The Effects of Supervision on Bank Performance: Evidence from Discontinuous Examination Frequencies

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[1] The views expressed herein are my own and do not necessarily reflect those of the Board of Governors or the staff of the Federal Reserve System.

Research Question

Does banking supervision affect bank performance?

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  - U.S. federal bank regulators allocate more than 10,000 people and more than $2 billion to supervision and related activities.
- Policymakers support banking supervision.
  - U.S. President Barack Obama (2009) on the 2007-2008 crisis:
    - "We were facing one of the largest financial crises in history and those responsible for oversight were caught off guard and without the authority to act."

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- **Problem:** Idea that supervision improves bank performance conflicts with the empirical evidence.
- Levine(2005) summarizes research on the effects of supervision across countries:
  - "For most countries, the data indicate that strengthening official supervisory powers will make things worse, not better."
- Other studies - with U.S. and international data - suggest mixed effects of supervision on performance.

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- Possible explanations for weak evidence that supervision improves bank performance:
  - Most studies use international data.
  - Supervision is endogenous to performance.
    - U.S. regulation requires that regulators supervise riskier banks more carefully.
    - Regulators treat and rate banks more stringently, even when regulation does not require it.
    - Regulation responds to bank performance (e.g. Dodd-Frank).

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- The law requires that banks be examined at least once every 12 months, but they may qualify for a lower frequency of at least once every 18 months.
  - Banks must be safe and sound and
  - Total assets must be lower than a threshold
    - $250 million between 1997 and 2006.
    - $500 million since 2006.

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- We break the endogeneity between supervision and performance using the minimum frequency of examinations of commercial banks imposed by law.
- The law requires that banks be examined at least once every 12 months, but they may qualify for a lower frequency of at least once every 18 months.
  - Banks must be safe and sound and
  - Total assets must be lower than a threshold
    - $250 million between 1997 and 2006.
    - $500 million since 2006.
- Very similar banks can be examined at very different frequencies, if they fall on different sides of a continuous variable threshold.
  - This generates an exogenous source of variation in examination frequencies.

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- Banks may qualify for an 18-month interval, depending on
  - less than $500 million in assets,
  - well capitalized,
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  - not recently acquired,
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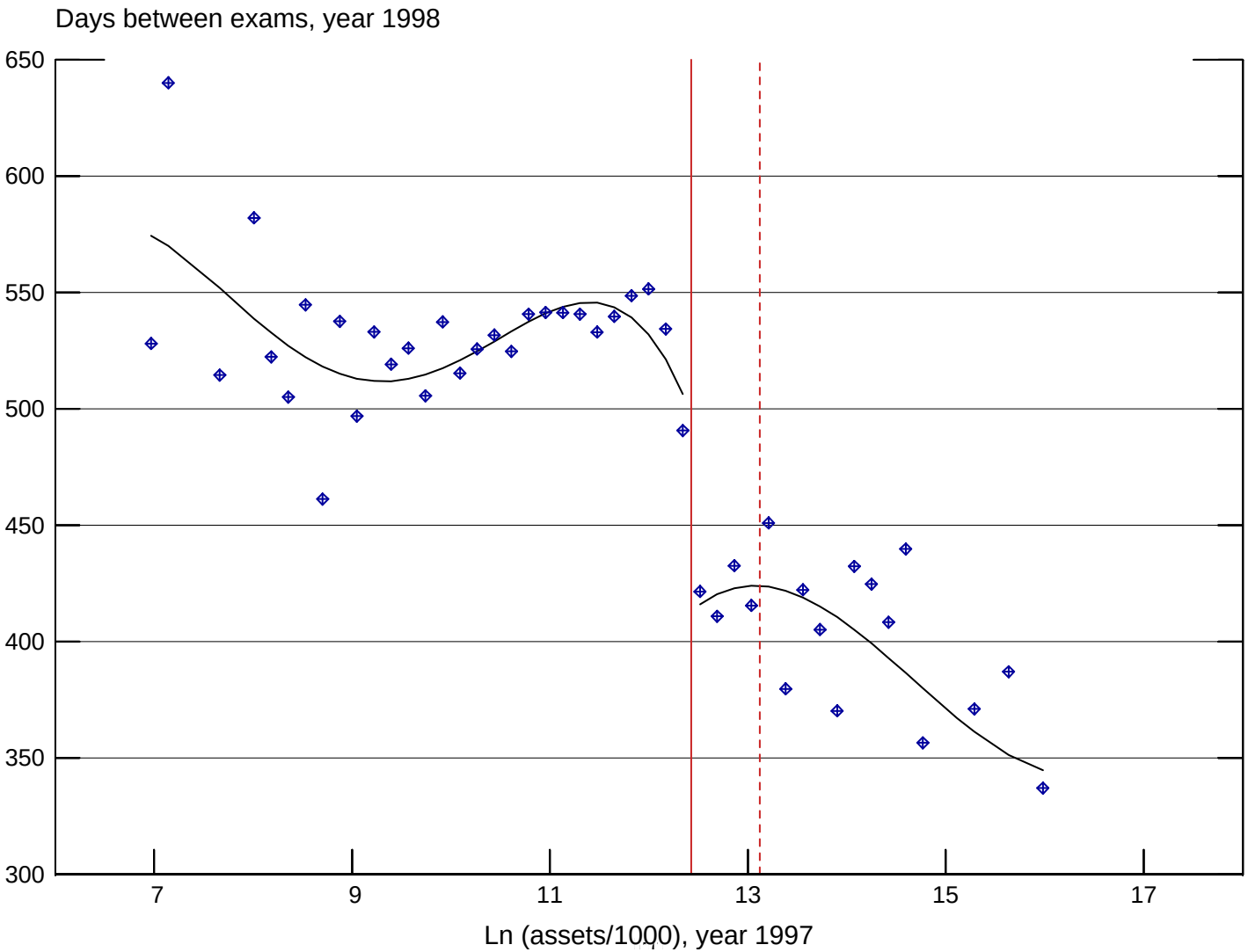
  - not subject to formal enforcement actions.
- We will look at banks that satisfy the last five requirements, leaving **assets** as the only active forcing variable.

Frequency of Examinations

- Among banks that satisfy the last five requirements, the asset thresholds matter for the frequency of examinations.

Frequency of Examinations



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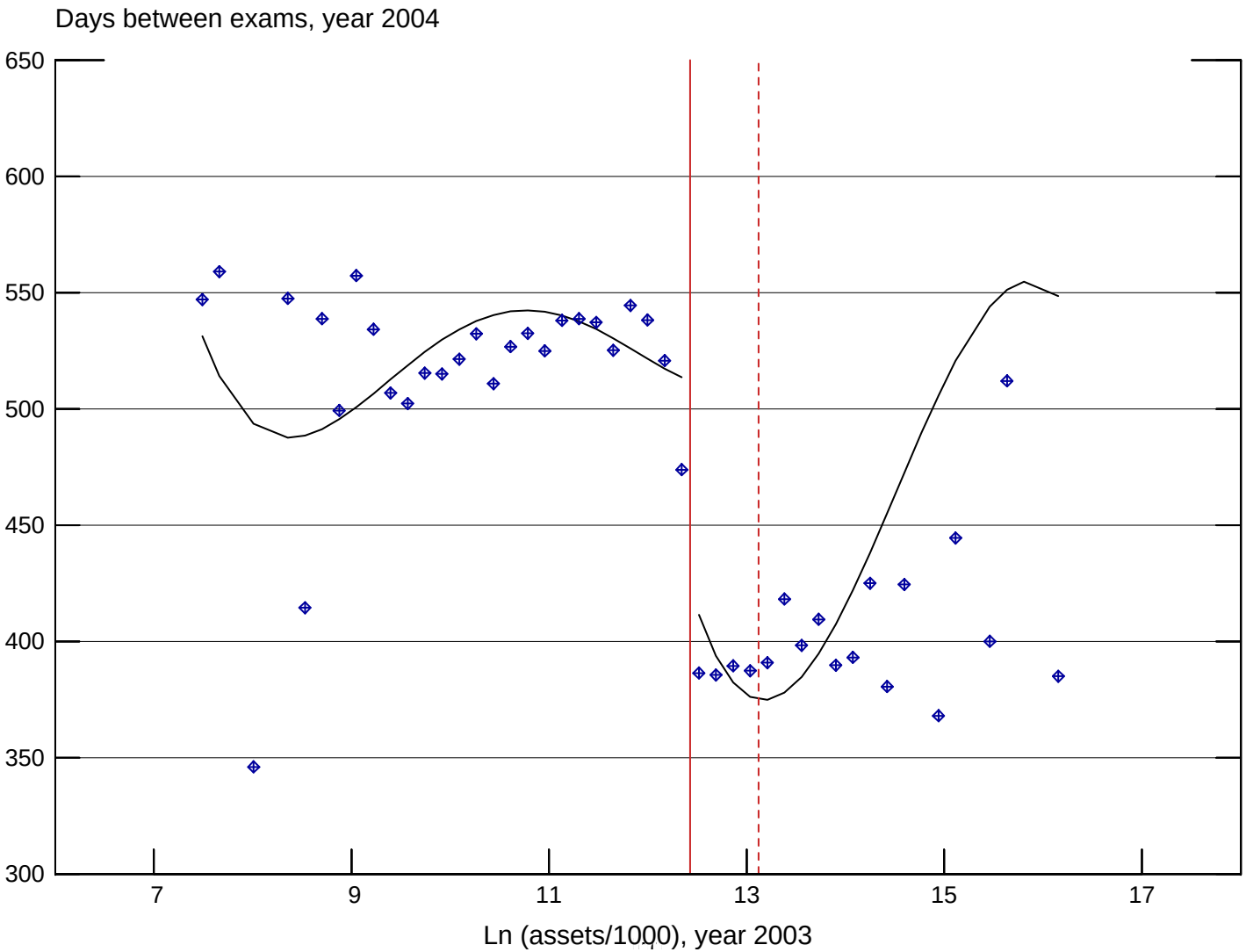

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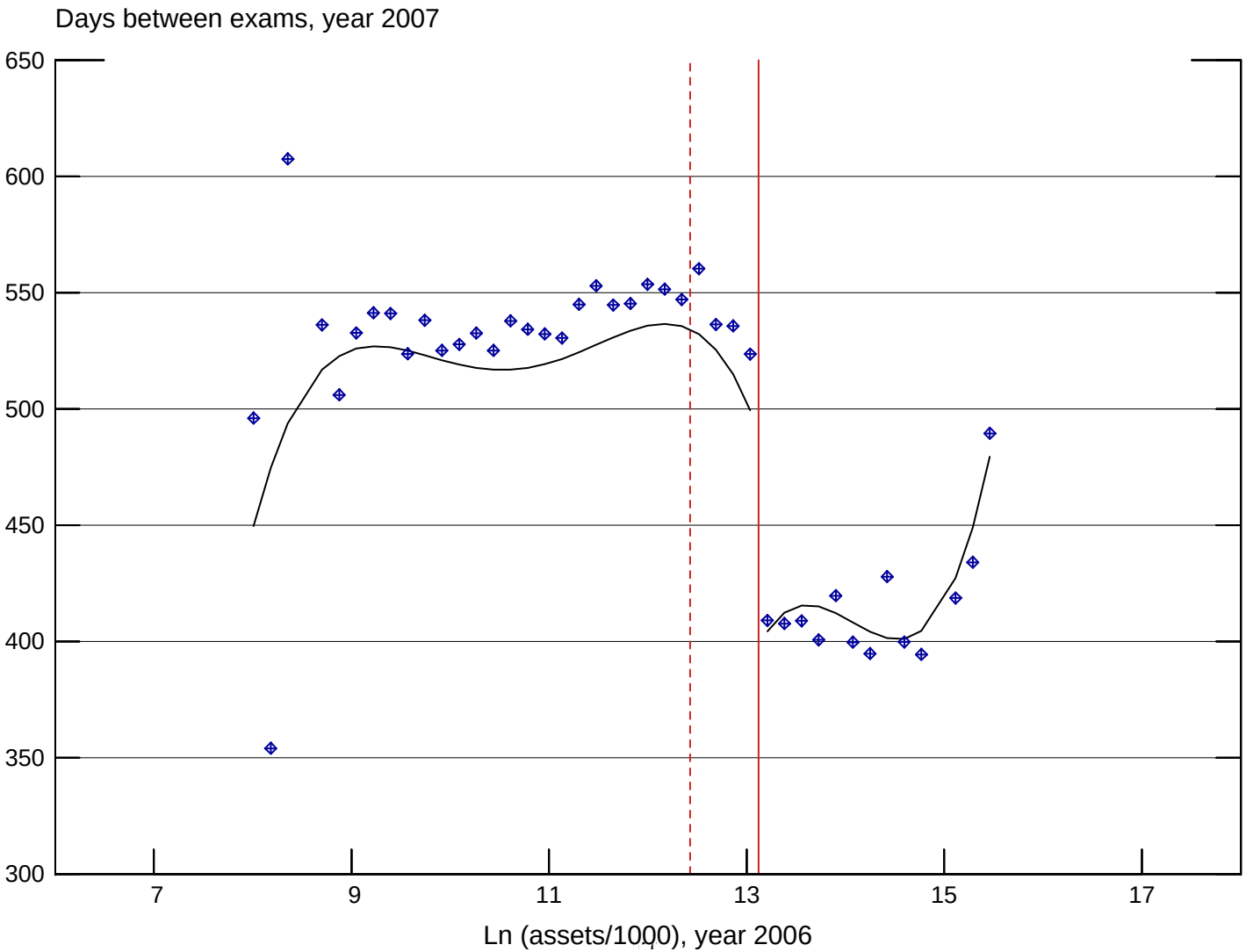

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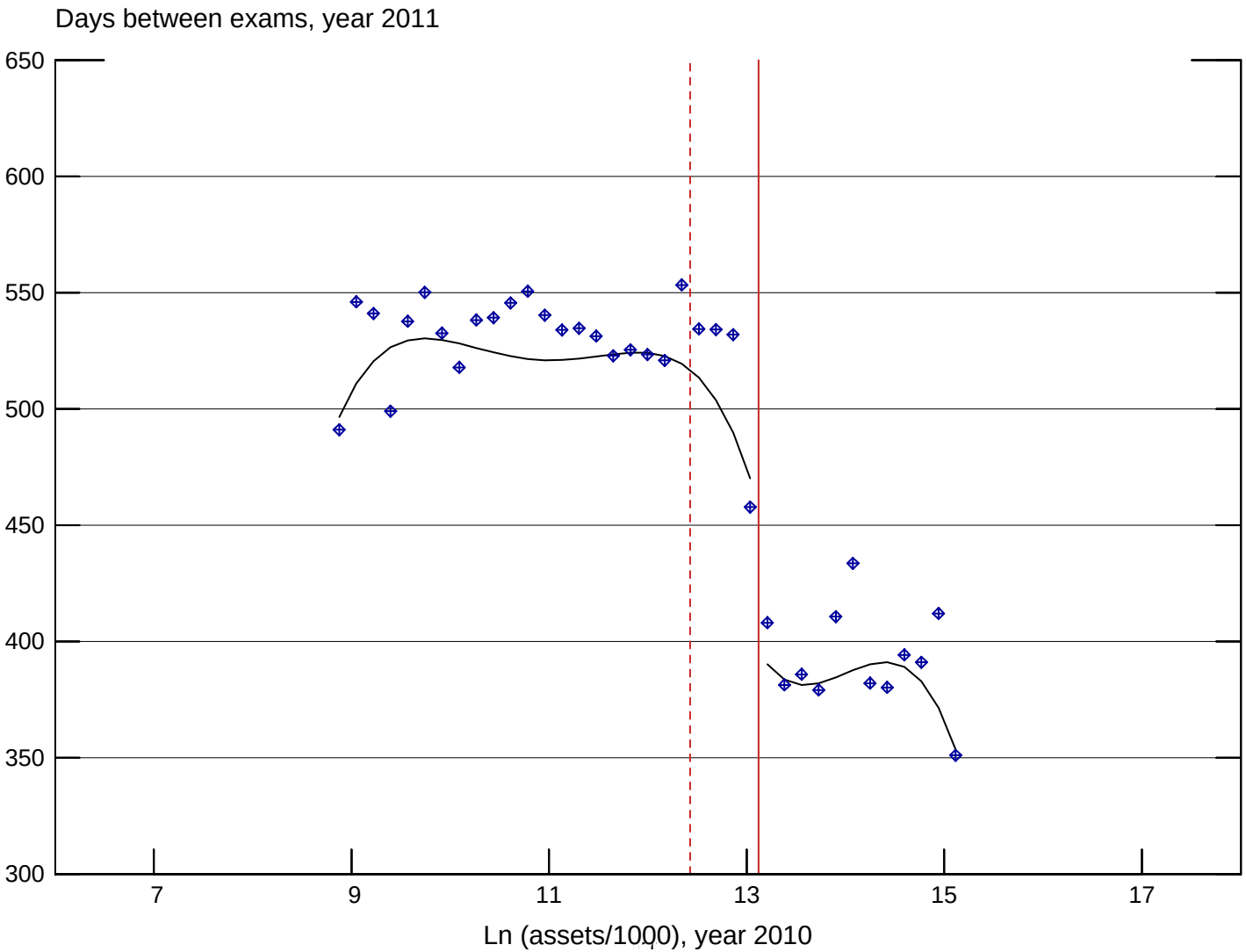

Empirical Strategy

We estimate the following TSLS model:

$$Y_{it} = \beta D_{it} + g(A_{it}) + \gamma_i + \tau_t + \varepsilon_{it} \tag{1}$$

$$D_{it} = \delta 1(A_{it} < c_t) + h(A_{it}) + \varphi_i + \upsilon_t + \xi_{it} \tag{2}$$

where

- Y_{it}: measure of performance of bank i in year t,
- D_{it}: days between examinations at bank i in year $t-1$,
- A_{it}: bank i's total assets in year $t-2$,
- $g(.)$ and $h(.)$: flexible functions of A_{it}.

Dependent variables measuring bank performance

- We analyze two groups of dependent variables, which measure bank performance:
  - Profitability measures:
    - Return on equity (ROE)
    - Net interest margin to total loans (NIM/TL)
  - Loan loss and delinquency measures:
    - Nonperforming loans to total loans (NPL/TL)
    - Charge-offs to total loans (CO/TL)
    - Provisions for loan and lease losses to total loans (PLLL/TL)

Results on profitability

Table 3: Profitability measures, all banks, years 1994-2012

	Panel A: OLS		Panel B: IV	
Dependent Variable	ROE	NIM/TL	ROE	NIM/TL
Days between examinations (hundreds of days)	-0.07%	0.00%	-1.68%	0.13%
	-1.59	0.18	-3.71	0.77
Assets	-50.48%	-89.88%	0.99%	0.25%
	-2.83	-5.93	1.84	0.31
$Assets^2$	7.39%	10.77%	-0.03%	-0.01%
	2.78	4.83	-2.22	-0.45
$Assets^3$	-0.45%	-0.59%	0.08%	0.23%
	-2.64	-4.10	0.09	1.18
$Assets^4$	0.01%	0.01%	-5.52%	0.37%
	2.42	3.58	-0.79	0.22
1(Assets ≥ $250MM)			36.91%	-19.75%
			0.84	-0.30
(Assets - threshold) × 1(Assets ≥ $250MM)			32.14%	-1.90%
			1.57	-0.34
$(Assets - threshold)^2 \times 1(Assets \geq \$250MM)$			-28.59%	5.29%
			-1.61	0.90
$(Assets - threshold)^3 \times 1(Assets \geq \$250MM)$			0.53%	-0.18%
			0.90	-0.57
1(Assets ≥ $500MM)			-10.27%	-0.92%
			-1.39	-0.08
(Assets - threshold) × 1(Assets ≥ $500MM)			5.12%	-5.51%
			0.93	-1.91
$(Assets - threshold)^2 \times 1(Assets \geq \$500MM)$			33.52%	-5.42%
			1.89	-0.76
$(Assets - threshold)^3 \times 1(Assets \geq \$250MM)$			29.18%	-5.23%
			1.64	-0.89
Bank fixed effects?	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes
Number of banks	7,557	7,557	7,557	7,557
Number of observations	67,198	67,198	67,198	67,198

Note: This table displays results of OLS regressions based on equation (1) (Panel A), and IV regressions based on equations (2) and (3) (Panel B). The "Assets" are measured in time t-2, "Days between examinations" are measured at t-1, and all dependent variables are measured at time t. The entire data set 1994-2012 is used. "ROE" is Returns on Equity and "NIM/TL" is Net Interest Margin as a percentage of Total Loans. Bank-level clustered T-statistics are shaded in grey.

Results on loan loss and delinquency

Table 4: Loan loss and deliquency measures, all banks, years 1994-2012

	Panel A: OLS			Panel B: IV		
Dependent Variable	NPL/TL	CO/TL	PLLL/TL	NPL/TL	CO/TL	PLLL/TL
Days between examinations (hundreds of days)	0.02%	0.00%	0.01%	0.64%	0.09%	0.16%
	2.95	0.29	2.67	4.26	3.21	4.99
Assets	5.92%	1.44%	2.03%	36.76%	16.64%	9.98%
	1.87	0.33	0.60	4.11	2.84	1.88
$Assets^2$	-1.01%	-0.13%	-0.25%	-4.93%	-2.49%	-1.30%
	-2.33	-0.18	-0.46	-3.36	-2.62	-1.52
$Assets^3$	0.07%	0.00%	0.01%	0.28%	0.16%	0.07%
	2.72	0.03	0.31	2.67	2.42	1.20
$Assets^4$	0.00%	0.00%	0.00%	-0.01%	0.00%	0.00%
	-2.95	0.14	-0.13	-2.06	-2.22	-0.89
1(Assets ≥ \$250MM)				0.35%	0.04%	0.05%
				2.79	1.04	1.52
(Assets - threshold) × 1(Assets ≥ \$250MM)				-0.57%	0.15%	0.32%
				-0.46	0.28	0.75
$(Assets - threshold)^2 \times 1(Assets \geq \$250MM)$				-2.68%	-1.00%	-3.01%
				-0.79	-0.53	-1.97
$(Assets - threshold)^3 \times 1(Assets \geq \$250MM)$				4.62%	0.98%	3.57%
				1.51	0.50	2.27
1(Assets ≥ \$500MM)				-0.14%	0.19%	0.05%
				-1.00	1.50	0.44
(Assets - threshold) × 1(Assets ≥ \$500MM)				-2.25%	-0.68%	-1.85%
				-1.85	-0.68	-2.32
$(Assets - threshold)^2 \times 1(Assets \geq \$500MM)$				-7.63%	-0.23%	-4.02%
				-2.24	-0.09	-2.07
$(Assets - threshold)^3 \times 1(Assets \geq \$250MM)$				-4.51%	-1.01%	-3.62%
				-1.47	-0.51	-2.31
Bank fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Number of banks	7,547	7,547	7,547	7,547	7,547	7,547
Number of observations	67,101	67,101	67,103	67,101	67,101	67,103

Note: This table displays results of OLS regressions based on equation (1) (Panel A), and IV regressions based on equations (2) and (3) (Panel B). "Assets" are measured in time t-2, "Days between examinations" are measured at t-1, and all dependent variables are measured at time t. The entire data set 1994-2012 is used. "NPL/TL" is Non-performing Loans as a percentage of Total Loans, "CO/TL" is Charge-offs as a percentage of Total Loans, and "PLLL/TL" is Provision for Loan and Lease Losses as a percentage of Total Loans. Bank-level clustered T-statistics are shaded in grey.

Robustness: even more flexible specification

Table 5: All banks, years 1994-2012, 5th order polynomial and quartic splines

	Panel A: Profitability		Panel B: Loan loss and delinquency		
Dependent Variable	ROE	NIM/TL	NPL/TL	CO/TL	PLLL/TL
Days between examinations (hundreads of days)	-1.68%	0.11%	0.64%	0.09%	0.16%
	-3.73	0.69	4.26	3.23	4.97
Assets	505.90%	950.54%	185.90%	-41.01%	-70.07%
	1.28	1.18	2.10	-0.60	-1.06
Assets^2	-115.81%	-219.31%	-38.39%	10.24%	16.46%
	-1.31	-1.23	-1.95	0.66	1.10
Assets^3	12.51%	24.09%	3.92%	-1.20%	-1.84%
	1.30	1.25	1.85	-0.71	-1.12
Assets^4	-0.65%	-1.28%	-0.20%	0.07%	0.10%
	-1.26	-1.27	-1.77	0.75	1.12
Assets^5	0.01%	0.03%	0.00%	0.00%	0.00%
	1.20	1.28	1.71	-0.77	-1.12
1(Assets $\geq$ \$250MM)	-0.32%	-0.12%	0.24%	0.04%	0.09%
	-0.41	-0.50	2.13	1.16	2.10
(Assets - threshold) $\times$ 1(Assets $\geq$ \$250MM)	1.68%	0.02%	1.44%	0.28%	-0.11%
	0.22	0.00	0.83	0.36	-0.14
(Assets - threshold)^2 $\times$ 1(Assets $\geq$ \$250MM)	-25.92%	-16.93%	-18.98%	-1.30%	0.90%
	-0.57	-0.84	-1.82	-0.25	0.20
(Assets - threshold)^3 $\times$ 1(Assets $\geq$ \$250MM)	102.56%	31.57%	41.39%	2.10%	-4.95%
	0.93	0.67	1.74	0.16	-0.49
(Assets - threshold)^4 $\times$ 1(Assets $\geq$ \$250MM)	-97.98%	-21.26%	-27.49%	-0.77%	6.41%
	-1.16	-0.59	-1.58	-0.07	0.84
1(Assets $\geq$ \$500MM)	0.83%	-0.25%	-0.07%	0.09%	-0.06%
	1.19	-0.68	-0.50	0.80	-0.74
(Assets - threshold) $\times$ 1(Assets $\geq$ \$500MM)	15.94%	-1.96%	0.90%	0.27%	-1.77%
	1.45	-0.37	0.47	0.16	-1.55
(Assets - threshold)^2 $\times$ 1(Assets $\geq$ \$500MM)	96.30%	5.82%	9.81%	-0.91%	-9.21%
	1.56	0.22	0.87	-0.11	-1.65
(Assets - threshold)^3 $\times$ 1(Assets $\geq$ \$500MM)	168.99%	26.03%	34.79%	0.65%	-12.26%
	1.33	0.49	1.41	0.04	-1.10
(Assets - threshold)^4 $\times$ 1(Assets $\geq$ \$500MM)	97.58%	20.44%	27.36%	0.76%	-6.40%
	1.15	0.57	1.58	0.07	-0.84
Bank fixed effects?	Yes	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes	Yes
Number of banks	7,557	7,557	7,547	7,547	7,547
Number of observations	67,198	67,198	67,101	67,101	67,103

Note: This table displays results of IV regressions based on equations (2) and (3). The "Assets" are measured in time t-2, "Days between examinations" are measured at t-1, and all dependent variables are measured at time t. The entire data set 1997-2012 is used. "ROE" is Returns on Equity, "NIM/TL" is Net Interest Margin as a percentage of Total Loans, "NPL/TL" is Non-performing Loans as a percentage of Total Loans, "CO/TL" is Charge-offs as a percentage of Total Loans, and "PLLL/TL" is Provision for Loan and Lease Losses as a percentage of Total Loans. Bank-level clustered T-statistics are shaded in grey.

Robustness: banks close to the thresholds

Table 6: Banks within +/- $50MM of the thresholds, years 1994-2012

	Panel A: Profitability		Panel B: Loan loss and delinquency		
Dependent Variable	ROE	NIM/TL	NPL/TL	CO/TL	PLLL/TL
Days between examinations (hundreds of days)	-2.52%	-0.06%	0.73%	0.14%	0.19%
	-4.90	-0.29	4.74	2.95	3.25
Assets	-9.11%	-3.42%	2.57%	0.16%	0.73%
	-5.03	-2.93	5.96	0.34	3.72
1(Assets ≥ $250MM)	-0.72%	0.20%	0.13%	0.09%	0.05%
	-2.39	1.37	1.96	1.74	1.99
(Assets - threshold) × 1(Assets ≥ $250MM)	7.84%	3.41%	-2.00%	-0.12%	-0.48%
	3.88	2.24	-4.42	-0.26	-1.69
1(Assets ≥ $500MM)	-0.84%	-0.60%	0.00%	0.10%	0.02%
	-1.37	-1.61	0.00	1.76	0.34
(Assets - threshold) × 1(Assets ≥ $500MM)	2.60%	7.77%	0.80%	-0.37%	-0.75%
	0.28	1.13	0.40	-0.34	-1.08
Bank fixed effects?	Yes	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes	Yes
Number of banks	1,348	1,348	1,348	1,348	1,348
Number of observations	5,520	5,520	5,508	5,508	5,508

Note: This table displays results of IV regressions based on equations (2) and (3). The "Assets" are measured in time t-2, "Days between examinations" are measured at t-1, and all dependent variables are measured at time t. Restricted to banks that have Total Assets within +/- $50 million of the two asset thresholds. "ROE" is Returns on Equity, "NIM/TL" is Net Interest Margin as a percentage of Total Loans, "NPL/TL" is Non-performing Loans as a percentage of Total Loans, "CO/TL" is Charge-offs as a percentage of Total Loans, and "PLLL/TL" is Provision for Loan and Lease Losses as a percentage of Total Loans. Bank-level clustered T-statistics are shaded in grey.

Robustness: national banks only

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Table 7: National banks only, years 1994-2012

	Panel A: Profitability		Panel B: Loan loss and delinquency		
Dependent Variable	ROE	NIM/TL	NPL/TL	CO/TL	PLLL/TL
Days between examinations (hundreds if days)	-1.69%	-0.09%	0.42%	0.07%	0.12%
	-1.62	-0.59	3.74	1.85	2.77
Assets	-1070.88%	1758.70%	126.58%	55.89%	84.59%
	-1.30	2.21	1.41	1.18	1.92
Assets^2	148.31%	-249.84%	-18.60%	-8.25%	-12.06%
	1.25	-2.23	-1.45	-1.23	-1.94
Assets^3	-9.03%	15.64%	1.20%	0.53%	0.76%
	-1.21	2.25	1.48	1.27	1.94
Assets^4	0.20%	-0.36%	-0.03%	-0.01%	-0.02%
	1.17	-2.26	-1.50	-1.29	-1.94
1(Assets $\geq$ \$250MM)	2.63%	0.42%	0.45%	0.02%	0.07%
	0.90	1.93	2.49	0.52	1.53
(Assets - threshold) $\times$ 1(Assets $\geq$ \$250MM)	-32.62%	1.46%	-0.04%	0.51%	0.23%
	-1.42	0.60	-0.02	0.92	0.36
(Assets - threshold)^2 $\times$ 1(Assets $\geq$ \$250MM)	93.45%	9.72%	-2.53%	-2.10%	-1.45%
	1.58	1.33	-0.38	-1.03	-0.61
(Assets - threshold)^3 $\times$ 1(Assets $\geq$ \$250MM)	-83.99%	-1.43%	4.90%	3.11%	2.73%
	-1.66	-0.21	0.79	1.48	1.14
1(Assets $\geq$ \$500MM)	1.95%	0.30%	-0.07%	0.04%	-0.01%
	1.31	1.18	-0.35	0.45	-0.08
(Assets - threshold) $\times$ 1(Assets $\geq$ \$500MM)	21.22%	0.56%	-2.60%	-1.76%	-1.66%
	1.36	0.18	-1.26	-2.06	-1.71
(Assets - threshold)^2 $\times$ 1(Assets $\geq$ \$500MM)	77.74%	2.22%	-7.24%	-3.82%	-4.08%
	1.57	0.29	-1.12	-1.50	-1.46
(Assets - threshold)^3 $\times$ 1(Assets $\geq$ \$500MM)	81.18%	7.35%	-4.37%	-3.01%	-2.44%
	1.63	1.10	-0.71	-1.42	-1.02
Bank fixed effects?	Yes	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes	Yes
Number of banks	1,887	1,887	1,885	1,885	1,885
Number of observations	15,589	15,589	15,566	15,566	15,566

Note: This table displays results of IV regressions based on equations (2) and (3). Only national banks are included. The "Assets" are measured in time t-2, "Days between examinations" are measured at t-1, and all dependent variables are measured at time t. The entire data set 1994-2012 is used. "ROE" is Returns on Equity, "NIM/TL" is Net Interest Margin as a percentage of Total Loans, "NPL/TL" is Non-performing Loans as a percentage of Total Loans, "CO/TL" is Charge-offs as a percentage of Total Loans, and "PLLL/TL" is Provision for Loan and Lease Losses as a percentage of Total Loans. Bank-level clustered T-statistics are shaded in grey.

Effects of bank examination at longer horizons

What are the "intent-to-treat" effects of $D_{i,t-1}$ on $Y_{i,t+2}$ (Cellini et al., 2010)?

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What are the "intent-to-treat" effects of $D_{i,t-1}$ on $Y_{i,t+2}$ (Cellini et al., 2010)?

Table 8: All banks, years 1994-2012, 3-year ahead performance

	Panel A: Profitability		Panel B: Loan loss and delinquency		
Dependent Variable	ROE	NIM/TL	NPL/TL	CO/TL	PLLL/TL
Days between examinations (hundreds if days)	-0.03%	0.17%	0.43%	0.08%	0.04%
	-0.10	1.27	2.36	2.18	1.22
Assets	70.70%	-9.85%	13.58%	6.39%	2.52%
	1.37	-0.17	1.33	1.30	0.60
Assets^2	-12.67%	3.21%	-1.49%	-0.81%	-0.35%
	-1.46	0.32	-0.86	-0.96	-0.49
Assets^3	1.00%	-0.33%	0.06%	0.04%	0.02%
	1.60	-0.43	0.45	0.67	0.36
Assets^4	-0.03%	0.01%	0.00%	0.00%	0.00%
	-1.77	0.52	-0.10	-0.40	-0.19
1(Assets $\geq$ \$250MM)	0.38%	-0.06%	0.15%	-0.06%	-0.02%
	0.95	-0.32	0.94	-1.37	-0.43
(Assets - threshold) $\times$ 1(Assets $\geq$ \$250MM)	4.41%	-0.84%	0.10%	0.90%	0.35%
	1.08	-0.60	0.09	2.07	0.77
(Assets - threshold)^2 $\times$ 1(Assets $\geq$ \$250MM)	2.15%	-4.79%	-4.23%	-3.98%	-2.58%
	0.15	-1.17	-1.28	-2.97	-1.67
(Assets - threshold)^3 $\times$ 1(Assets $\geq$ \$250MM)	-3.74%	5.68%	5.13%	3.64%	2.89%
	-0.26	1.40	1.65	2.66	1.96
1(Assets $\geq$ \$500MM)	0.25%	-0.26%	0.04%	-0.04%	0.00%
	0.46	-1.17	0.23	-0.54	-0.08
(Assets - threshold) $\times$ 1(Assets $\geq$ \$500MM)	2.67%	-3.03%	-2.47%	-0.68%	-1.12%
	0.49	-1.46	-2.01	-0.94	-1.95
(Assets - threshold)^2 $\times$ 1(Assets $\geq$ \$500MM)	10.49%	-6.85%	-7.10%	-3.90%	-3.63%
	0.65	-1.29	-2.03	-2.44	-2.28
(Assets - threshold)^3 $\times$ 1(Assets $\geq$ \$500MM)	4.15%	-6.31%	-5.17%	-3.64%	-2.89%
	0.29	-1.58	-1.67	-2.65	-1.95
Bank fixed effects?	Yes	Yes	Yes	Yes	Yes
Time fixed effects?	Yes	Yes	Yes	Yes	Yes
Number of banks	6,219	6,219	6,209	6,209	6,209
Number of observations	52,143	52,143	52,070	52,070	52,071

Note: This table displays results of IV regressions based on equations (2) and (3). The "Assets" are measured in time t-2, "Days between examinations" are measured at t-1, and all dependent variables are measured at time t+2. The entire data set 1994-2012 is used. "ROE" is Returns on Equity, "NIM/TL" is Net Interest Margin as a percentage of Total Loans, "NPL/TL" is Non-performing Loans as a percentage of Total Loans, "CO/TL" is Charge-offs as a percentage of Total Loans, and "PLLL/TL" is Provision for Loan and Lease Losses as a percentage of Total Loans. Bank-level clustered T-statistics are shaded in grey.

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- Extensions: How can we assess the effectiveness of supervision for TBTF firms? How can we evaluate the effects of supervision on systemic risk?