

# INTERNAL LOAN RATINGS, SUPERVISION, AND PROCYCLICAL LEVERAGE\*

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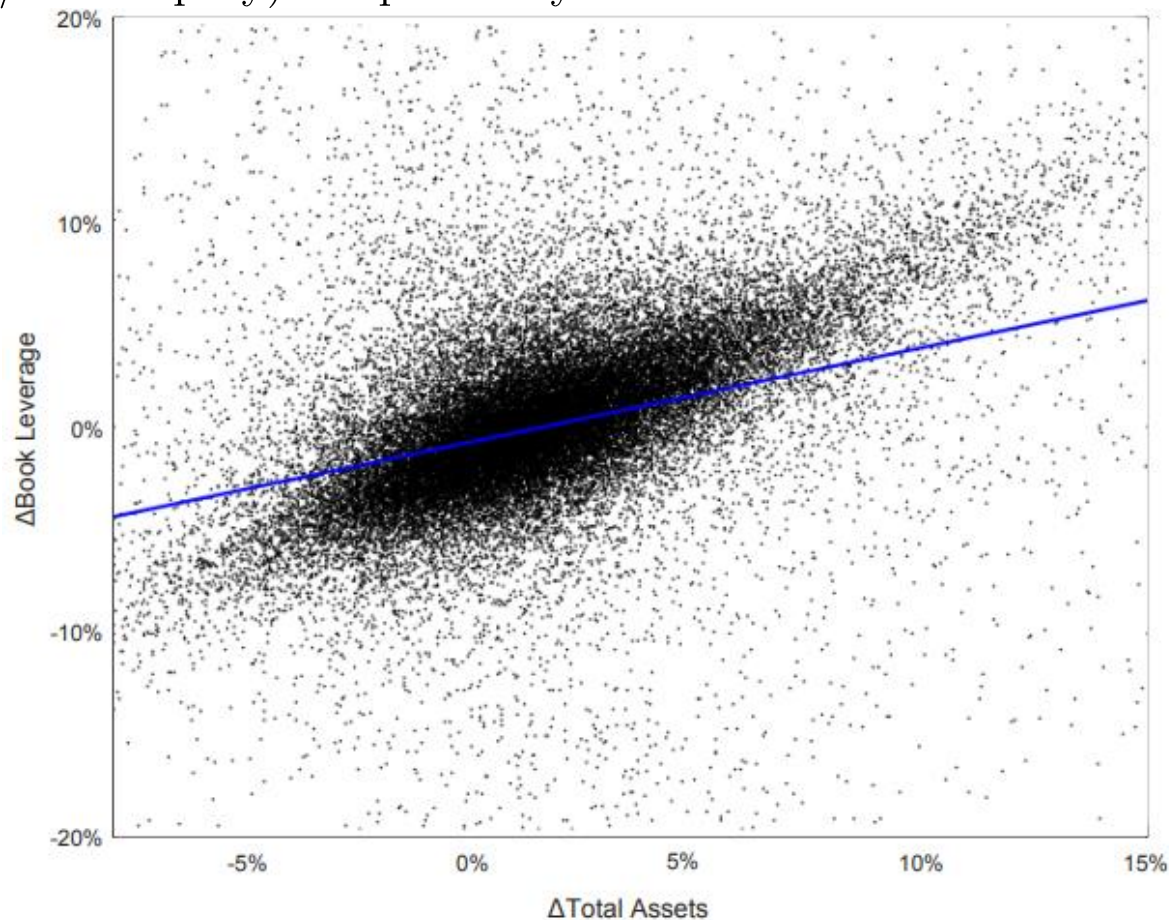
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# LEVERAGE & FINANCIAL STABILITY

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- ▶ Bank leverage is procyclical – Adrian & Shin '10, '14, Laux & Rauter '17
  - ▶ GDP growth or bank book asset growth and changes in book leverage (i.e., assets/book equity) are positively associated



# LEVERAGE & FINANCIAL STABILITY

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- ▶ If banks did not adjust their balance sheets to changes in net worth, then leverage would fall when assets rise
- ▶ If more  $NPV > 0$  projects exist in strong economic conditions, then total credit should increase in booms and decrease in busts
- ▶ Is bank leverage *excessively* procyclical?
  - ▶ **Key question:** are banks' leverage adjustments larger than justified by economic conditions?
  - ▶ If procyclical leverage adjustments create feedback to credit and asset prices, then leverage adjustments **amplify** business cycles
- ▶ Basel II guides banks to assess risk weights and loan loss provisions, which affect equity capital, with internal risk ratings
  - ▶ For profit and regulatory capital, banks have incentive to inflate internal loan ratings — Plosser & Santos '18, Gopalan, Gopalan, & Koharki '19
  - ▶ When loan performance deteriorates, banks with inflated ratings must reconcile the ex ante leniency of risk assessments *and* declining economic values

# THIS PAPER

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1. Do banks systematically inflate loan ratings?
    - ▶ Apply simple structural Markov model of ratings transitions to build intuition for “ratings inflation” and estimate average drift
    - ▶ Analyze ratings inflation conditional on observable information known to banks at the time of origination
  
  2. Can supervision mitigate ratings inflation and its consequences?
    - ▶ Use mixed randomized-targeted structure of SNC Program loan-level exams to estimate ATE of supervision on ratings inflation and explore external validity
    - ▶ Analyze spillover effects of supervision (i.e., “learning”) within banks’ portfolios
    - ▶ Estimate counterfactual contributions to book equity of loan loss reserves to quantify impact of ratings inflation on bank leverage
- **Ratings inflation is common, mitigated by supervision, and contributes to the procyclicality of bank leverage**

# RATINGS INFLATION

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- ▶ Consider a Markov model with two states, pass (0) and non-pass (1), with unconditional probabilities of  $p_0$  and  $p_1$ , respectively
- ▶ In steady state, the unconditional probabilities are constant

$$\begin{pmatrix} p_0 \\ p_1 \end{pmatrix} = \begin{pmatrix} p_0 \\ p_1 \end{pmatrix} \begin{pmatrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{pmatrix}$$

- ▶ A linear regression representation of a Markov transition model has the following form,

$$R_{i,t} = \alpha + \beta R_{i,t-1} + \epsilon_{i,t}.$$

where state probabilities map to regression coefficients:

$$\begin{pmatrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{pmatrix} = \begin{pmatrix} 1 - \alpha & \alpha \\ 1 - \alpha - \beta & \alpha + \beta \end{pmatrix} \quad \begin{pmatrix} p_0 \\ p_1 \end{pmatrix} = \begin{pmatrix} \frac{1 - \alpha - \beta}{1 - \beta} \\ \frac{\alpha}{1 - \beta} \end{pmatrix}$$

# RATINGS INFLATION

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- ▶ Similarly, the unconditional expected change in ratings can also be represented as a linear regression
- ▶ Changes in ratings are given by a drift term,  $\gamma$ , plus noise,  $\epsilon$ :

$$R_{i,t} - R_{i,t-1} = \gamma + \epsilon_{i,t}$$

- ▶ The unconditional expected rating,  $R_{i,t}$ , is:

$$E[R_{i,t}] = \frac{\alpha}{1 - \beta}$$

- ▶ So, the unconditional expected change in ratings is zero:

$$E[R_{i,t}] - E[R_{i,t-1}] = \frac{\alpha}{1 - \beta} - \frac{\alpha}{1 - \beta} = 0$$

$$\gamma = 0$$

# RATINGS INFLATION

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▶ Key model insights:

1. The unconditional expected change in ratings, or “drift” ( $\gamma$ ), is zero
  - Non-zero drift in linear regression implies initial ratings that were too high (inflated) or too low (deflated)
    - ▶ e.g., estimating positive unconditional drift indicates that initial ratings were, on average, too lenient (i.e., more passes than would be expected)
2. As shown in the paper, the same is true of expected changes in ratings conditional on characteristics of loan  $i$  in the long run
  - Characteristics observable at origination should **not** predict drift
    - ▶ e.g., if information available to the lender predicts drift, then lenders are not incorporating information used in screening and pricing loans into ratings

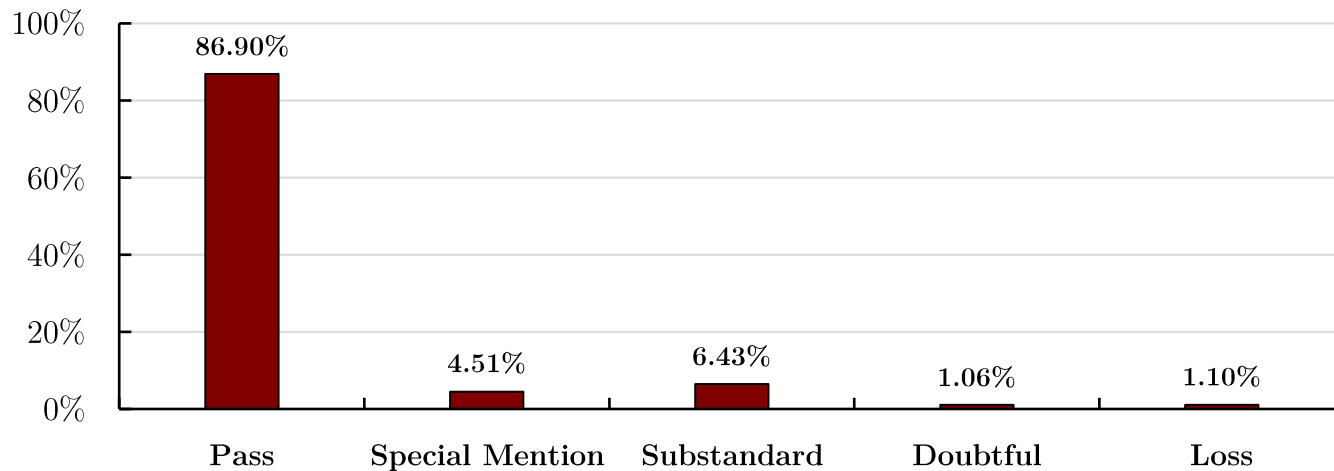
# DATA SOURCES

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- ▶ Shared National Credit Detailed Database
  - ▶ Confidential information about commercial credits >\$20M and held by >2 unaffiliated supervised institutions
  - ▶ Internal loan ratings, examination schedules, supervisory ratings, loan characteristics, banks' loan shares, etc.
- ▶ Loan Pricing Corporation's DealScan Database
  - ▶ Match to SNC at facility level for other terms (e.g., all-in-drawn spread)
- ▶ COMPUSTAT/CRSP
  - ▶ Stock prices and financial statement data (e.g., EBITDA/Total Assets)
- ▶ FFIEC 031 and 041 Regulatory Filings (Call Reports)
  - ▶ Bank-level balance sheet and income statement data (e.g., loan growth)



# RATINGS INFLATION



Rating	Category	Description	
1	Pass	In good standing	
2	Special Mention	Potential weaknesses that deserve management's close attention	
Classified	3	Substandard	Inadequately protected by obligor paying capacity or collateral pledged
	4	Doubtful	Collection in full, based on available information, is improbable
	5	Loss	Uncollectible; continuance as bankable commitment is not warranted

# RATINGS INFLATION

Fixed Effects	Coef. (drift)	Time	Agent	Sector	Obligor	Time- Agent	Time- Agent- Sector	Adj. R <sup>2</sup>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time	0.069***	158.88 0.000						0.024
Time + Agent	0.069***	132.96 0.000	4.15 0.000					0.035
Time + Agent + Sector	0.069***	132.70 0.000	4.11 0.000	22.01 0.000				0.036
Time + Agent + Obligor	0.067***	70.45 0.000	1.82 0.000		2.55 0.000			0.176
Time-Agent + Obligor	0.067***				2.56 0.000	3.09 0.000		0.204
Time-Agent-Sector + Obligor	0.068***				2.62 0.000		2.91 0.000	0.257

## ► Notes:

- More variation explained by time and obligor than by agent, consistent with common incentives across banks
- Incremental R<sup>2</sup> jumps significantly for obligor fixed effects and time-agent-sector interactive fixed effects, consistent with lender specialization
- ~0.07 drift when ~14% of loans are below “pass” corresponds to a 50% annual increase in non-pass loans

# RATINGS INFLATION, EXPLAINED

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- ▶ Investigate ratings inflation heterogeneity based on banks' B/S incentives and value-relevant information
  - ▶ Larger exposures translate into larger provisions (i.e., losses) conditional on downgrades
    - ▶ More ratings inflation for commitments with high utilization rates and utilized amounts
  - ▶ Borrower characteristics known at origination and equilibrium contract terms reflect obligor credit quality
    - ▶ Less ratings inflation for larger obligors, obligors with more liquidity, less leverage, high profitability, and lower stock return volatility
    - ▶ More ratings inflation for commitments with high interest rate spreads
- Information used in screening and pricing loans is omitted from ratings, particularly for larger credit exposures

# SNC PROGRAM

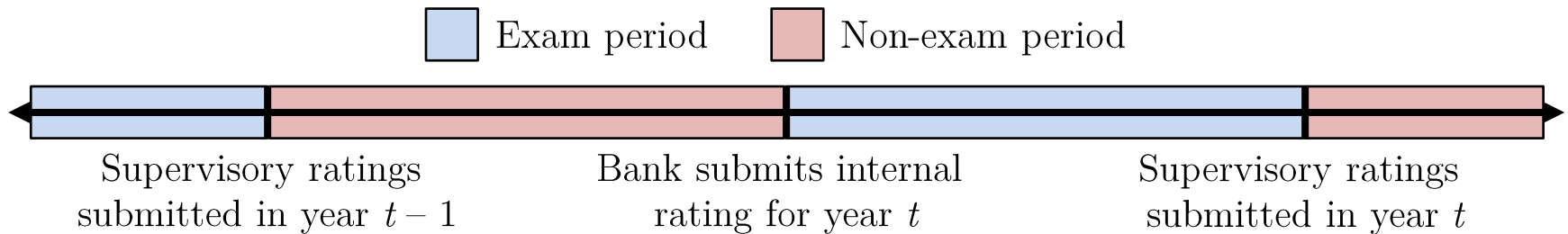
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- ▶ Since 1975, the SNC Program tracks credits large and complex credits shared by multiple regulated financial institutions
  - ▶ Governed jointly by Federal Reserve System, OCC, and FDIC
- ▶ SNC Program implements a mixed randomized-targeted structure for loan-level exams
  - ▶ Credits are categorized into groups (“buckets”) based on their size, previous loan rating, and lender type
  - ▶ Credits are selected at random conditional on their bucket to be examined, or “Read”; sampling probabilities vary by bucket
  - ▶ “Mandatory” reads are selected by the SNC Program Office based on borrower and loan characteristics observed prior to the exam
    - ▶ Comparing ATT from randomized exams to selected “mandatory” exams provides insights concerning external validity
- ▶ We restrict our sample to 2007 – 2015 due to changes in SNC Program implementation and detailed exam data availability
  - ▶ Semi-annual exam scheduling in 2016; eligibility requirements in 2018

# SNC PROGRAM

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- ▶ SNC Program tracks credits over time and contains information on banks' loan shares over the life of the credit



- ▶ SNC exam process:
  - ▶ Banks send loan-level information and internal ratings to supervisors
  - ▶ Loans are selected (targeted or random conditional on observables) for exams, comprising 26.5%–40.9% of SNC loans – Ivanov and Wang '22
  - ▶ Two examiners from different supervisory agencies are assigned to verify the accuracy of bank ratings and collect supporting documents and data
  - ▶ Supervisory ratings are determined through majority vote by assigned examiners (a third examiner from the remaining agency is breaks ties)

# SUPERVISION EFFECTS

	Current Exam Rating – Previous Exam Rating		
	(1)	(2)	(3)
Read	0.046*** (0.001)		0.054*** (0.000)
Mandatory		-0.088** (0.030)	-0.098** (0.016)
Constant	0.110*** (0.000)	0.136*** (0.000)	0.121*** (0.000)
Obs.	34,113	34,113	34,113
R <sup>2</sup>	0.431	0.431	0.432
Fixed Effects	Agent – Bucket – Time		
Clustering	Obligor		

► Notes:

- Exams increase timeliness of internal ratings by ~41% (= 0.046/0.110)
- Mandatory exams associated with significantly less timely internal ratings, consistent with selection criteria (i.e., borrower and loan features)

# FALSIFICATION TEST

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- ▶ For each exam, we observe three ratings:
  - ▶ Prior exam's supervisory rating
  - ▶ Current exam's agent rating
  - ▶ Current exam's supervisory rating } Pre-sampling
- ▶ Random assignment of “Read” implies that pre-sampling ratings changes should not be predicted by future exam status
- ▶ Previous dependent variable:

$$\Delta Rating = Current Exam Rating - Previous Exam Rating$$

- ▶ Decompose into **falsification** and **treatment effect**:

$$\begin{aligned} \Delta Rating = & (Agent Rating - Previous Exam Rating) \\ & + (Current Exam Rating - Agent Rating) \end{aligned}$$

# SUPERVISION EFFECTS

	Agent Rating – Previous Exam Rating		
	(1)	(2)	(3)
Read	-0.001 (0.952)		0.010 (0.385)
Mandatory		-0.150*** (0.030)	-0.152** (0.000)
Constant	0.110*** (0.000)	0.131*** (0.000)	0.128*** (0.000)
Obs.	34,113	34,113	34,113
R <sup>2</sup>	0.438	0.440	0.440
Fixed Effects	Agent – Bucket – Time		
Clustering	Obligor		

► Notes:

- “Read” is not explained by pre-sampling ratings updates
- Mandatory exam selection is associated with significantly less timely internal ratings, consistent with selection criteria



# SUPERVISION EFFECTS

	Current Exam Rating – Agent Rating		
	(1)	(2)	(3)
Read	0.047*** (0.000)		0.043*** (0.000)
Mandatory		0.063*** (0.001)	0.054*** (0.006)
Constant	0.000 (0.989)	0.006* (0.067)	-0.006** (0.040)
Obs.	34,113	34,113	34,113
R <sup>2</sup>	0.274	0.273	0.275
Fixed Effects	Agent – Bucket – Time		
Clustering	Obligor		

► Notes:

- The entire “Read” effect is driven by within-exam ratings updates
- “Mandatory” reads are associated with *more* timely internal ratings, consistent with a treatment effect during the SNC exam period
- No evidence of drift during SNC exam period, suggesting that ratings inflation is driven by banks’ rating submissions, not supervision

# SUPERVISION SPILLOVERS

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- ▶ Causal effect estimates may be biased due to a particular type of SUTVA violation – Berg et al. '21
  - ▶ No interdependencies of causal effects of supervision on ratings inflation
- ▶ We can test this assumption in our setting using the spillovers estimation methodology introduced by Berg et al. '21
  - Allow the effect of treatment on treated and control units to depend on the fraction of treated units

$$\begin{aligned}\Delta Rating_{ibgt} &= \alpha_{b \times g \times t} + \beta_T Read_{ibgt} + \beta_T^{Spill} (Read_{ibgt} \times Read\%_{gt}) \\ &\quad + \beta_C^{Spill} ((1 - Read_{ibgt}) \times Read\%_{gt}) + \epsilon_{ibgt}\end{aligned}$$

- ▶ Examinations may produce new or make salient existing information about risks relevant to a broader set of obligors

# SUPERVISION EFFECTS

	Current Exam Rating – Agent Rating	
	(1)	(2)
Read	0.047*** (0.000)	0.027*** (0.001)
Read×Read%		0.400*** (0.006)
(1 – Read)×Read%		–0.069 (0.422)
Constant	0.000 (0.989)	–0.000 (0.998)
Obs.	34,113	34,113
R <sup>2</sup>	0.274	0.283
Fixed Effects	————— Agent – Bucket – Time —————	
Clustering	————— Obligor —————	

► Notes:

- No evidence of contemporaneous spillover effects on non-examined loans
- Some evidence that intensity of treatment effect scales with fraction of treated units (e.g., learning during exam)

# SUPERVISION EFFECTS

	Future Agent Rating – Current Exam Rating			
	(1)	(2)	(3)	(4)
Read	0.007 (0.673)	0.011 (0.534)		
Read×Read%		0.076 (0.664)		
(1 – Read)×Read%		0.661** (0.024)		
Down			–0.329*** (0.000)	–0.335*** (0.000)
Down×Down%				0.281 (0.421)
(1 – Down)×Down%				–0.192 (0.831)
Constant	0.055*** (0.000)	0.050*** (0.000)	0.066*** (0.000)	0.066*** (0.000)
Obs.	21,078	21,078	21,078	21,078
R <sup>2</sup>	0.244	0.244	0.251	0.251
Fixed Effects	Agent – Bucket – Time			
Clustering	Obligor			

► Notes:

- No evidence of future drift or reversals, on average, but evidence of reversals for downgraded loans
- Some evidence of positive spillovers on non-examined credits, potentially consistent with learning (not driven by downgrades)

# COUNTERFACTUALS

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- ▶ Consider a counterfactual in which loan loss provisioning is fixed across banks and banks have *perfect foresight* for ratings
  - ▶ Perfect foresight: apply loan rating at maturity to all periods
  - ▶ Provision per guidance (20% – substandard, 50% – doubtful, 100% – loss)
- ▶ Calculate provisions under observed and counterfactual ratings:

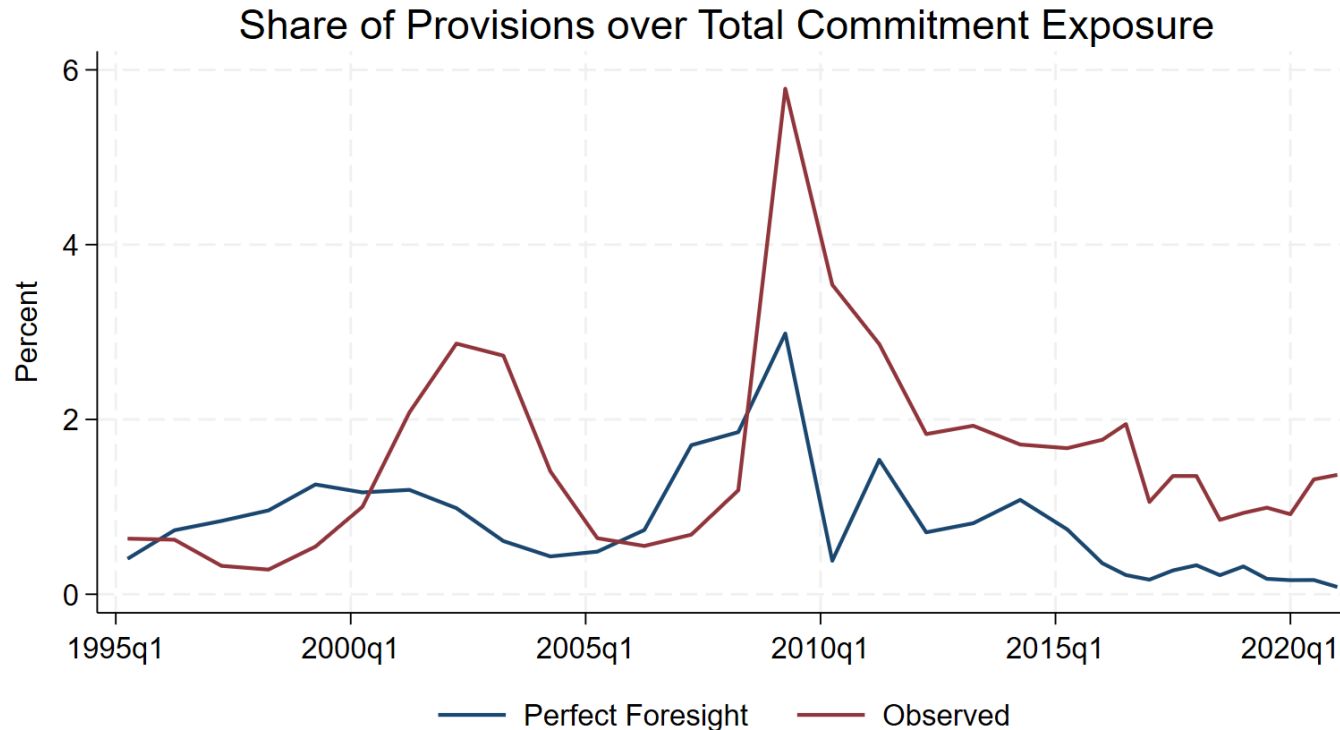
$$Provisions_{bt}^{Observed} = \sum_{i \in B} (r(Rating_{ibt}) \times CommittedAmount_{ibt})$$

$$Provisions_{bt}^{PerfectForesight} = \sum_{i \in B} (r(Rating_{ibT}) \times CommittedAmount_{ibt})$$

- ▶ To quantify, calculate reserves as a share of (lagged) total equity:

$$\frac{Provisions_{b,t}}{Equity_{b,t-1}} = \frac{\left( \frac{Provision_{b,t}^{SNC}}{Commitment_{b,t}^{SNC}} \times Loans_{b,t} \right)}{Equity_{b,t-1}}$$

# COUNTERFACTUALS

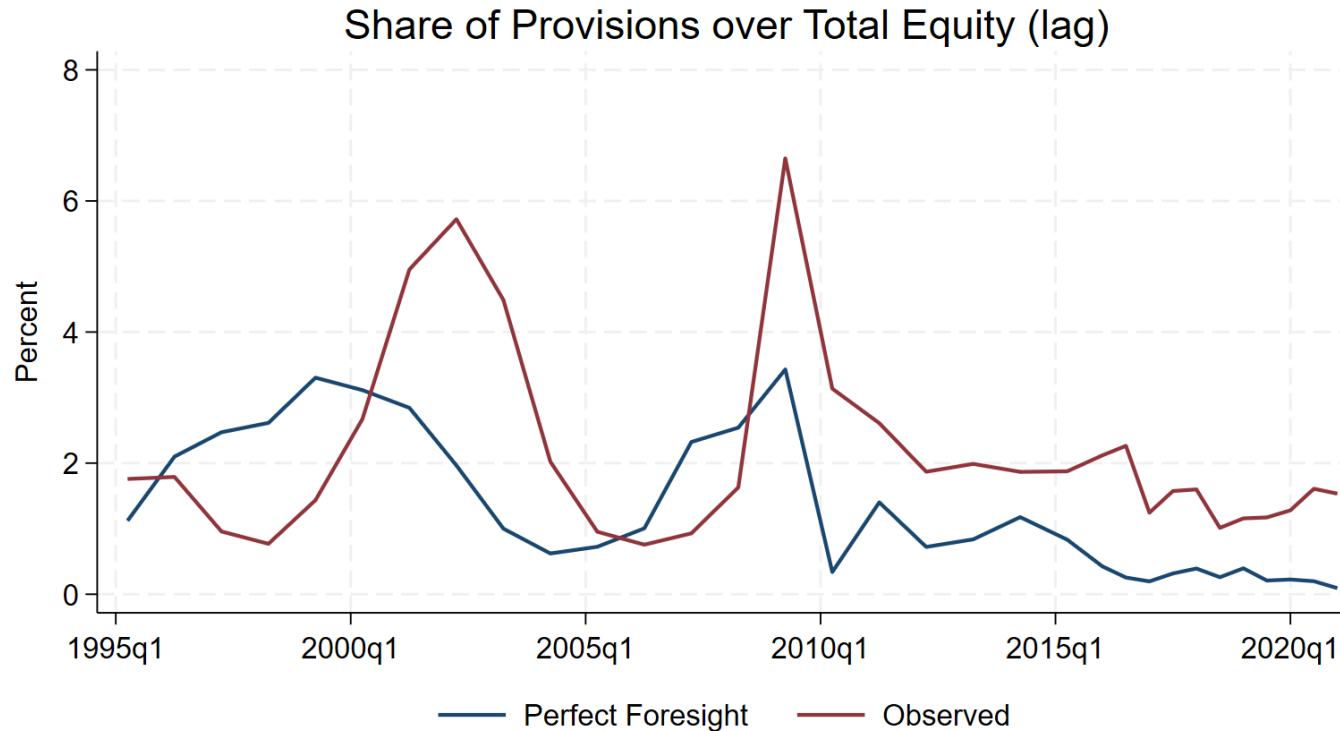


Note: Commitment exposures are used to calculate provisions. C&I loan portfolio is used.

## ► Notes:

- *Perfect foresight* would reduce leverage procyclicality – smaller capital declines in banking crises (e.g., 2009)
- Magnitudes are economically significant, reducing equity capital by as much as ~2 p.p.

# COUNTERFACTUALS



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# CONCLUSIONS

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- ▶ Ratings inflation is systematic and predictable based on characteristics known to lenders at the time of origination
- ▶ Targeted loan-level supervision reduces delayed recognition of loan non-performance, but limited evidence of spillovers
- ▶ Reducing ratings inflation would substantially reduce the procyclicality of bank leverage, and therefore also potential credit-driven amplification of economic cycles

**Thank you!**



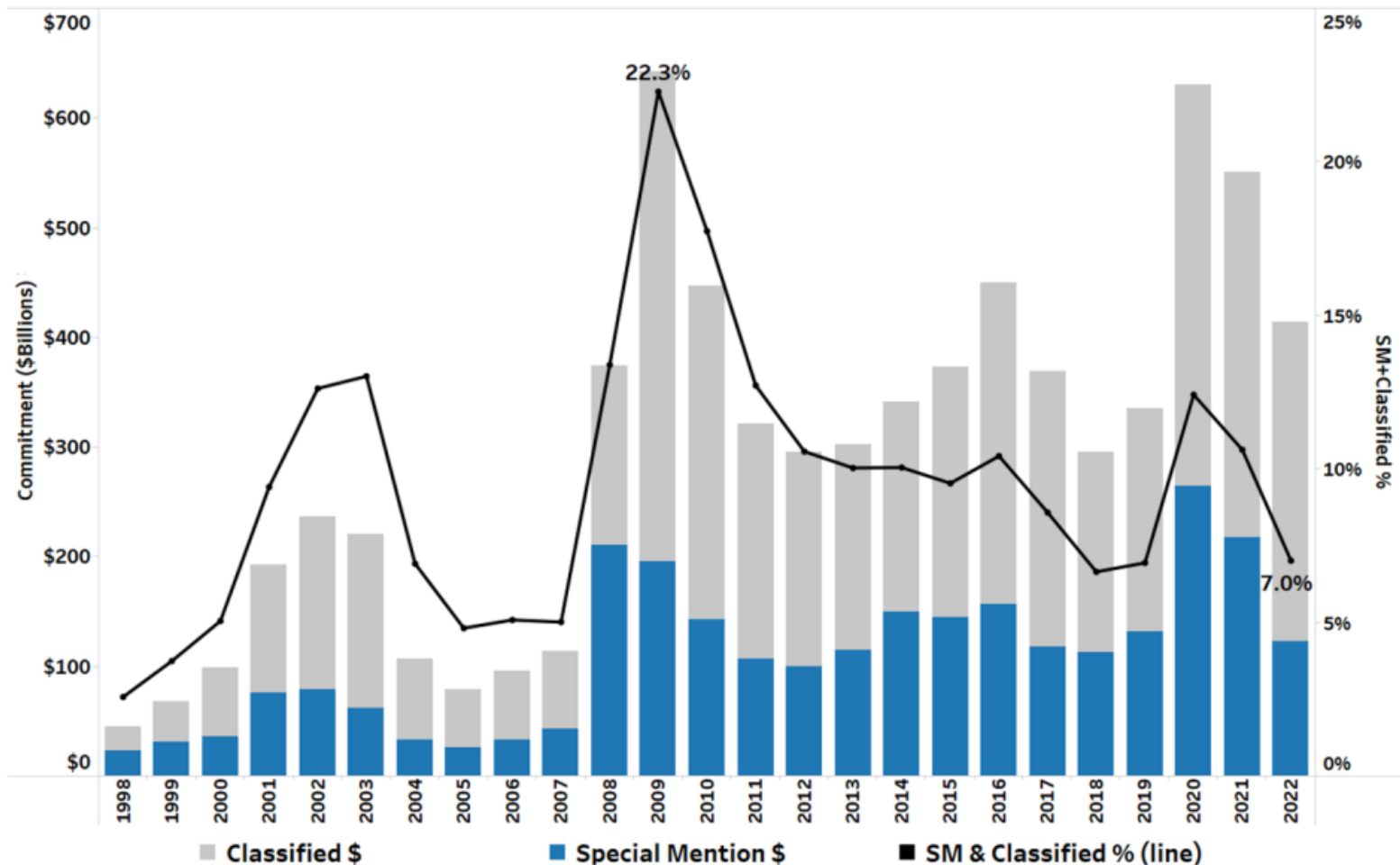
**Thank you!**

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# LOAN RATINGS & LEVERAGE

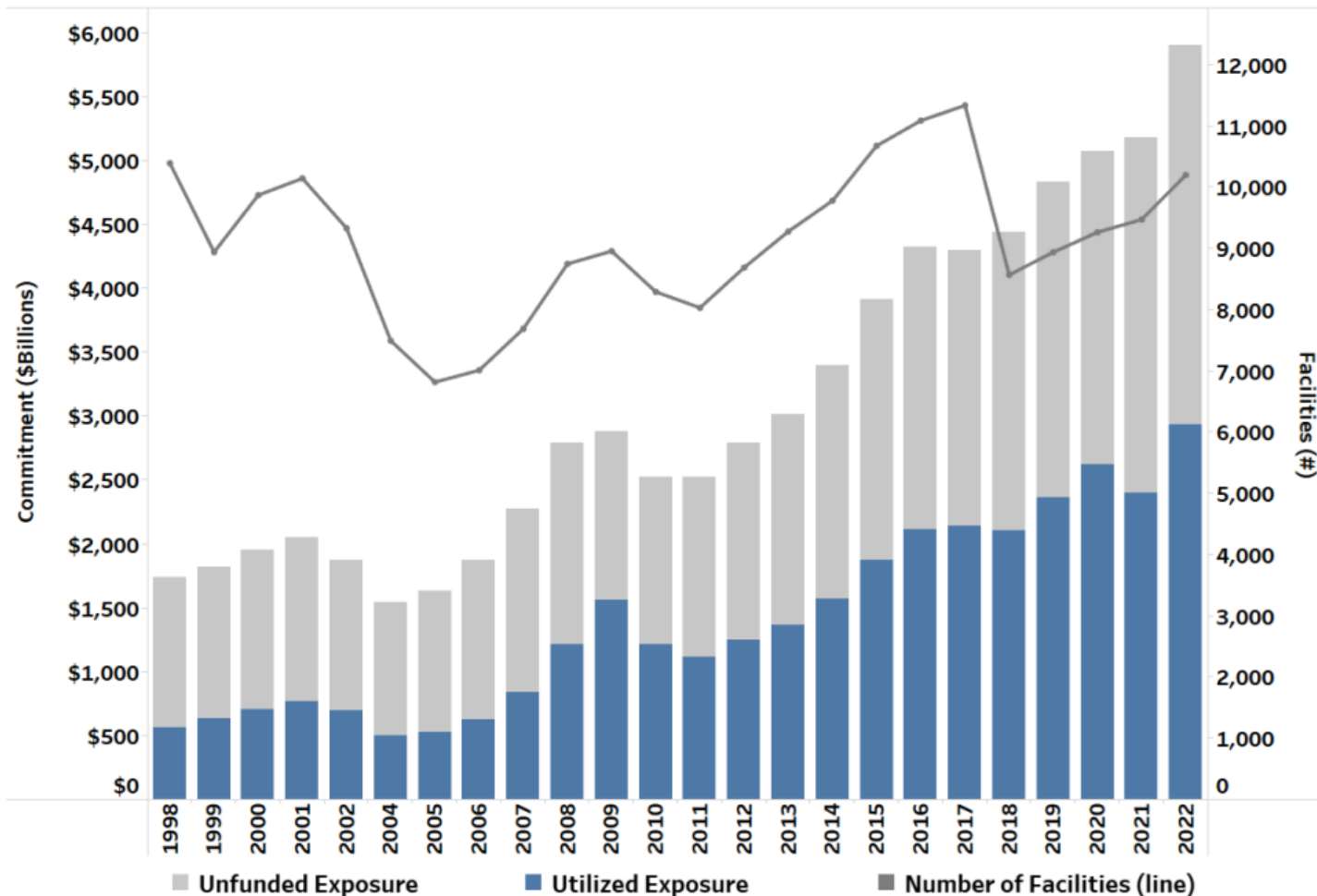
- ▶ Do loan ratings seem to anticipate loan performance?

Exhibit 3: Overall Special Mention Plus Classified Volume and Percentage Trends



# LOAN RATINGS & SUPERVISION

Exhibit 1: Overall Credit Facilities and Commitment Trends



Note: The decline in the number of SNC credit facilities between 2017 and 2018 mainly reflects the minimum commitment increase from \$20 million to \$100 million.