Bank Sentiment, Loan Loss Provisioning, and Lending

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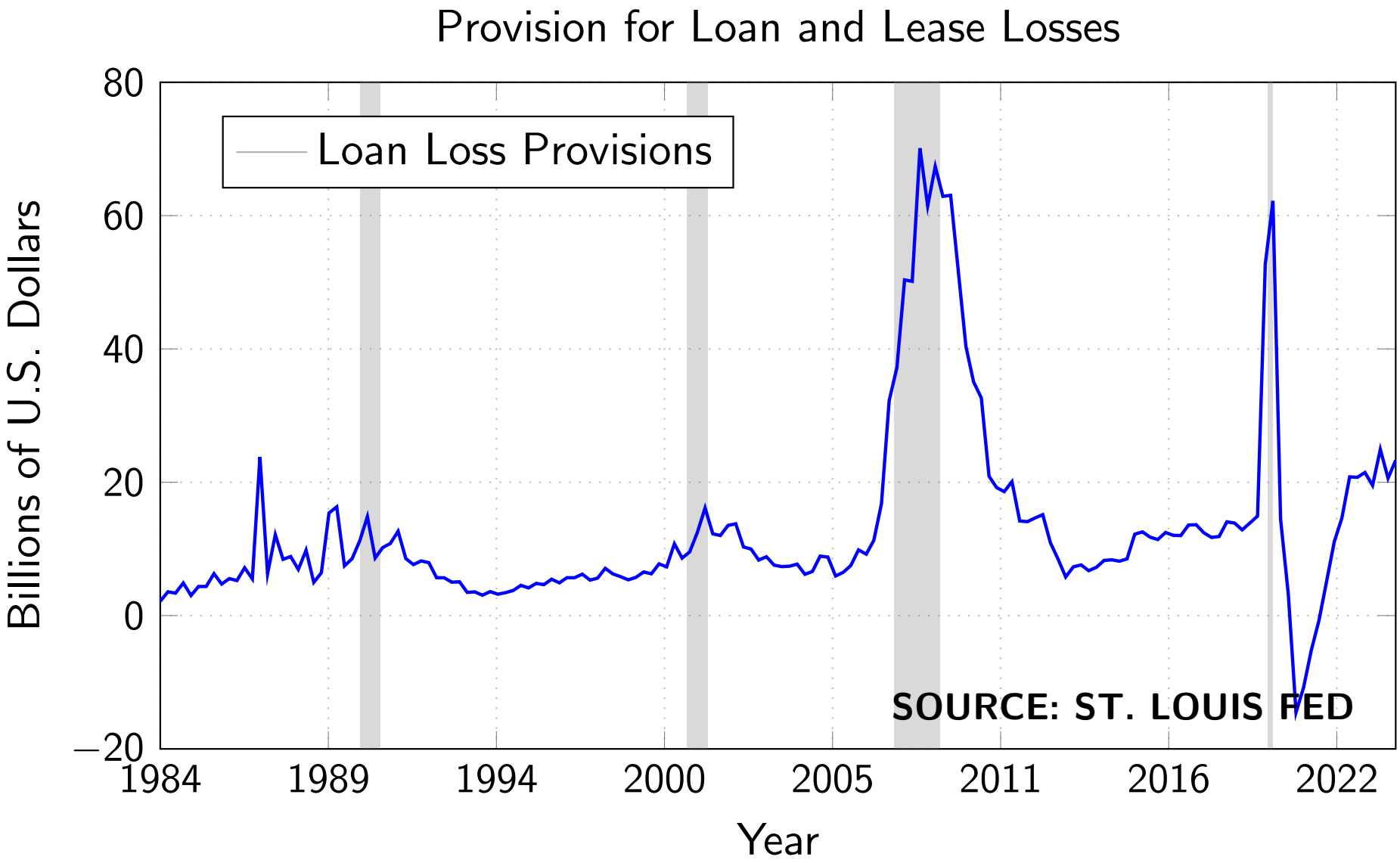
Motivation: Bank Sentiment, LLP, and Lending

- **Loan loss provisions (LLP)** are critical buffers against potential loan losses, directly impacting:
  - A bank's capital adequacy and lending capacity.
  - Risk management and regulatory supervision.
- LLPs exhibit clear procyclicality:
  - **During downturns:** High provisions restrict lending, exacerbating economic stress (Laeven and Majnoni, 2003; Beatty and Liao, 2011).
  - **During booms:** Low provisions may fuel excessive lending, creating financial bubbles (Acharya and Naqvi, 2012; Borio et al., 2001).
- Accounting Standards for LLPs:
  - Incurred Loss Model: Until 2019
  - Current Expected Credit Loss Model: From 2020

Loan Loss Provisions (LLPs) Over Time



Challenges in Setting LLP

- **Key Issues:**
  - **Reactive Nature:** Losses recognized after trigger events.
  - **Procyclicality:** Delayed recognition amplifies financial distress.
- **Discretion Exists:**
  - Managers assess timing and likelihood of losses, introducing subjectivity.
  - LLPs often used for earnings management (Beatty and Liao, 2011).
- **Potential Problems:**
  - **Subjectivity:** Heavily reliant on managerial judgment.
  - **Behavioral Biases:** Overconfidence or pessimism may distort estimates.
- **Policy Shift:**
  - CECL was introduced to address IL shortcomings with a forward-looking approach.

CECL Model and Sentiment

- **Changes in CECL:**
  - Forward-looking approach estimating expected losses over loan lifetime.
  - Incorporates forecasts and borrower creditworthiness.
- Transition from the **IL Model** to the **CECL Model** has increased:
  - Managerial discretion in estimating LLPs.
  - **Potential** subjectivity and vulnerability to sentiment-driven biases.
- **Implications:**
  - Opportunities for proactive risk management.
  - **Vulnerability to sentiment-driven biases**

Question in This Paper

- **Key Question:** How does bank sentiment affect loan loss provisioning, separate from economic fundamentals?

Hypothesis Development

Hypotheses

- **Hypothesis 1-A**: Banks with negative sentiment have **more** LLP.
- **Hypothesis 1-B**: Banks with negative sentiment have **less** LLP.

Rationale

- **H1-A**: Banks with negative sentiment may responsibly manage their risks, increasing their LLP. Negative sentiment can overstate the perceived likelihood of adverse events and expectations about the future (Johnson and Tversky (1983); Berger, Kim, and Ma (2024)).
- **H1-B**: Banks with negative sentiment may inflate their capital (to avoid regulatory scrutiny) or focus on short-term (less risky) lending, reducing their LLP.

Hypothesis Development

Hypotheses

- **Hypothesis 2-A**: The impact of bank sentiment on loan loss provisions is **more** pronounced during recessions.
- **Hypothesis 2-B**: The impact of bank sentiment on loan loss provisions is **less** pronounced during recessions.

Rationale

- **H2-A**: Negative sentiment amplifies the perceived likelihood of adverse events during uncertain times (McLean and Zhao (2014); Hribar et al. (2017)).
- **H2-B**: During recessions, banks act as prudent risk managers due to preserved "institutional memory" (Berger and Udell (2004)) and a meticulous corporate culture (Thakor (2015)).

Hypothesis Development

Hypotheses

- **Hypothesis 3-A**: Sentiment-driven loan loss provisions **reduce** bank loans.
- **Hypothesis 3-B**: Sentiment-driven loan loss provisions **increase** bank loans.

Rationale

- **H3-A**: Higher loan loss provisions reduce the capital ratio, limiting risk-taking behavior (Repullo (2004); Von Thadden (2004)).
- **H3-B**: Higher loan loss provisions act as a cash buffer against future losses, enabling banks to take more risks despite lower capital ratios (Diamond and Rajan (2001); Freixas and Rochet (2008); Acharya et al. (2015)).

Data and Key Variables: Bank Sentiment Measure

- We use BERT and GPT (LLMs) to build **a novel and more reliable measure** of bank management sentiment from the textual information of annual reports (Form 10-K) filed by bank holding companies.
  - We analyze the entire 10-K documents.
  - For a robustness check, we also focus on the Managerial Discussion and Analysis (MD&A) section.
- **Two-step approach** to extract bank sentiment distinct from key economic fundamentals and other economic agents' sentiment (Lemmon and Portniaguina (2006); Hribar et al. (2017)).
  - **Step 1**: Construct a measure of the tone in annual reports.
  - **Step 2**: Decompose the tone into the segment explained by economic fundamentals (rational reaction) and the unexplainable part (sentiment).

Data and Key Variables: Bank Sentiment Measure - Step 1

Step 1: Measuring the Tone in Annual Reports

- Using large language models (FinBERT by Huang et al. (2023) and GPT), sentences are sorted into three groups:
  - Negative
  - Positive
  - Neutral
- The net-negative sentence ratio is calculated as follows:

Net Negative Sentence Ratio

$$Net\ Negative\ Sentence\ Ratio_{i,t} = \frac{\#\ of\ Neg.\ Sentence_{i,t} - \#\ of\ Pos.\ Sentence_{i,t}}{\#\ of\ Total\ Sentence_{i,t}} \quad (1)$$

Data and Key Variables: Bank Sentiment Measure - Step 1

Sentiment Analysis Results

GPT: Negative **FinBERT: Negative** **LM: Positive**

Analysis Statement

We expect our operating expenses to increase in future periods, and if our revenue growth does not increase to offset these anticipated increases in our operating expenses, it will have a material adverse effect on our business, financial condition and results of operations and we may not be able to achieve or maintain profitability.

Source Information

Entity: Hanover Bancorp, Inc.
Document: Form 10-K
Reporting Date: 2021-09-30

Data and Key Variables: Bank Sentiment Measure - Step 2

Step 2: Segregating Bank Sentiment

- Bank-level controls ($Z_{i,t}$):
  - Stability: lagged Tier 1 Capital Ratio
  - Liquidity: lagged Liquidity
- Macro-level controls (M):
  - Monetary Policy: Yield on 3-month T-bills (YLD3), Yield spread (T10Y3MM)
  - Credit Market: Default spread (DEF)
  - Economic Indicators: Unemployment rate (URATE), Economic growth (GDP)
  - Sentiment: Investor sentiment, Consumer sentiment

Regression Equation

$$\textit{Net Negative Sentence Ratio}_{i,t} = \gamma_0 + \lambda' Z_{i,t} + \sum_{\tau=-1}^{1} \mu_\tau M_{t+\tau} + \epsilon_{i,t} \quad (2)$$

Summary Statistics

Panel A: *Loan Loss Provision* Variables	Obs.	Mean	Std. Dev.	25^{th} pct.	Median	75^{th} pct.
Dependent variable						
Loan Loss Provision$_{i,t}$	9,405	0.006	0.008	0.001	0.003	0.006
Main independent variables						
Neg-BankSentiment$_{i,t}$	9,405	-0.001	0.026	-0.016	0.001	0.017
BankSentiment_OnlyNegative$_{i,t}$	9,405	0.000	0.020	-0.013	-0.001	0.013
BankSentiment_OnlyPositive$_{i,t}$	9,405	0.001	0.020	-0.012	-0.002	0.010
Control variables						
Net Charge-offs$_{i,t+1}$	9,405	0.005	0.008	0.001	0.002	0.005
Chg. in Non-performing Loans$_{i,t-1}$	9,405	0.001	0.013	-0.003	0.000	0.003
Chg. in Non-performing Loans$_{i,t}$	9,405	0.001	0.014	-0.003	0.000	0.004
$1_{Size=Middle}$	9,405	0.289	0.454	0.000	0.000	1.000
$1_{Size=Large}$	9,405	0.284	0.451	0.000	0.000	1.000
Chg. in Total Loans$_{i,t}$	9,405	0.114	0.184	0.018	0.079	0.163
Earnings Before Provision$_{i,t}$	9,405	0.025	0.016	0.017	0.024	0.032
Loan Loss Reserve$_{i,t-1}$	9,405	0.014	0.008	0.010	0.013	0.017
Tier 1 Capital Ratio$_{i,t-1}$	9,405	0.121	0.035	0.099	0.117	0.138
Liquidity$_{i,t-1}$	9,405	0.042	0.038	0.021	0.032	0.050

Empirical Model and Results: Bank Sentiment and LLP

- Regression model:

$$\textit{Loan Loss Provision}_{i,t} = \alpha + \beta \textit{Neg-BankSentiment}_{i,t} + \Gamma \cdot X_{i,t} + \eta_i + \tau_t + \epsilon_{i,t} \quad (3)$$

- Bank controls $X_{i,t}$ include **future charge-offs**, growth of non-performing loans, growth of total loans, earnings before provisions, and lagged loan loss reserves.
- Bank fixed effects and year fixed effects.
- Standard errors are clustered at the bank- and year-level.
- **Hypothesis 1-A**: $\hat{\beta} > 0$ (Negative bank sentiment increases loan loss provisions).
- **Hypothesis 1-B**: $\hat{\beta} < 0$ (Negative bank sentiment decreases loan loss provisions).

Empirical Model and Results: Bank Sentiment and LLP

	(1)	(2)	(3)	(4)
	Dep. Variable = *Loan Loss Provision*$_t$			
Neg-BankSentiment$_t$	0.0585***	0.0356***	0.0295***	0.0235***
	(3.78)	(4.01)	(4.57)	(4.08)
Net Charge-offs$_{t+1}$		0.435***	0.428***	0.404***
		(7.70)	(7.55)	(7.44)
Chg. in Non-performing Loans$_{t-1}$		0.109***	0.107***	0.110***
		(4.34)	(4.55)	(5.20)
Chg. in Non-performing Loans$_t$		0.0348	0.0404	0.0608**
		(1.47)	(1.67)	(2.37)
$1_{Size=Middle}$			0.000148	0.000170
			(0.73)	(0.92)
$1_{Size=Large}$			0.000595	0.000851**
			(1.57)	(2.33)
Chg. in Total Loans$_t$			-0.00125	-0.00106
			(-1.16)	(-1.08)
Earnings Before Provision$_t$			-0.0454***	-0.0403***
			(-3.59)	(-3.43)
Loan Loss Reserve$_{t-1}$				0.154***
				(3.75)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	9,405	9,405	9,405	9,405

Instrumental Variable Analysis

- Instrument Variable: **MLB World Series Outcomes**:
  - Winning team influences local sentiment near bank headquarters.
  - Prior studies: Edmans et al., 2007; Chang et al., 2012; Card and Dahl, 2011
  - **(Relevance)** Google Search Volume Index (SVI) for winning team names reflects local sentiment.
  - **(Exclusion)** Banks' geographically diverse operations ensure MLB outcomes do not directly influence LLP decisions.
- Focused on banks with fiscal year-end in December, aligning with the timing of MLB results (October-November).
- Used Google SVI for the names of winning teams as an instrumental variable for Neg-BankSentiment.

Instrumental Variable Analysis

Dep. Variable =	(1) *Neg-BankSentiment*$_t$	(2) *Loan Loss Provision*$_t$
WORLD SERIES$_t$	-0.003***	
	(0.009)	
Neg-BankSentiment$_t$		0.568***
		(0.005)
Net Charge-offs$_{t+1}$	0.307***	0.201***
	(<0.000)	(0.006)
Chg. in Non-performing Loans$_{t-1}$	0.051***	0.093***
	(0.009)	(<0.000)
Chg. in Non-performing Loans$_t$	0.047***	0.029**
	(0.002)	(0.047)
$1_{Size=Middle}$	0.005***	-0.002*
	(0.004)	(0.057)
$1_{Size=Large}$	0.006***	-0.002
	(0.004)	(0.184)
Chg. in Total Loans$_t$	-0.019***	0.008*
	(<0.000)	(0.066)
Earnings Before Provision$_t$	-0.231***	0.067
	(0.000)	(0.239)
Loan Loss Reserve$_{t-1}$	0.442***	-0.102
	(<0.000)	(0.308)
Bank F.E.	YES	YES
Year F.E.	YES	YES
Observations	6,211	6,211

The Impact of Sentiment during Recessions

	(1)	(2)	(3)	(4)
	Dep. Variable = *Loan Loss Provision*$_t$			
Neg-BankSentiment$_t$ × *Recessions*$_t$	0.0943**	0.0490**	0.0450**	0.0470**
	(2.34)	(2.31)	(2.23)	(2.43)
Neg-BankSentiment$_t$	0.0431***	0.0279***	0.0228***	0.0164***
	(3.94)	(3.89)	(4.19)	(3.68)
Net Charge-offs$_{t+1}$		0.429***	0.422***	0.398***
		(7.77)	(7.64)	(7.53)
Chg. in Non-performing Loans$_{t-1}$		0.107***	0.105***	0.108***
		(4.44)	(4.63)	(5.38)
Chg. in Non-performing Loans$_t$		0.0324	0.0380	0.0585**
		(1.41)	(1.62)	(2.34)
$1_{Size=Middle}$			0.000165	0.000187
			(0.84)	(1.04)
$1_{Size=Large}$			0.000649*	0.000911**
			(1.73)	(2.49)
Chg. in Total Loans$_t$			-0.00123	-0.00103
			(-1.15)	(-1.06)
Earnings Before Provision$_t$			-0.0423***	-0.0370***
			(-3.52)	(-3.39)
Loan Loss Reserve$_{t-1}$				0.156***
				(3.77)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	9,405	9,405	9,405	9,405

Robustness Tests

- **Test 1**: Measuring the tone in annual reports.
  - Using **GPT and Loughran and McDonald (2011) dictionary**, we sort all sentences into negative, positive and neutral groups.
- **Test 2**: Measuring the tone in **MD&A section of annual reports**.
  - Using FinBERT (Huang et al. (2023)), we sort all sentences into negative, positive and neutral groups.
- Both T1 and T2 hold.

Sentiment-Driven LLP and Bank Lending: Extensive Margin

	(1)	(2)	(3)
	Dep. Variable = $Loan\ Growth_{t+1}$		
$Sentiment\text{-}Driven\ LLP_t$	-9.431***	-8.855***	-9.558***
	(-9.61)	(-8.12)	(-7.70)
$Neg\text{-}BankSentiment_t$	-0.605***	-0.545**	-0.485**
	(-4.00)	(-3.73)	(-3.40)
$Deposits_{t-1}$		0.143*	0.106
		(2.15)	(1.68)
$Net\ Income_{t-1}$		1.649***	1.657***
		(5.60)	(5.24)
$Chg.\ in\ Non\text{-}performing\ Loans_{t-1}$			0.675*
			(2.45)
$Chg.\ in\ Non\text{-}performing\ Loans_t$			-0.0665
			(-0.34)
$1_{Size=Middle}$			-0.0348*
			(-2.29)
$1_{Size=Large}$			-0.0867***
			(-4.04)
Bank F.E.	YES	YES	YES
Year F.E.	YES	YES	YES
Observations	9,405	9,405	9,405

Sentiment-Driven LLP and Bank Lending: Intensive Margin

	(1)	(2)	(3)
	Dep. Variable = *Credit Spread*$_{i,j,t+1}$		
Sentiment-Driven LLP$_{i,t}$	1714.8**	1645.2**	1589.8*
	(2.27)	(2.22)	(2.10)
Neg-BankSentiment$_{i,t}$	163.5**	128.8	119.9
	(2.09)	(1.61)	(1.42)
Maturity$_{i,j,t+1}$		-0.207**	-0.201**
		(-2.51)	(-2.36)
$1_{LoanType=Line\ of\ Credit}$		-41.00***	-39.99***
		(-9.30)	(-9.06)
Facility Amount$_{i,j,t+1}$		-0.0169***	-0.0168***
		(-4.33)	(-4.32)
Borrower's Cash$_{j,t}$			7.699
			(0.50)
Borrower's Long-term Debt$_{j,t}$			74.59***
			(7.53)
Borrower's Tangible Asset$_{j,t}$			29.19**
			(2.49)
Bank F.E.	YES	YES	YES
Firm F.E.	YES	YES	YES
Year F.E.	YES	YES	YES
Observations	17,122	17,122	17,122

Conclusion

Main findings are:

- Bank sentiment can drive the loan loss provisioning.
- Sentiment-driven LLP can distort the bank lending.

The results are robust to:

- Various large-language models (BERT and GPT) to extract bank sentiment measures
- Various source of linguistic information (Form 10-K, MD&A section only)
- Instrumental variable analysis using exogenous WS results

The behavior of banks in setting LLP is not entirely objective and forward-looking. Sentiment-driven LLP can amplify the cyclicality of lending.