Supervising Failing Banks

Online Appendix

Sergio Correia, Stephan Luck, and Emil Verner*

*Correia: Federal Reserve Bank of Richmond, sergio.correia@rich.frb.org; Luck: Federal Reserve Bank of New York, stephan.luck@ny.frb.org; Verner: MIT Sloan and NBER, everner@mit.edu.

A Data Appendix

A.1 CAMELS Rating System

In the following we describe the different CAMELS rating categories in detail. For more background, see the FDIC examination manual here.

- Composite 1: Financial institutions in this group are sound in every respect and generally have components rated 1 or 2. Any weaknesses are minor and can be handled in a routine manner by the board of directors and management. These financial institutions are the most capable of withstanding the vagaries of business conditions and are resistant to outside influences such as economic instability in their trade area. These financial institutions are in substantial compliance with laws and regulations. As a result, these financial institutions exhibit the strongest performance and risk management practices relative to the institution's size, complexity, and risk profile, and give no cause for supervisory concern

- Composite 2: Financial institutions in this group are fundamentally sound. For a financial institution to receive this rating, generally no component rating should be more severe than 3. Only moderate weaknesses are present and are well within the board of directors' and management's capabilities and willingness to correct. These financial institutions are stable and are capable of withstanding business fluctuations. These financial institutions are in substantial compliance with laws and regulations. Overall risk management practices are satisfactory relative to the institution's size, complexity, and risk profile. There are no material supervisory concerns and, as a result, the supervisory response is informal and limited.

- Composite 3: Financial institutions in this group exhibit some degree of supervisory concern in one or more of the component areas. These financial institutions exhibit a combination of weaknesses that may range from moderate to severe; however, the magnitude of the deficiencies generally will not cause a component to be rated more severely than 4. Management may lack the ability or willingness to effectively address weaknesses within appropriate time frames. Financial institutions in this group generally are less capable of withstanding business fluctuations and are more vulnerable to outside influences than those institutions rated a composite 1 or 2. Additionally, these financial institutions may be in significant noncompliance with laws and regulations. Risk management practices may be less than satisfactory relative to the institution's size, complexity, and risk profile. These financial institutions require more than normal supervision, which may include formal or informal enforcement actions. Failure appears unlikely, however, given the overall strength and financial capacity of these institutions.

- Composite 4: Financial institutions in this group generally exhibit unsafe and unsound practices or conditions. There are serious financial or managerial deficiencies that result in unsatisfactory performance. The problems range from severe to critically deficient. The weaknesses and problems are not being satisfactorily addressed

or resolved by the board of directors and management. Financial institutions in this group generally are not capable of withstanding business fluctuations. There may be significant noncompliance with laws and regulations. Risk management practices are generally unacceptable relative to the institution's size, complexity, and risk profile. Close supervisory attention is required, which means, in most cases, formal enforcement action is necessary to address the problems. Institutions in this group pose a risk to the deposit insurance fund. Failure is a distinct possibility if the problems and weaknesses are not satisfactorily addressed and resolved.

- Composite 5: Financial institutions in this group exhibit extremely unsafe and unsound practices or conditions; exhibit a critically deficient performance; often contain inadequate risk management practices relative to the institution's size, complexity, and risk profile; and are of the greatest supervisory concern. The volume and severity of problems are beyond management's ability or willingness to control or correct. Immediate outside financial or other assistance is needed in order for the financial institution to be viable. Ongoing supervisory attention is necessary. Institutions in this group pose a significant risk to the deposit insurance fund and failure is highly probable.

A.2 Forms FFIEC 031, 041, and 051: 2000 through 2023

We use the Federal Financial Institutions Examination Council (FFIEC) Consolidated Reports of Condition and Income ("Call Report"), forms FFIEC 031, 041, and 051. These data provide quarterly information on balance sheets and income statements on a consolidated basis for all commercial banks operating in the United States and regulated by the FRS, the FDIC, and the OCC.

A.3 Call Revision Data

Banks submit their Call Report data quarterly through the FFIEC's Central Data Repository (CDR). Their submission must be processed (and accepted) at most 30 calendar days after the end of each quarter.[1] In order for a submission to be accepted by the CDR, it must pass a series of validity and quality checks, known as the "FFIEC Edit Criteria", which help to ensure the report is internally consistent and accounting identities hold. Only once a submission passes the edit criteria and is accepted it will enter the FFIEC's internal system. See the inter-agency "Guidelines for Resolving Edits" for more information.

FFIEC 031 and 041 instructions:

> A bank's primary federal bank supervisory authority may require the filing of an amended Call Report if reports as previously submitted contain significant errors, as determined by the supervisory authority, in how the reporting bank classified or categorized items in the reports, i.e., on what line of the report an item has been reported.
>
> When dealing with the recognition and measurement of events and transactions in the Call Report, amended reports may be required if a bank's primary federal bank supervisory authority determines that the reports as previously submitted contain errors that are material for the reporting bank. Materiality is a qualitative characteristic of accounting information that is addressed in FASB Concepts Statement No. 8, "Conceptual Framework for Financial Reporting," as follows: "Information is material if omitting it or misstating it could influence decisions that users make on the basis of the financial information of a specific reporting entity. In other words, materiality is an entity-specific aspect of relevance based on the nature or magnitude or both of the items to which the information relates in the context of an individual entity's financial report."

Data corrections are allowed after a submission is accepted, including for prior periods. This can occur for multiple reasons, such as if a new call report flags inconsistencies across time in reported amounts.

Table A.1 shows the probability of Call Report revisions from 2007 through 2024 for selected line items.

[1] Banks with multiple non-shell foreign offices are allowed a longer period of 35 calendar days.

Table A.1: *Summary Statistics: Call Report Data Revisions, 2007-2024.*

	Probability of revision	Days to first revision		Numbers of revisions	
		Mean	Median	Mean	Median
Report:					
Entire call report	0.296	114	64	1.4	1.0
Balance sheet	0.266	116	65	1.4	1.0
Income statement	0.123	116	90	1.2	1.0
Line items:					
Total assets	0.052	122	87	1.1	1.0
Non-performing loans	0.018	106	75	1.1	1.0
Loan-loss provisions	0.019	112	88	1.1	1.0
Total equity capital	0.050	124	89	1.1	1.0
Net income	0.046	120	87	1.1	1.0

Notes: This table reports summary statistics on FFIEC call report data corrections between 2007Q2 (the first quarter where this information is broadly available) and 2024Q3. The "Days to first revision" and "Number of revisions" columns are conditional on at least one revision.

B Additional Tables

Table B.2: *Summary Statistics: Bank-level data from 2000 through 2023.*

	N	Mean	Std. dev.	1st	10th	25th	Median	75th	90th	99th
Assets (in million)	637,180	1,559.20	26,128.70	13.89	48.98	93.91	199.27	466.23	1,169.53	15,681.90
Number of Employees	637,179	202.36	2,942.31	4.00	10.00	19.00	38.00	84.00	196.00	1,775.00
Age	637,182	36.73	18.83	1.00	7.00	19.00	43.00	51.00	58.00	63.00
CET 1/RWA	574,581	0.22	2.02	0.07	0.10	0.12	0.14	0.19	0.27	1.54
Tier 1 Capital/RWA	609,338	0.22	1.76	0.08	0.10	0.12	0.14	0.19	0.27	1.50
Equity/RWA	609,338	0.23	1.76	0.09	0.11	0.13	0.15	0.20	0.28	1.50
TCE/assets	634,939	0.11	0.09	0.05	0.07	0.08	0.10	0.12	0.15	0.41
Equity/assets	637,180	0.12	0.16	0.06	0.08	0.09	0.10	0.12	0.15	0.74
Net income/assets	637,175	0.01	0.02	-0.02	0.00	0.00	0.00	0.01	0.01	0.03
Liquid assets/assets	636,842	0.30	0.17	0.03	0.11	0.18	0.27	0.39	0.53	0.83
Deposits/loans	637,176	0.82	0.12	0.01	0.73	0.80	0.85	0.88	0.90	0.93
Time deposits/assets	637,176	0.33	0.15	0.00	0.13	0.22	0.34	0.44	0.53	0.69
Compensation/empl.	635,665	40,728.02	32,238.92	8,232.14	13,219.51	20,833.33	35,357.14	53,141.30	73,316.24	130771.43

Notes: This table reports summary statistics for the bank-level data based on the FFIEC Call Report.

Table B.3: *Summary Statistics: Bank-level data from 2000 through 2023 for failing banks.*

	N	Mean	Std. dev.	1st	10th	25th	Median	75th	90th	99th
Assets (in million)	18,310	3,041.76	34,190.30	16.36	49.46	109.14	240.52	554.55	1,508.55	52,833.29
Number of Employees	18,310	488.64	7,032.51	5.00	12.00	21.00	42.00	94.00	226.00	2,096.00
Age	18,310	22.36	17.37	1.00	3.00	6.00	17.00	41.00	47.00	54.00
CET 1/RWA	16,902	0.12	0.11	0.01	0.06	0.09	0.10	0.13	0.18	0.43
Tier 1 Capital/RWA	18,310	0.12	0.11	0.01	0.07	0.09	0.11	0.13	0.18	0.45
Equity/RWA	18,310	0.14	0.11	0.03	0.08	0.10	0.12	0.14	0.20	0.46
TCE/assets	18,310	0.09	0.05	0.01	0.05	0.07	0.08	0.10	0.13	0.29
Equity/assets	18,310	0.09	0.06	0.01	0.05	0.07	0.09	0.10	0.13	0.31
Net income/assets	18,310	-0.00	0.02	-0.07	-0.02	-0.00	0.00	0.01	0.01	0.02
Liquid assets/assets	18,310	0.19	0.12	0.02	0.06	0.11	0.17	0.25	0.37	0.61
Deposits/loans	18,310	0.83	0.11	0.40	0.72	0.80	0.85	0.89	0.92	0.97
Time deposits/assets	18,310	0.47	0.16	0.03	0.26	0.36	0.47	0.58	0.67	0.82
Compensation/empl.	18,301	38,017.47	24,779.59	7,689.19	13,052.17	19,783.78	33,888.89	50,035.71	66,214.29	116308.52

Notes: This table reports summary statistics for the bank-level data based the FFIEC Call Report.

Table B.4: *Balance Test: Bank Characteristics by Expected Exam Lead Early in GFC*

	Expect State		Expect Federal		Difference	
	Mean	Std	Mean	Std	Diff	t-stat
CAMELS Rating	1.575	0.495	1.581	0.494	0.006	0.346
Size (Assets, in log)	18.705	1.227	18.762	1.147	0.057	1.440
Equity/Assets	0.111	0.058	0.110	0.051	-0.002	-1.023
Net income/Assets	0.010	0.015	0.009	0.013	-0.000	-1.070
Deposits/Assets	0.817	0.091	0.814	0.089	-0.003	-1.058
Time Deposits/Assets	0.393	0.123	0.390	0.115	-0.003	-0.873
Wholesale Funding/Assets	0.046	0.058	0.054	0.098	0.008	0.862
Loans/Assets	0.655	0.163	0.662	0.160	0.007	1.248
NPL/Loans	0.012	0.013	0.012	0.012	0.000	0.501

This table reports selected observable characteristics as of 2007Q4 across bank that were expected to receive either a state or a federal-led exam early in the GFC. Standard errors are clustered at the bank level.

Table B.5: *Effect of Supervisory Strictness on CAMELS and the Number and Length of On-site Examinations during the GFC: OLS*

Dependent variable	CAMELS	Prob of CAMELS≥3	No. of FRS/FDIC exam	No. of exams	Length of exams
	(1)	(2)	(3)	(4)	(5)
High supervisory strictness	0.24***	0.090***	0.84***	0.54***	3.26***
	(0.023)	(0.0094)	(0.059)	(0.064)	(0.96)
Observations	3604	3604	3604	3604	3575
Mean dep. var	2.05	0.21	2.88	4.59	49.0
R^2	0.37	0.29	0.29	0.23	0.31
State FE	✓	✓	✓	✓	✓
Baseline Controls	✓	✓	✓	✓	✓

Notes: This table reports results from estimating (3). The outcome, y_b, is either the bank's average CAMELS rating, the probability of being rated with a 3 or higher, the number of total exams, the number of exams led by a federal agency (FDIC or FRS), or the length of the average exam (in days) from 2008q3 through 2013q4. High supervisory strictness$_b$ is a dummy that indicates whether bank b was subject to at least one exam led by a federal agency in the early phase of the GFC, defined as the 18 months following the failure of Lehman Brothers. We provide both OLS and 2SLS estimates. The sample is restricted to state-member banks and non-member banks that are supervised by either the Federal Reserve, the FDIC, or state regulatory agencies as well as to banks that qualified for the rotating schedule before 2008q3. Baseline controls are a bank's size, equity over assets, time deposits over assets, non-performing loans over total loans, and net income over assets as of 2008q2. Robust standard errors. *,**, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table B.6: *Loss Rates for Uninsured Depositors in Bank Failure*

Era	Number of failures	Share of failures with losses to depositors	Conditional loss rate	Unconditional loss rate
1992-2007	302	0.43	0.24	0.10
2008-2022	536	0.06	0.43	0.03
All	838	0.2	0.28	0.06

Notes: The data are as reported in FDIC (2023). The conditional loss rate is the loss rate for failures involving a loss for uninsured depositors.

Table B.7: *Costs for the FDIC Insurance Fund and Speed of Failure*

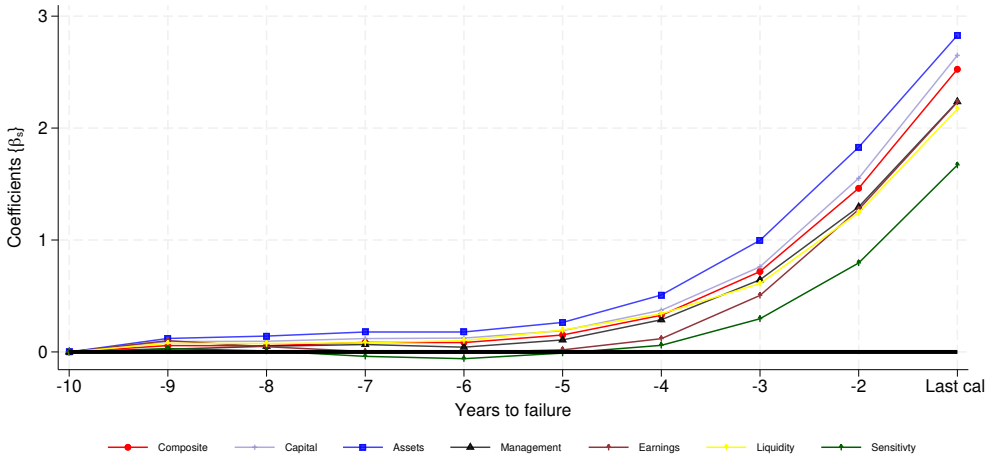
Dependent variable	DIF costs/assets			
	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)
High supervisory strictness	-0.067**	-0.12**	-0.080**	-0.13**
	(0.031)	(0.052)	(0.032)	(0.053)
Speed of failure	-0.000065**	-0.000073**	-0.000037	-0.000031
	(0.000028)	(0.000028)	(0.00011)	(0.00011)
Observations	116	116	116	116
Mean dep. var	0.22	0.22	0.22	0.22
R^2	0.54	0.19	0.56	0.20
State FE	✓	✓	✓	✓
Baseline Controls	✓	✓	✓	✓
Year of failure FE			✓	✓
First-stage F-stat		16.1		15.7

Notes: This table reports results from estimating (3), where y_b is the cost the FDIC incurred as a share of the failed banks assets at failure. High supervisory strictness$_b$ is a dummy that indicates whether bank b was subject to at least one exam led by a federal agency in the early phase of the GFC, defined as the 18 months following the failure of Lehman Brothers. Speed of failure$_b$ is the number of days elapsed since between the failure of Lehman Brothers and bank b. We provide both OLS and 2SLS estimates. In the 2SLS model, we instrument whether a bank is subject to a federal exam in the early phase of the GFC with whether it was having rotating exams in the four previous exams. The sample is restricted to state-member banks and non-member banks that are supervised by either the Federal Reserve, the FDIC, or state regulatory agencies as well as to banks that qualified for the rotating schedule before September 2008. Baseline controls are a bank's size, equity over assets, time deposits over assets, non-performing loans over total loans, and net income over assets as of 2008q2. Robust standard errors. *,**, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

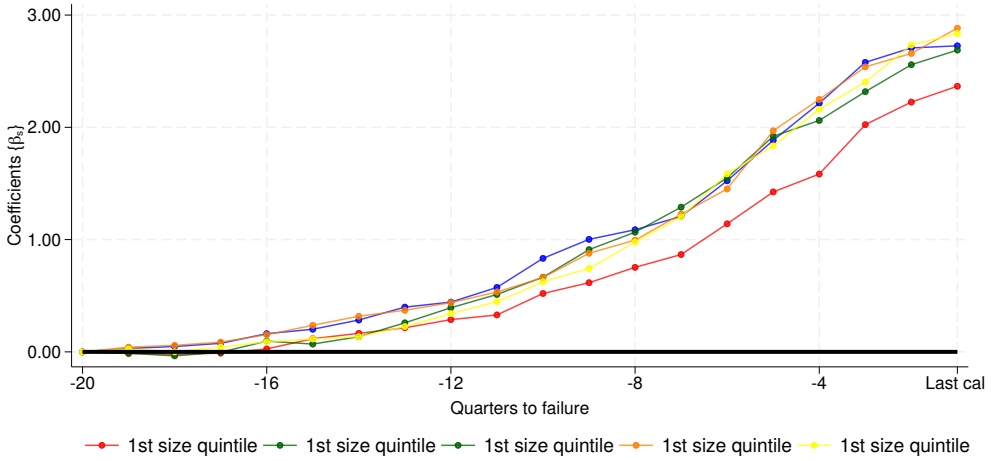
C Additional Figures

Figure C.1: *CAMELS Ratings by Type and Bank Size in Failing Banks: 2000-2023*

(a) *CAMELS in failing banks by rating type*

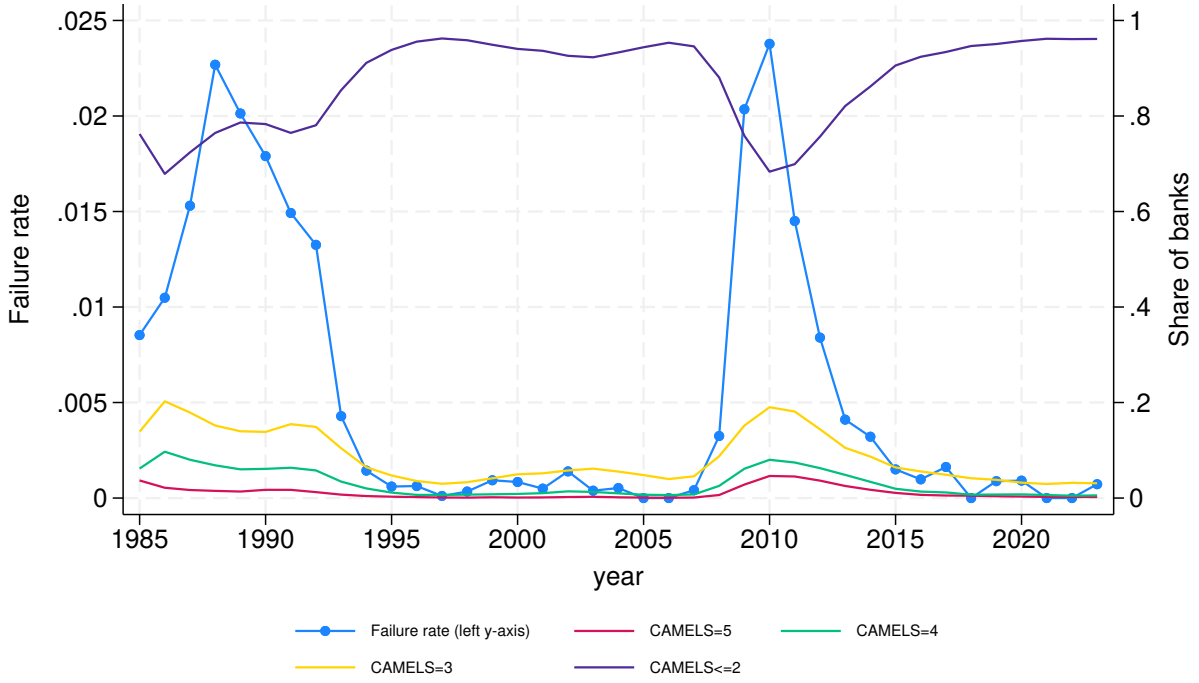


(b) *CAMELS in failing banks by bank size*



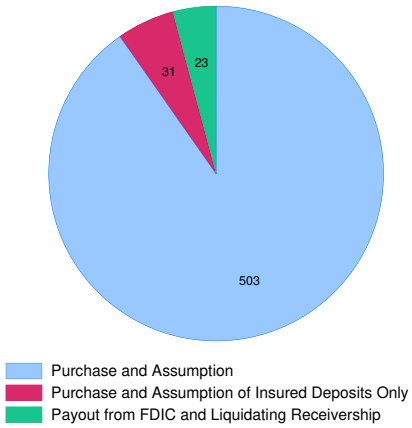
Notes: The figure presents the sequence of coefficients from estimating Equation (1), where the dependent variable is the ratio indicated in the figure legend. The specification includes a set of bank fixed effects. The sample is restricted to failing banks that fail sometime between 2000 and 2023 and includes data for the 5 years before failure.

Figure C.2: *CAMELS Ratings and Bank Failure Rates*



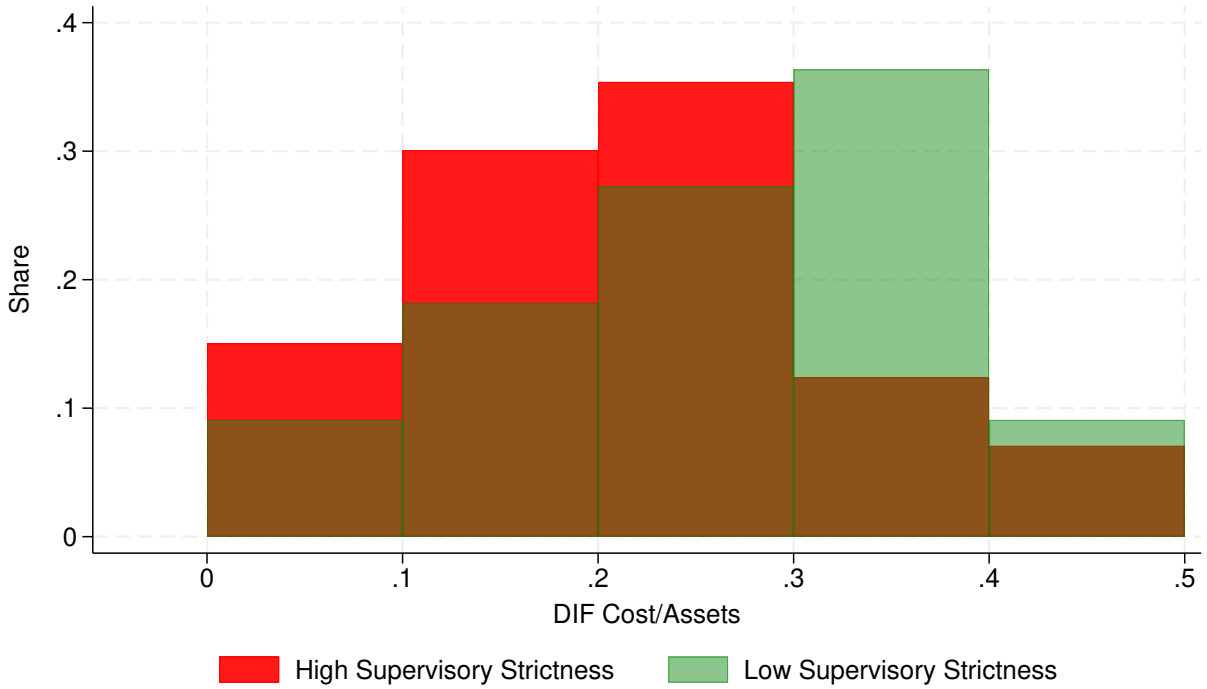
Notes: This figure shows the distribution of CAMELS ratings (right y-axis) and the realized rate of bank failures (left y-axis) from 1985 through 2023.

Figure C.3: *Resolution of Failing Banks by Resolution Type, 2000-2023*



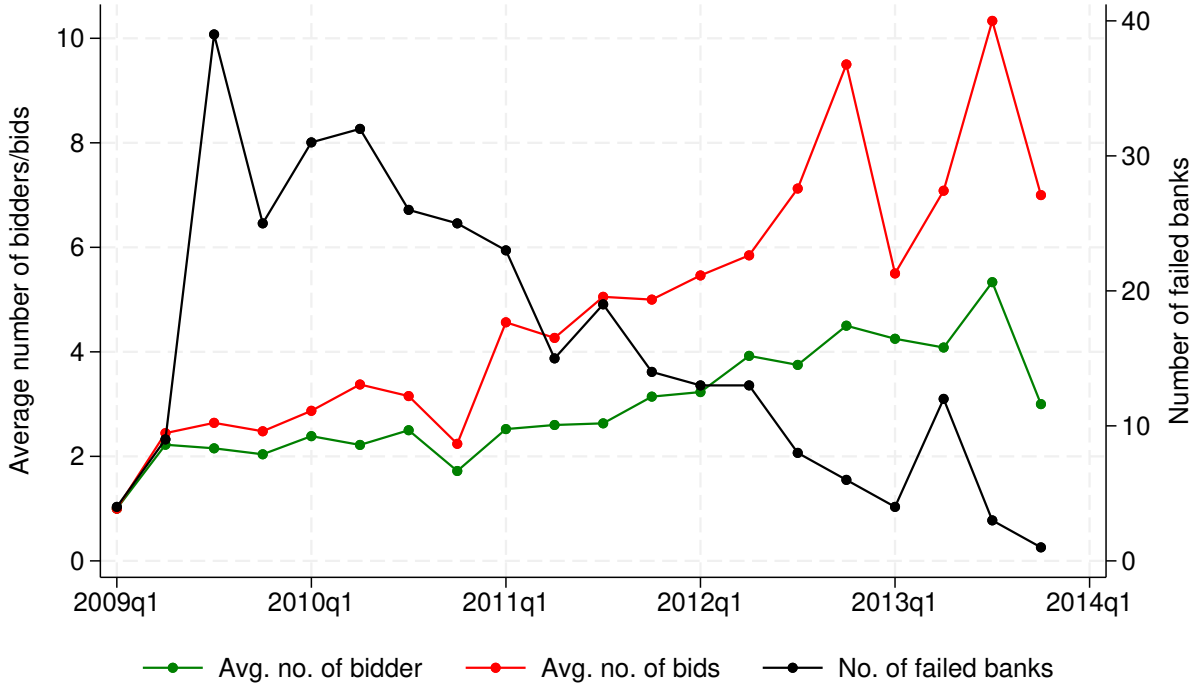
Notes: This figure shows the count of resolution types of FDIC member banks that failed between 2000 and 2023. There are three types of failures. PA: "Purchase and Assumption", where the insured and uninsured deposits, certain other liabilities and a portion of the assets were sold to an acquirer. PI: "Purchase and Assumption of the insured deposits only", where the traditional P&A was modified so that only the insured deposits were assumed by the acquiring institution. And, PO: "Payout", where the insurer paid the depositors directly and placed the assets in a liquidating receivership.

Figure C.4: *Cost of Failure to the FDIC DIF by Supervisory Strictness*



Notes: This figure plots a histogram of the cost of failure to the FDIC DIF for failures during the GFC (measured between 2008q3-2013q4) by whether banks were exogenously exposed to high or low supervisory strictness as the onset of the GFC. The sample is restricted to state-member banks and non-member banks that are supervised by either the Federal Reserve, the FDIC, or state regulatory agencies as well as to banks that qualified for the rotating schedule before September 2008.

Figure C.5: *Number of Bidders on Failed Banks during the GFC*



Notes: This figure plots the number of failed banks, the average number of bidders, and the average number of bids in FDIC failed bank auctions. The data are from Allen et al. (2023a).

D Additional Results

D.1 The Predictive Power of Supervisory Rating for Bank Failure

In this section, we study the predictive power of CAMELS ratings more formally. We consider the predictive power at different predictions horizons and compare it to the predictive power of financial information that can be obtained in publicly available call report.

To more formally understand whether CAMELS captures bank failure risk, we estimate simple predictive regression models of the following form:

$$\text{Failure}_{b,t+1} = \alpha + \sum_{k=1}^{5} \beta_k \times \mathbf{1}[\text{CAMELS}_{b,t} = k] + \Gamma X_{b,t} + \epsilon_{b,t+1}, \tag{A.1}$$

where $\text{Failure}_{b,t+1}$ is an indicator variable equal to one if bank b fails over the next year, and $\mathbf{1}[\text{CAMELS}_{bt} = k]$ is an indicator variable that equals one when bank b has a CAMELS rating of k at time t, with k ranging from 1 through 5. In addition to CAMELS ratings, we include information from banks' publicly available financial statements, $X_{b,t}$. This allows us to compare the predictive power of supervisory ratings with the predictive power of information from financial statements. Specifically, we include income-to-assets to proxy for a bank's risk of insolvency, time deposits-to-assets to proxy for a bank's reliance on relatively expensive noncore funding, and quintiles of bank loan growth to proxy bank credit growth and risk-taking.[2] Finally, we also consider the interaction between the insolvency measure and noncore funding, as well as interactions of all of the variables from financial statements with the CAMELS rating.

To quantify the power of these observables for predicting bank failure, we construct the receiver operating characteristic (ROC) curve. The ROC curve is a standard tool used to evaluate binary classification ability. The ROC curve traces out the true positive rate against the false positive rate as we vary the classification threshold. We then calculate the area under the ROC curve (AUC). An uninformative predictor has an AUC of 0.5, whereas an informative predictor has an AUC of greater than 0.5. The AUC metric is commonly used in the literature on predicting financial crises.[3] Furthermore, we test both in-sample and pseudo-out-of-sample classification performance. The pseudo-out-of-sample AUC is constructed by estimating Equation (A.1) iteratively on an expanding sample and predicting the probability of failure for each bank in the h years after the call report measured at time t, using only data up to year t. In addition to the AUC, in Appendix Table D.12 we also provide the precision-recall curve, an alternative metric

[2] These measures have been shown to predict failure with a high degree of accuracy (Correia et al., 2024). We calculate quintiles of loan growth using the distribution of loan growth up to year t to avoid look-ahead bias.

[3] For reference, the in-sample AUC for predicting financial crises in aggregate data based on credit and asset price growth is typically in the 0.65–0.75 range (see e.g., Schularick and Taylor, 2012; Drehmann and Juselius, 2014; Baron et al., 2021; Greenwood et al., 2022; Müller and Verner, 2024). Correia et al. (2024) further show that the AUC when predicting individual bank failures is around 0.86 for the historical, pre-FDIC U.S. banking system and 0.95 for the contemporary U.S. banking system.

that is well-suited to evaluating classification performance for rare outcomes. The basic findings are robust to this alternative metric.

Before proceeding, we make two remarks on the interpretation of these predictive regressions. First, CAMELS ratings may not anticipate all failures if supervisors can act to avert some failures, for example, by requiring troubled banks to raise equity. Second, we note that the comparison between the predictive performance of CAMELS ratings and metrics from financial statements must be interpreted within the context of a specific equilibrium. In particular, as we show below, supervisors play an important role in auditing and ensuring the accuracy of bank financial statements. Thus, a high predictive performance of financial metrics does not necessarily imply that a similarly strong performance could be obtained in a regime with less supervisory scrutiny, as the quality of financial statements could deteriorate.

Table D.8 shows that CAMELS bank supervisory ratings are highly predictive of bank failure at short horizons. The AUC is 96% at the one-year horizon (see column 1). Figure D.8 plots the ROC curve for predicting failure at the one-year horizon—corresponding to Panel A of Table D.8. A model based on confidential CAMELS ratings can identify around 75% of true positives with less than 1% false positives and close to 90% of true positives with around 5% false positives. This evidence indicates that supervisors typically do anticipate bank failures in this sample.

Previous work has established that bank failures in the contemporary U.S. banking system are substantially predictable based on variables capturing income, capitalization, funding structure, and credit growth (see, e.g., Cole and Gunther, 1998; Wheelock and Wilson, 2000; Cole and White, 2012; Correia et al., 2024). At the one-year horizon, we find that the AUC (both in- and out-of-sample) is slightly higher when using a bank's confidential supervisory rating as the predictor, compared to when using measures of bank solvency and funding vulnerabilities (see columns 2-4). Moreover, interacting measures of bank solvency and funding and the CAMELS rating can improve the AUC further, especially at longer prediction horizons (column 5). These findings suggest that supervisory ratings contain some soft information for predicting failure in the near term that is not yet reflected in financial statements, in addition to capturing the information in public financial statements.[4]

We also consider the ability of CAMELS to predict failures at longer horizons. Panel B in Table D.8 shows that when predicting whether a bank will fail in two to three years, an econometric specification based on bank financial metrics slightly outperforms CAMELS ratings. Moreover, Panel C shows that when predicting failure in four to five years, an econometric specification based solely on bank credit growth outperforms the CAMELS ratings, both in- and out-of-sample. This is consistent with credit growth being a strong leading indicator of bank failures, see Figure D.6, and banking crises (e.g. Schularick and Taylor, 2012; Greenwood et al., 2022; Müller and Verner, 2024). The outperformance of

[4]Note that when we merge CAMELS ratings and Call Report data, we carry ratings forward until an examination leads to a change in a CAMELS rating. This gives rise to the potential concern that because financial data are updated quarterly and supervisory ratings are updated only every 12 months or 18 months, the informational value of CAMELS ratings may be lower outside of examination dates (see, e.g., Cole and Gunther, 1998; Hirtle and Lopez, 1999). In additional unreported regressions, we restrict the sample to examination dates only and find similar levels and differences in the AUC across specifications.

Table D.8: ***Predicting Bank Failures with Supervisory Ratings and Bank Fundamentals***

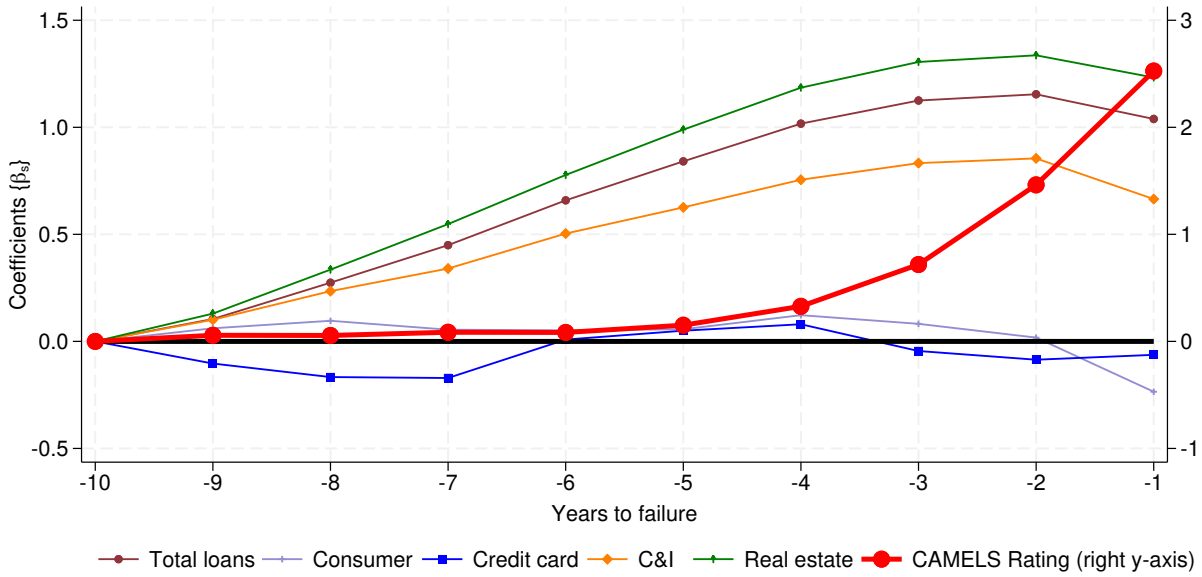
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Failure in $t+1$						
AUC (in-sample)	0.961	0.935	0.767	0.936	0.963	0.936
AUC (out-of-sample)	0.960	0.933	0.722	0.936	0.957	0.929
N	633759	633751	585720	585717	585717	630437
No of Banks	11222	11222	10749	10749	10749	11221
Mean of dep. var.	.29	.29	.29	.29	.29	.29
Panel B: Failure between $t+2$ and $t+3$						
AUC (in-sample)	0.835	0.845	0.743	0.867	0.897	0.844
AUC (out-of-sample)	0.762	0.808	0.671	0.832	0.858	0.801
N	633759	633751	585720	585717	585717	630437
No of Banks	11222	11222	10749	10749	10749	11221
Mean of dep. var.	.59	.59	.55	.55	.55	.58
Panel C: Failure between $t+4$ and $t+5$						
AUC (in-sample)	0.750	0.771	0.781	0.816	0.837	0.770
AUC (out-of-sample)	0.656	0.723	0.738	0.778	0.790	0.724
N	633759	633751	585720	585717	585717	630437
No of Banks	11222	11222	10749	10749	10749	11221
Mean of dep. var.	.55	.55	.5	.5	.5	.55
Specification details						
CAMELS	✓				✓	
Insolvency × Non-core funding		✓		✓	✓	✓
Credit growth			✓	✓	✓	
Insolvency × Non-core funding × CAMELS					✓	
Age controls	✓	✓	✓	✓	✓	✓
Excluding data revisions						✓

Notes: This table reports the area under the receiver operating characteristic curve (AUC) across different specifications and horizons using in-sample and pseudo-out-of-sample classification. The regression coefficients underlying the estimation in columns (1) through (4) are reported in Table D.9 (Panel A), Table D.10 (for Panel B), and Table D.11 (for Panel C) in the Appendix. See Table D.12 below for precision-recall statistics.

financial metrics is even stronger when using a range of balance sheet metrics (column 4 in Panel C). The difference is substantial, with an out-of-sample AUC of 77% for the model based on financial metrics, compared to 66% for the model based on CAMELS. Overall, the evidence indicates that supervisory CAMELS ratings have strong predictability for failures in the near term, but other financial metrics, especially credit growth, contain additional information at longer horizons.

The worse performance of CAMELS relative to credit growth at longer horizons suggests CAMELS does not fully incorporate the medium-run risks associated with rapid

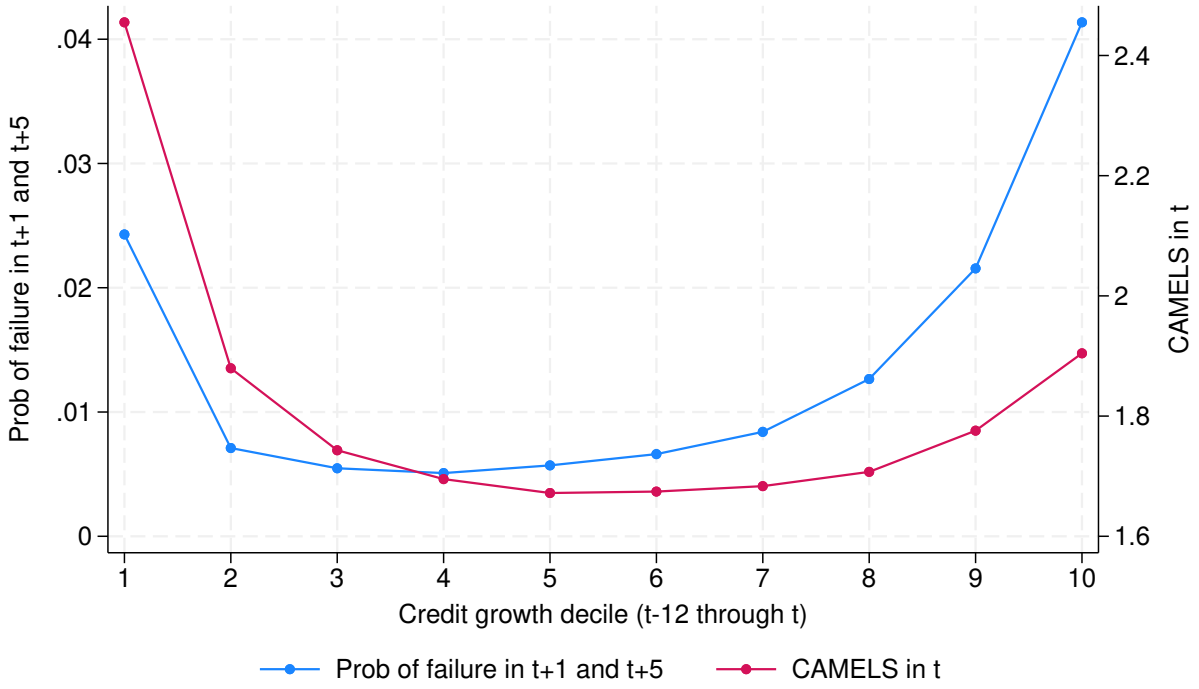
Figure D.6: ***Loan Growth in Failing Banks: 2000-2023***



Notes: The figure presents the sequence of coefficients from estimating Equation (1), where the dependent variable is the log of the type of loan indicated in the figure legend. The specification includes a set of bank fixed effects. The sample is restricted to the 524 failing banks that fail between 2000 and 2023 and includes data for the 5 years before failure.

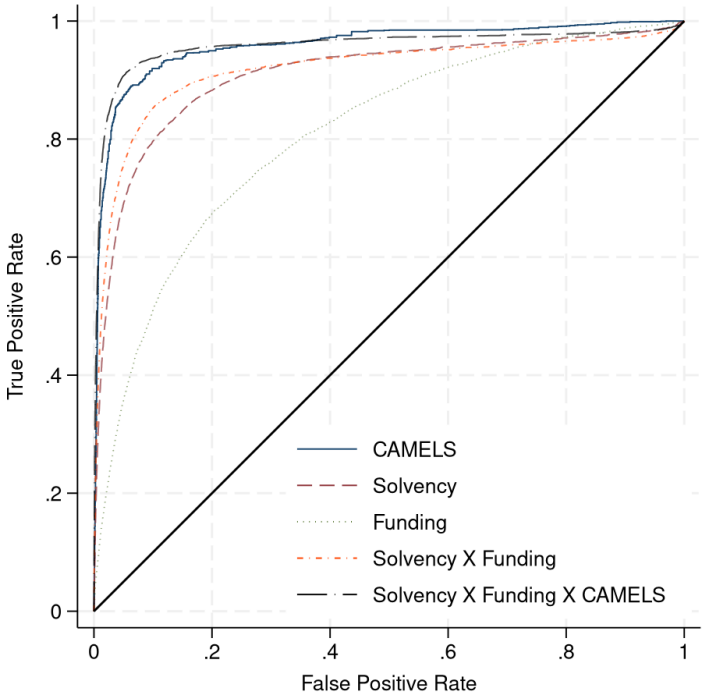
credit growth. In line with this intuition, Figure D.7 shows that, while the probability of failure over the next five years is highest in banks with the fastest loan growth over the past three years, CAMELS ratings only rise slightly across loan growth quintiles. Moreover, Figure C.2 shows that the share of troubled banks with a rating of 3 to 5 remained historically low between 2000 and 2007, during a period of historically rapid credit growth. This evidence indicates that CAMELS ratings have historically not reflected the risk of rapid loan growth for medium-term failure. This may be because supervisors neglect downside risks, much like bank investors (Baron and Xiong, 2017; Fahlenbrach et al., 2018). At the same time, it may also reflect incentive problems. Supervisors may face the challenge that type I errors based on loan growth (i.e., restricting strong banks with sound businesses from growing) are particularly economically and politically costly.

Figure D.7: *Three-Year Credit Growth, Probability of Failure, and CAMELS*



Notes: This figure plots the probability of failure over the next five years (left y-axis) and CAMELS this year (right y-axis) across deciles of loan growth over the past 12 quarters (three-years). Data are from 2000 onwards.

Figure D.8: *ROC Curves for Predicting Bank Failure: 2000-2023*



Notes: This figure plots the receiver operating characteristic (ROC) curve for the estimates based on columns (1) through (4) in Table D.8 Panel C.

Table D.9: ***Predicting Bank Failures: 2000-2023***

Horizon h	Fail within next year			
	(1)	(2)	(3)	(4)
Regulatory Rating:				
- CAMELS = 2	0.00			
	(0.00)			
- CAMELS = 3	0.21**			
	(0.00)			
- CAMELS = 4	2.02***			
	(0.01)			
- CAMELS = 5	19.26***			
	(0.03)			
Solvency:				
- Net Income/Assets		9.23***		35.16***
		(0.02)		(0.07)
Funding:				
- Time Deposits/Deposits		4.04***		4.73***
		(0.01)		(0.01)
- NI/Assets × TD/Dep.		-222.29***		-289.79***
		(0.31)		(0.42)
Credit Growth:				
- Q1 of credit growth from t-3 to t			0.57***	0.18***
			(0.00)	(0.00)
- Q2 of credit growth from t-3 to t			0.01	-0.04***
			(0.00)	(0.00)
- Q4 of credit growth from t-3 to t			-0.01	0.01
			(0.00)	(0.00)
- Q5 of credit growth from t-3 to t			-0.05	-0.02
			(0.00)	(0.00)
N	633759	633751	585720	585717
No of Banks	11222	11222	10749	10749
Mean of dep. var.	.29	.29	.29	.29

Notes: This table presents OLS estimates of (A.1) with failure within the next year as the dependent variables for the 2000-2023 sample. In addition to the reported predictor variables, we also include the log of a bank's age. Standard errors in parentheses are clustered at the bank level; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.10: ***Predicting Bank Failures: 2000-2023***

Horizon h	Fail within next three years			
	(1)	(2)	(3)	(4)
Regulatory Rating:				
- CAMELS = 2	0.23**			
	(0.00)			
- CAMELS = 3	1.11***			
	(0.00)			
- CAMELS = 4	4.42***			
	(0.01)			
- CAMELS = 5	10.78***			
	(0.01)			
Solvency:				
- Net Income/Assets		5.11***		15.25***
		(0.01)		(0.02)
Funding:		ref.		ref.
- Time Deposits/Deposits		5.05***		5.07***
		(0.01)		(0.01)
- NI/Assets $\times$ TD/Dep.		-146.55***		-174.39***
		(0.18)		(0.19)
Credit Growth:				
- Q1 of credit growth from t-3 to t			0.27***	0.01
			(0.00)	(0.00)
- Q2 of credit growth from t-3 to t			-0.02	-0.06***
			(0.00)	(0.00)
- Q4 of credit growth from t-3 to t			0.08*	0.09**
			(0.00)	(0.00)
- Q5 of credit growth from t-3 to t			0.72***	0.73***
			(0.00)	(0.00)
N	633759	633751	585720	585717
No of Banks	11222	11222	10749	10749
Mean of dep. var.	.59	.59	.55	.55

Notes: This table presents OLS estimates of (A.1) with failure between $t+1$ and $t+3$ as the dependent variables for the 2000-2023 sample. In addition to the reported predictor variables, we also include the log of a bank's age. Standard errors in parentheses are clustered at the bank level; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.11: ***Predicting Bank Failures: 2000-2023***

Horizon h	Fail within next five years			
	(1)	(2)	(3)	(4)
Regulatory Rating:				
- CAMELS = 2	0.36***			
	(0.00)			
- CAMELS = 3	0.49***			
	(0.00)			
- CAMELS = 4	1.12***			
	(0.00)			
- CAMELS = 5	1.50***			
	(0.00)			
Solvency:				
- Net Income/Assets		0.27		1.04
		(0.00)		(0.01)
Funding:				
- Time Deposits/Deposits		2.73***		2.38***
		(0.01)		(0.00)
- NI/Assets $\times$ TD/Dep.		-8.11		-11.15*
		(0.07)		(0.07)
Credit Growth:				
- Q1 of credit growth from t-3 to t			0.01	-0.01
			(0.00)	(0.00)
- Q2 of credit growth from t-3 to t			-0.04*	-0.04**
			(0.00)	(0.00)
- Q4 of credit growth from t-3 to t			0.22***	0.21***
			(0.00)	(0.00)
- Q5 of credit growth from t-3 to t			1.17***	1.16***
			(0.00)	(0.00)
N	633759	633751	585720	585717
No of Banks	11222	11222	10749	10749
Mean of dep. var.	.55	.55	.5	.5

Notes: This table presents OLS estimates of (A.1) with failure between $t+1$ and $t+5$ as the dependent variables for the 2000-2023 sample. In addition to the reported predictor variables, we also include the log of a bank's age. Standard errors in parentheses are clustered at the bank level; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table D.12: ***Predicting Bank Failures with Supervisory Ratings and Bank Fundamentals: Precision Recall***

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Prediction horizon $t+1$						
PR-AUC (in-sample)	0.171	0.180	0.012	0.189	0.348	0.162
PR-AUC (out-of-sample)	0.190	0.171	0.009	0.176	0.324	0.155
Mean of dep. var.	0.003	0.003	0.003	0.003	0.003	0.003
Ratio (in-sample)	58.902	61.913	4.006	64.889	119.404	56.667
Ratio (out-of-sample)	50.678	45.739	2.434	46.888	86.383	41.911
Precision at 10% recall (in-smp.)	0.220	0.349	0.021	0.373	0.562	0.320
Precision at 10% recall (o.o.s.)	0.276	0.292	0.013	0.295	0.503	0.280
Panel B: Prediction horizon $t+2 \to t+3$						
PR-AUC (in-sample)	0.057	0.068	0.015	0.073	0.086	0.057
PR-AUC (out-of-sample)	0.051	0.055	0.012	0.058	0.071	0.045
Mean of dep. var.	0.006	0.006	0.006	0.006	0.006	0.006
Ratio (in-sample)	9.627	11.535	2.661	13.233	15.555	9.716
Ratio (out-of-sample)	6.557	7.166	1.732	8.111	9.880	5.914
Precision at 10% recall (in-smp.)	0.114	0.142	0.020	0.142	0.166	0.108
Precision at 10% recall (o.o.s.)	0.084	0.107	0.015	0.115	0.125	0.086
Panel C: Prediction horizon $t+4 \to t+5$						
PR-AUC (in-sample)	0.015	0.020	0.017	0.025	0.027	0.020
PR-AUC (out-of-sample)	0.012	0.015	0.014	0.019	0.019	0.015
Mean of dep. var.	0.006	0.006	0.005	0.005	0.005	0.006
Ratio (in-sample)	2.629	3.631	3.438	5.011	5.352	3.656
Ratio (out-of-sample)	1.803	2.299	2.388	3.098	3.195	2.301
Precision at 10% recall (in-smp.)	0.020	0.037	0.022	0.042	0.046	0.039
Precision at 10% recall (o.o.s.)	0.018	0.020	0.017	0.022	0.024	0.020
Specification details						
CAMELS	✓				✓	
Insolvency × Non-core funding		✓		✓	✓	✓
Credit growth			✓	✓	✓	
Insolvency × Non-core funding × CAMELS					✓	
Age controls	✓	✓	✓	✓	✓	✓
Excluding data revisions						✓

Notes: This table reports the area under the precision-recall curve (PR-AUC) across different specifications and horizons using in-sample and pseudo-out-of-sample classification. The regression coefficients underlying the estimation of column (1) through (4) are reported in Table D.11 (for Panel A), Table D.10 (Panel B), and Table D.9 (Panel C) in the Appendix.

D.2 Capitalization and Enforcement Action

In this section, we discuss additional insights on the role of banking capitalization and enforcement actions. We first discuss the importance of a bank being undercapitalized in a legal sense for enforcement actions and show how the timing of undercapitalization can explain the absence of enforcement actions in some failing banks. Second, we show how the shaping of financial statements by supervisors matters for making enforcement actions legally permissible.

Timing of Enforcement and Capitalization To illustrate the importance of banking capitalizaton for enforcement actions, we estimate the following regression:

$$\text{Enforcement}_{bt} = \text{Capitalization}_{bt-1} + \epsilon_{bt},$$

where Enforcement_{bt} is a dummy indicating whether bank b was subject to a form of public enforcement at time t, and $\text{Capitalization}_{bt-1}$ is dummy indicating whether bank b is "well capitalized," "adequately capitalized," or "undercapitalized" and, if undercapitalized, whether it is "significantly" or "critically" undercapitalized.[5]

We find that a key determinant of enforcement action is a bank's capitalization. Table D.13 shows results from regressing a dummy whether bank is subject to enforcement action in a given quarter on its capitalization in the previous quarter. We find that the probability of being subject to enforcement action monotonically increases in a bank's capitalization. But this monotonicity masks some underlying heterogeneity. For instance, while the unconditional probability of being subject to PCA in any given quarter is only 0.3% and only modestly higher for in adequately banks compared to well capitalized banks, we find that significantly undercapitalized have a 6 percentage points and critically undercapitalized a 10 percentage point and this a much higher chance of being subject to PCA enforcement. Cease and Desist order or written agreement, in turn, are most common in adequately but not well or undercapitalized banks. The patterns suggest that supervisors first resort to relatively mild forms of enforcement action as a banks capitalization erodes but start to take more drastic action as default becomes a material risk. Figure D.11 below confirms this pattern when considering enforcement actions by CAMELS ratings.

While capitalization is a good candidate to explain whether enforcement action takes place or not, the timing and extend of a bank's decline in capitalization is also important. We find that failing banks tend to cross the legal thresholds that trigger drastic enforcement action such as PCA relatively late and close to the failure date. Figure D.9 plots results from estimating Equation (1) on a bank's capitalization. Figure D.9 reveals that failing banks become undercapitalized to an extent that requires formal legal action by supervisors only in the months right before failure. This short interval leaves little time for enforcement action to be formalized. For instance, Table D.14 shows that, on average, only 20% of all failing banks are critically undercapitalized within one year of failure, and only around 57% are critically undercapitalized within one quarter of failure. Thus, one potential explanation for the absence of enforcement action in some

[5]The detailed definitions can be found here.

Table D.13: *Enforcement actions and bank capitalization.*

Dependent Variable	Combined	PCA	Cease and Desist	Written	Informal
	(1)	(2)	(3)	(4)	(5)
Constant	0.67***	0.0015	0.27***	0.15***	0.22***
	(0.0034)	(0.0012)	(0.0028)	(0.0013)	(0.0010)
Adequately Capitalized	2.62***	0.13***	2.47***	0.25**	-0.15*
	(0.26)	(0.048)	(0.22)	(0.100)	(0.080)
Significantly Undercapitalized	5.09***	6.24***	-0.33	-0.40***	0.074
	(1.89)	(1.61)	(0.89)	(0.099)	(0.43)
Critically Undercapitalized	9.54***	10.0***	1.59	-0.22	-0.40***
	(2.01)	(1.71)	(1.22)	(0.35)	(0.088)
Observations	585553	585553	585553	585553	585553
Mean dep. var	0.74	0.029	0.32	0.16	0.22
R^2	0.045	0.093	0.035	0.032	0.042
Bank FE	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓

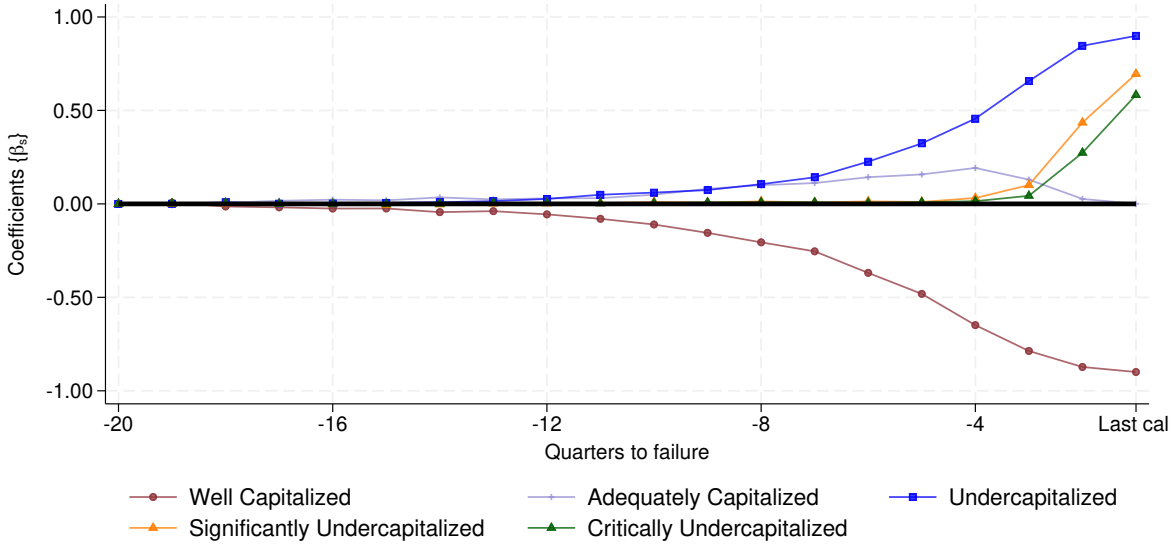
Notes: This table reports results from estimating a model of the following form:

$$\text{Enforcement}_{bt} = \text{Capitalization}_{bt-1} + \epsilon_{bt},$$

where Enforcement_{bt} is a dummy indicating whether bank b was subject to a form of public enforcement at time t, and $\text{Capitalization}_{bt-1}$ is dummy indicating whether bank b is well (coefficient omitted), adequately, under or significantly undercapitalized. Robust standard errors. *,**, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

failing banks, especially the most drastic forms of enforcement, is that failing banks, even as their solvency deteriorates for many years before failure, only become substantially undercapitalized right before failure, leaving little time for formal enforcement action.

Figure D.9: ***Capitalization in Failing Banks***



Notes: This figure plots the set of coefficients $\{\beta_t\}$ from estimating Equation (1) when using a dummy variable indicating whether a bank is well-, adequately-, or undercapitalized; and if undercapitalized whether it's significantly or critically undercapitalized.

Table D.14: *Bank Capitalization Before Failure.*

Well Capitalized	Adequately Capitalized	Undercapitalized		
		Total	Significantly	Critically
A. All banks				
0.98	0.01	0.01	0.00	0.00
B. Failing banks (within 5 years of failure)				
0.70	0.09	0.21	0.06	0.04
C. Failing banks (within 1 year of failure)				
0.17	0.12	0.71	0.29	0.21
D. Failing banks (within 1 quarter of failure)				
0.06	0.03	0.90	0.69	0.58

Notes: This table reports the share of banks by capitalization, distinguishing by whether a bank is well, adequately, or under-capitalized; and if under-capitalized whether its significantly or critically under-capitalized.

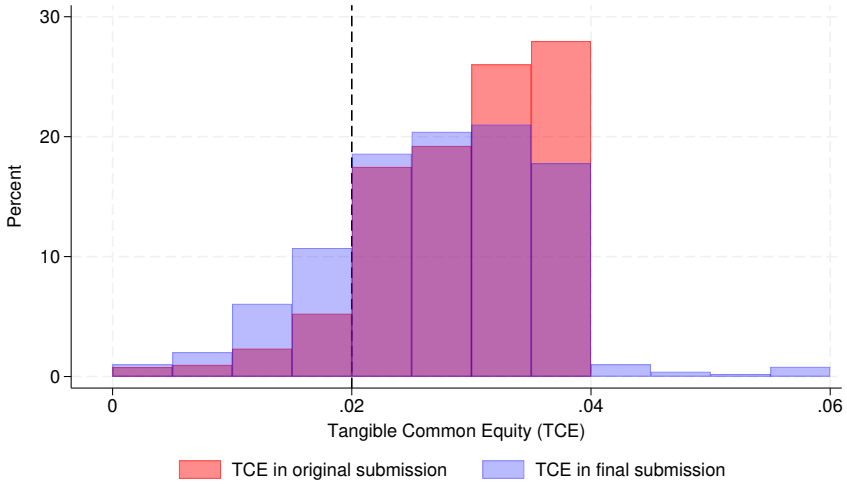
Call Report Revisions and Enforcement Actions Enforcement action is often formalized only when a bank is classified as either significantly or critically undercapitalized. This implies a potential interaction between supervisory audits—which require banks to restate their previously submitted financial statements—and legal supervisory intervention.

One way to understand the role of audits in helping pave the way for enforcement action is to study revisions around regulatory capital cutoffs that trigger drastic enforcement actions. For instance, a primary supervisor refers a bank to the FDIC, which in turn prepares a bank resolution when a bank becomes critically undercapitalized—that is, when its tangible common equity (TCE) falls short of 2% (see, e.g., Ivanov and Karolyi, 2023).[6]

To shed light on whether banks actively try to avoid crossing the cutoff that triggers this resolution process, Figure D.10 plots the distribution of TCE in banks with TCE less than 4% both before and after a resubmission of their Call Report during which income and equity to assets were restated. The figure suggests that there is a clear shift in banks' TCE moving below the 2 percent cutoff after resubmission. This shift of mass of banks with a TCE above 2% to banks with a TCE under 2% is in line with some banks taking advantage of their discretion in reporting financial statements, which allows them to maintain an official TCE ratio of above 2% and thus avoid triggering drastic action by the FDIC. However, following a supervisory on-site exam, some of these banks then report a TCE that crosses the threshold whereby the bank is referred to the FDIC. Thus, there is evidence of an interaction between the auditing function and enforcement function of supervisors, with on-site examinations leading to changes in banks' financial statements that pave the way for public enforcement action and resolution.

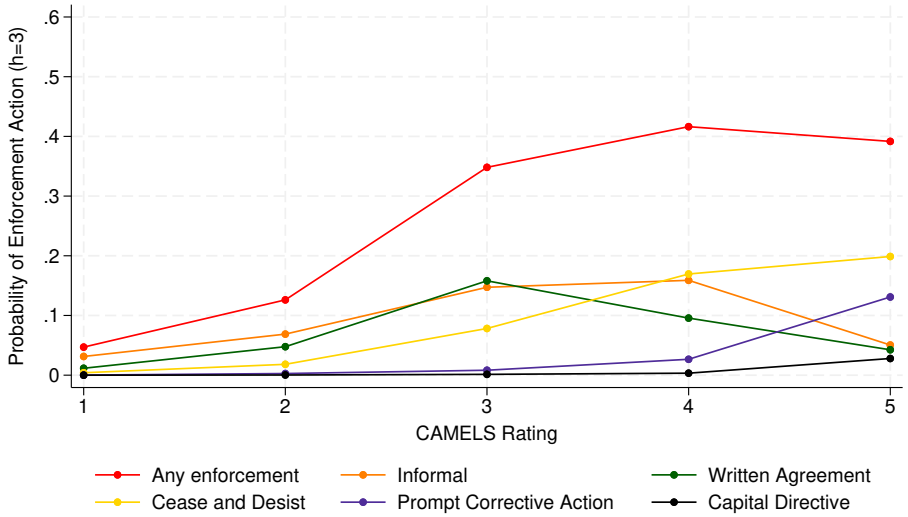
[6]See also the FDIC's resolution handbook.

Figure D.10: *Call Report Revisions around the Prompt Corrective Action Cutoff*



Notes: This figure plots the distribution of Tangible Common Equity (TCE) as reported in both the first submitted and the final Call Report, conditional on a bank having TCE below 4% and conditional on the bank subsequently revising its original submission. The vertical line indicates the 2% cutoff at which a bank becomes formally "critically under-capitalized" and PCA is triggered.

Figure D.11: *CAMELS Ratings and Enforcement Actions*



Notes: This figure plots the probability of enforcement actions from t to $t+4$ by CAMELS rating in t.