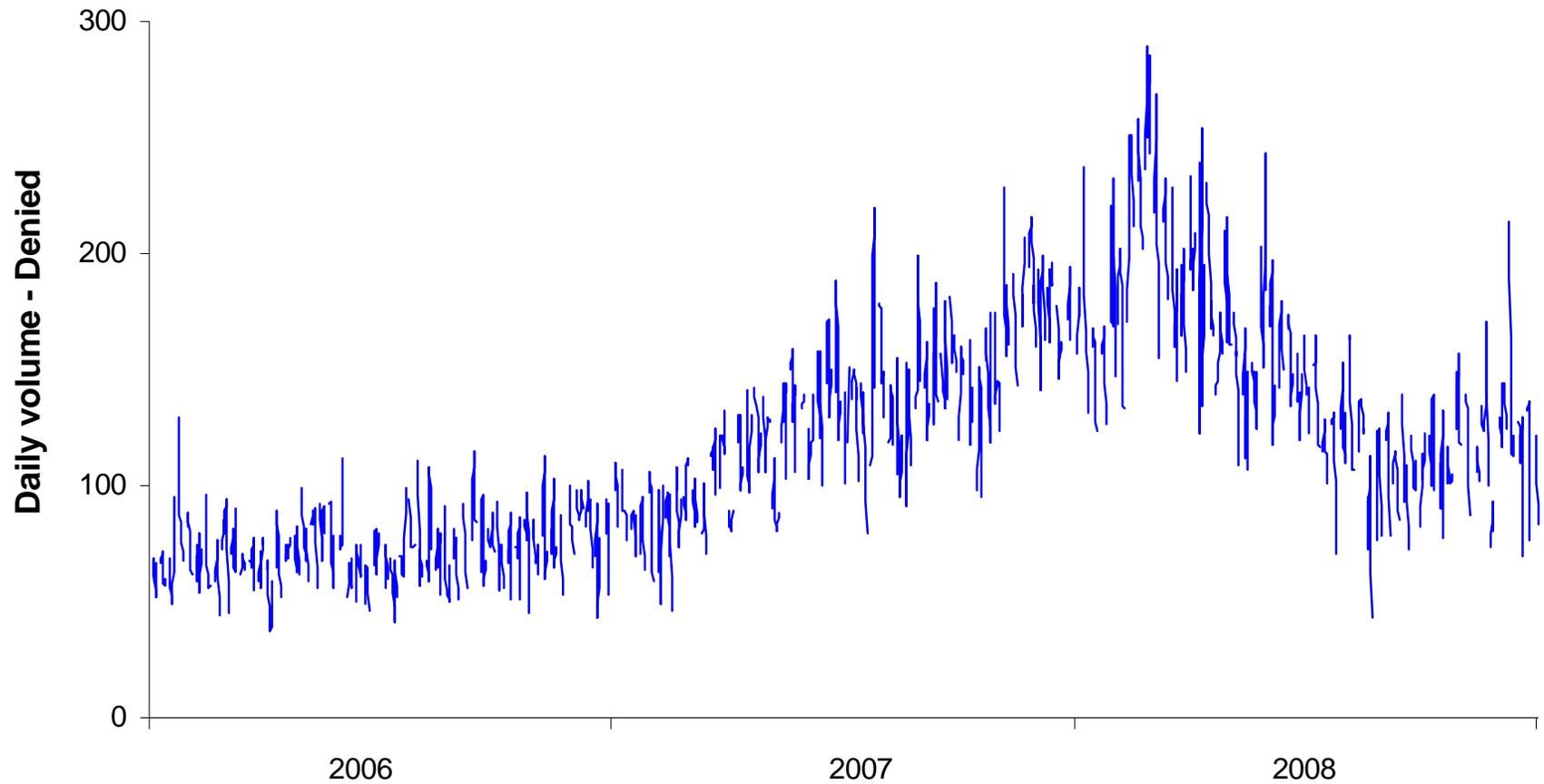
- Mortgage officers game their effort . . .



Results (2)

Is the output time-dependent?

... but only when it affects their contract



Results (4)

Is the output time-dependent?

$$(OLS) \quad Y_t = \alpha_0 + \beta \text{Distance}_t + \gamma \text{Month}_t + \delta \text{Year}_t + \lambda \text{Controls}_t + u_t$$

The dependent variable reflects the daily loan volume

	<i>Number of Originated Loans (ln)</i>	<i>Number of Denied Loans (ln)</i>	<i>Number of Apprd/Not-Accepted loans (ln)</i>
Independent Variables	[1]	[2]	[3]
End-of-Month indicator	1.204** (0.036)	0.074* (0.035)	0.050 (0.050)
<i>Control variables:</i>	Yes	Yes	Yes
Application volume (ln)			
Credit Score (mean)			
LTV (mean), DTI (mean), Month/Year effects			
Observations	751	751	750
R^2	0.483	0.714	0.877

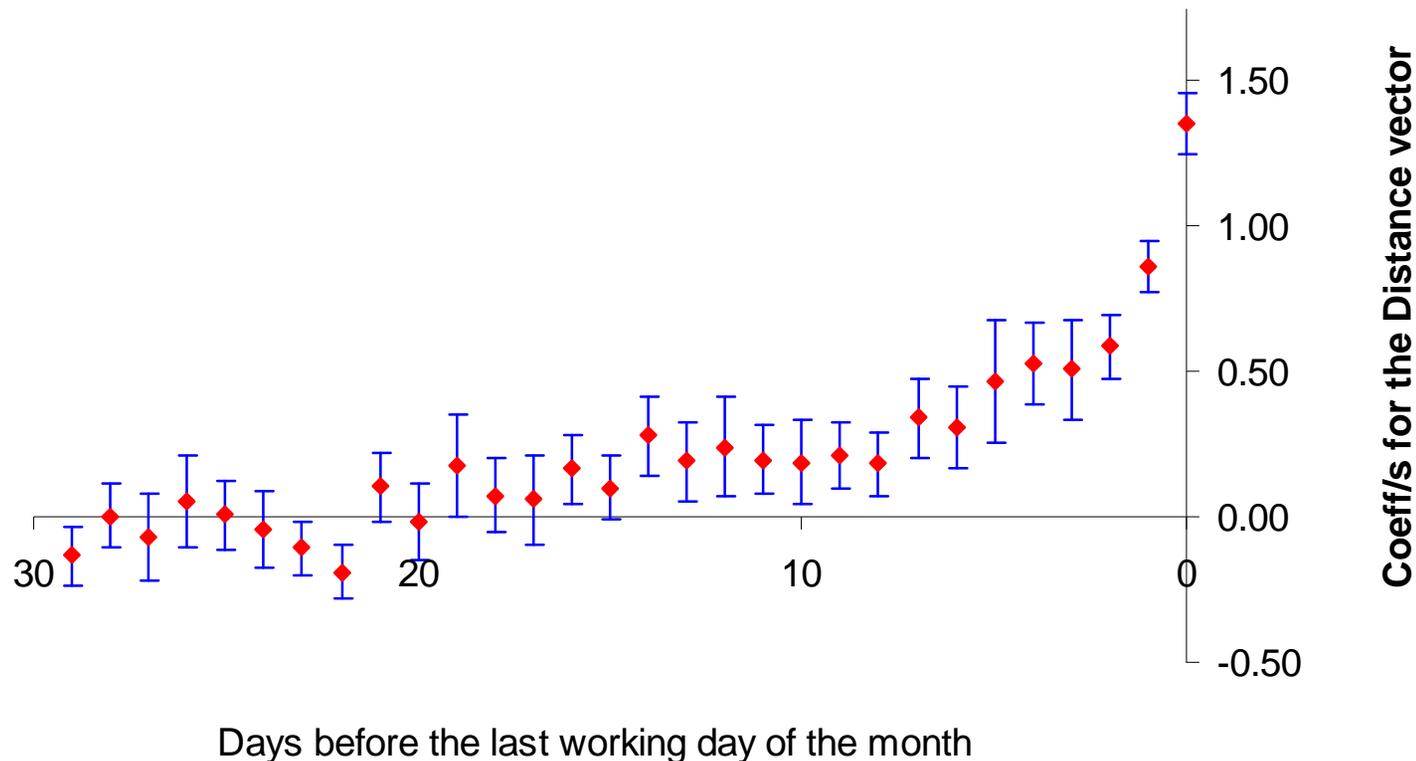
Asterisks denote significance at 1 percent (**) and 5 percent (*) levels.

Results (5)

Is the output time-dependent?

The increase in output is gradual

(for originated applications)



Zero distance denotes the last working day of the month, while the maximum distance is thirty days.

Results (6)

Increased effort or decreased quality?

$$(OLS) \quad Y_t = \alpha_0 + \beta \text{Distance}_t + \gamma \text{Month}_t + \delta \text{Year}_t + \lambda \text{Controls}_t + u_t$$

The dependent variable reflects the median decision duration

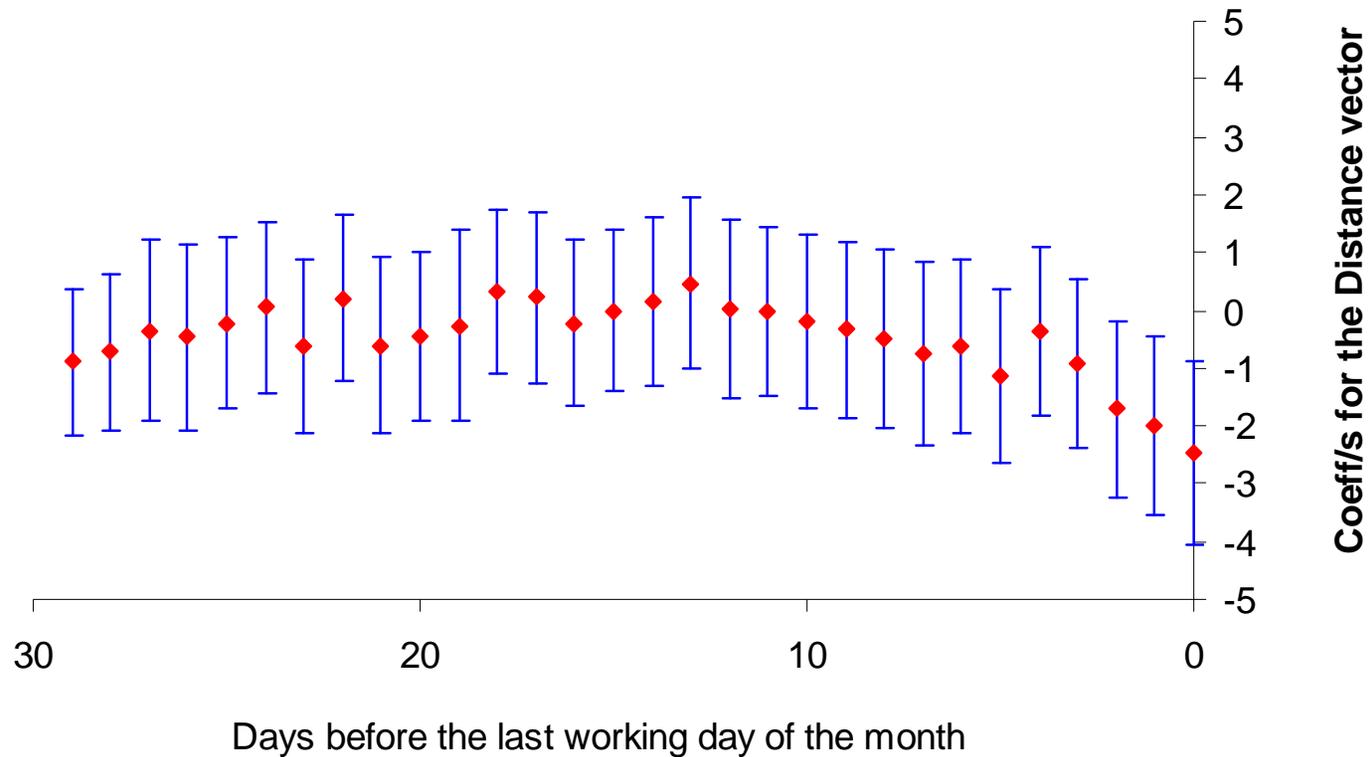
	<i>Decision Time for Originated Loans</i>	<i>Decision Time for Denied Loans</i>	<i>Decision Time for Approved/Not- Accepted Loans</i>
Independent Variables	[1]	[2]	[3]
End-of-Month indicator	-2.041** (0.310)	-0.152 (0.898)	-2.130 (1.655)
<i>Control variables:</i>	Yes	Yes	No
Application volume (ln), Month/Year effects			
Observations	751	751	750
R^2	0.473	0.391	0.474

Asterisks denote significance at 1 percent (**) and 5 percent (*) levels.

Results (7)

Increased effort or decreased quality?

The decrease in the processing time is gradual
(for originated applications)



Zero distance denotes the last working day of the month, while the maximum distance is thirty days.

Results (8)

Increased effort or decreased quality?

- **Indicators of decreased quality in mortgage officers' decision making:**
 - Applications approved at the end-of-month have lower creditworthiness (LTV, FICO, DTI)
 - *Ceteris paribus*, applications approved at the end-of-month have lower price (APR)

- **We find that:**
 - EoM approvals have lower FICO, higher LTV, and higher DTI. Pricing is no different for EoM approvals.
 - Although originating some mortgages of marginally lower-quality, the mortgage officers were appropriately pricing these loans for the additional risk.

Results (9)

Increased effort or decreased quality?

(Probit) The dependent variable reflects the likelihood of approval

Independent Variables	<i>All products</i>	<i>Fixed products</i>	<i>Non-Fixed products</i>
	[1]	[2]	[3]
End-of-Month indicator (EoM)	0.083** (0.004)	0.074** (0.005)	0.088** (0.009)
<i>cdf</i> (Credit score) × (EoM=1)	-0.053** (0.006)	-0.053** (0.006)	-0.031* (0.014)
<i>cdf</i> (LTV) × (EoM=1)	0.026** (0.007)	0.044** (0.009)	-0.007 (0.010)
<i>cdf</i> (DTI) × (EoM=1)	0.015* (0.006)	0.010 (0.006)	0.033* (0.014)
Observations	568,025	428,485	139,542
<i>Pseudo-R</i> ²	0.131	0.138	0.128

Other Control Vars: *cdf*(Credit score), *cdf*(LTV), *cdf*(DTI), Jumbo loan (0/1), Loan amount (ln), Jumbo loan × Loan amount, Refinance purpose (0/1), FHA-insured loan (0/1), VA-guaranteed loan (0/1), Second lien (0/1), Month effects, Year effects

Results (10)

Increased effort or decreased quality?

(OLS) The dependent variable is the APR of the approved loan

	<i>All products</i>	<i>Fixed products</i>	<i>NonFixed products</i>
Independent variables	[1]	[2]	[3]
End-of-Month indicator	0.003 (0.004)	0.001 (0.004)	-0.002 (0.012)
Other Control Vars: Credit score, LTV, DTI, Jumbo loan (0/1), Loan amount (ln), Jumbo loan × Loan amount, Refinance purpose (0/1), FHA-insured loan (0/1), VA-guaranteed loan (0/1), Second lien (0/1), Manufactured Housing, Non-owner occupied, Product code effects, Month effects, Year effects			
Observations	437,645	336,822	100,823
R^2	0.738	0.594	0.777

Asterisks denote significance at 1 percent (**) and 5 percent (*) levels.

Results (11)

Cost of nonlinear contracts

- Nonlinear contracts are costly to the firm if the EoM loans have higher delinquency rate.
- We find that that EoM loans have about 1% higher delinquency rate compared to loans originated during any other day of the month.
- Results robust across various estimations, specifications, and sub-samples.

Results (12)

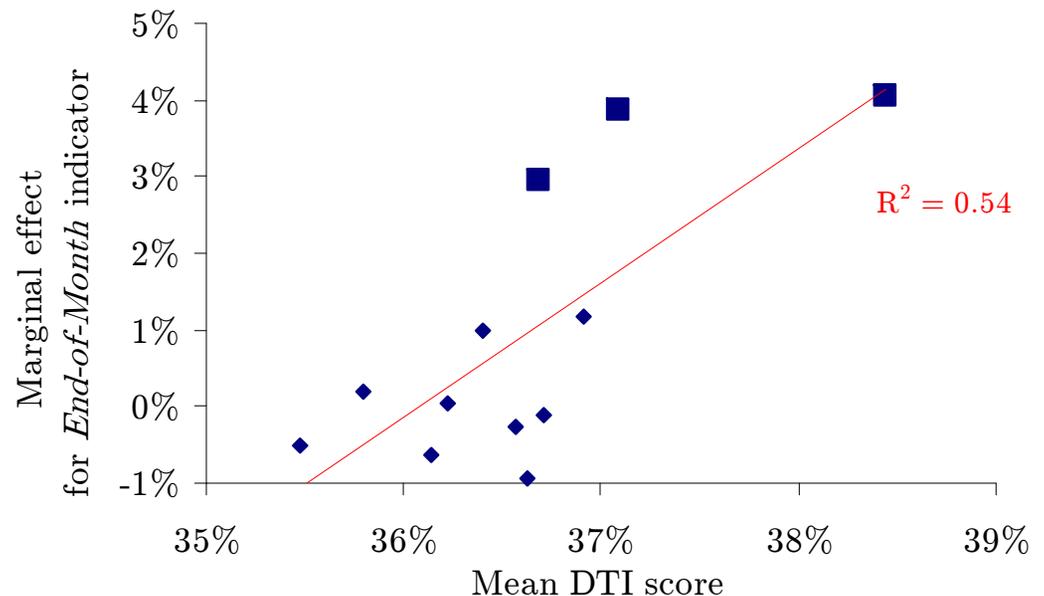
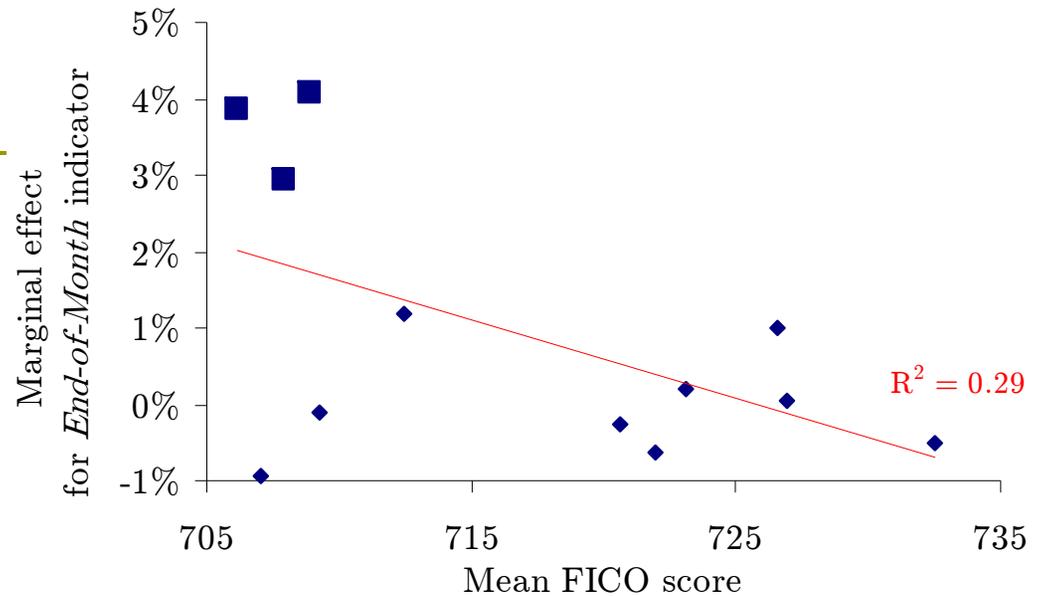
A closer look at nonlinear incentives & loan performance

- MOs approve some marginal applicants at the EoM
- “Marginal applicants” vary across time
- We would expect to have a negative effect on loan performance, when creditworthiness requirements are lower.
- Test: Examine correlations between *loan characteristics* and *marginal effects for EoM loans* across twelve quarters (2006-2008).

Results (13)

Quarterly estimates

- We confirm that EoM loans have lower performance only in quarters that creditworthiness requirements are lower.



Contribution

- We offer a novel insight into the incentive structures of the mortgage industry. Emphasize the role of incentives throughout the organizational hierarchy
- Mortgage officers substantially vary their output during the length of each month. Towards the end of each month, they increase their output by reducing their processing time and by approving some marginal applications.
- We provide evidence for adverse effects of nonlinear incentives on the bank.

Policy implications

- Since several US banks utilize nonlinear contracts for their mortgage officers, there could be systemic consequences from these incentive schemes.
- Lending institutions in HMDA 2009 with at least 8,000 originations; 12 out of 35 (34%) exhibit EoM spikes in originations.
- Are banks aware of the EoM effect?
- If yes, how do they use this private information?
e.g. Do banks sell more EoM loans in the secondary market?