Bank Sentiment and Loan Loss Provisioning

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Motivation: Bank Sentiment, LLP and Lending

- **Loan loss provision (LLP)** is a precautionary buffer against future loan losses, affecting a bank's capital adequacy and lending.
  - Before the Basel Accord, it was a part of regulatory capital. After the Basel, it is booked as an expense, reducing the capital.

- Traditionally, LLP has been based on the Incurred Loss (IL) model.
- Recent regulatory change from IL model to **expected credit loss (ECL) or current expected credit loss (CECL) model**.
  - Giving more discretion to bank managers and they will preemptively choose optimal LLP, mitigating the cyclicality.
  - Many controversies over whether this change is procyclical or countercyclical.
  - Empirical analysis is complicated by the implementation during COVID-19 period.

- **Bottom line**: Understanding banks' decision on LLP is important in terms of capital ratio, lending and its impact on the real economy.

Question in This Paper

- **Question: How objective and optimal is the behavior of bankers in setting LLP? Are they forward-looking rational bank managers?**
  - Specifically, we test the impact of bank sentiment on loan loss provisions, distinct from the impact of economic fundamentals and actual charge-offs.
  - Bank sentiment, broadly defined, is bank managers' belief about the current and future economic conditions (e.g., borrowers' credit conditions, economic conditions, bank liquidity or stability).

Hypothesis Development

Hypothesis

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

- H1-A: 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 want to inflate their capital (to avoid regulatory scrutiny) or focus on short-term (less risky) lending, reducing their need for LLP.

Hypothesis Development

Hypothesis

- **Hypothesis 2**: *The impact of bank sentiment on loan loss provisions is more pronounced during recessions than other times.*

- During uncertain times, negative sentiment heightens the perceived likelihood of adverse events (McLean and Zhao (2014); Hribar et al. (2017)).
- The impact of bank negative sentiment would be more pronounced during uncertain times.

Data and Key Variables: Bank Sentiment Measure

- Measuring bank manager sentiment is challenging as it reflects bank managers' beliefs, attitudes, and emotions, which are usually unobservable.
- Qualitative components in corporate disclosures can be useful sources for information.
  - Top corporate executives need to provide extensive and accurate information in disclosure documents (Sarbanes-Oxley Act of 2002).
- Utilizing large-language models (BERT and GPT), we build a measure of bank management sentiment from the textual information of annual reports (Form 10-K) filed by bank holding companies.
  - We analyze the whole 10-K documents.
  - For a robustness check, we also focus on the MD&A section.

Data and Key Variables: Bank Sentiment Measure

- It is important to segregate the bank sentiment from the fundamental-based beliefs and other economic agents' sentiments.
- **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**: Measuring the tone in annual reports.

  - Using large language models of FinBERT (Huang et al. (2023)) and GPT, we sort all sentences into negative, positive and neutral groups.
  - We calculate the net-negative ratio of negative sentences.

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

Data and Key Variables: Bank Sentiment Measure

- **Step 2**: Segregate the bank sentiment from fundamental-based beliefs and other sentiments

  - We regress the tone measure on the time-bank location fixed effects absorbing all time-varying local economic fundamentals.

$$\text{Net Negative Sentence Ratio}_{i,t} = \gamma + \rho State_i \times Year_t + \epsilon_{i,t} \qquad (2)$$

- **Bank sentiment measure**: the residuals of the estimated regression.
- The residuals of the estimated regression are distinct from all macroeconomic changes such as monetary policy, financial market conditions, and other macro-level sentiment measures.

Summary Statistics

Panel A: *Loan Loss Provision*						
Variables	Obs.	Mean	Std. Dev.	25th pct.	Median	75th pct.
Dependent variable						
Loan Loss Provision$_{i,t}$	9,290	0.006	0.009	0.001	0.003	0.006
Main independent variables						
Neg-BankSentiment$_{i,t}$	9,290	-0.001	0.024	-0.015	0.001	0.016
BankSentiment_OnlyNegative$_{i,t}$	9,290	0.000	0.019	-0.011	0.000	0.012
BankSentiment_OnlyPositive$_{i,t}$	9,290	0.001	0.019	-0.011	-0.002	0.010
Control variables						
Net Charge-offs$_{i,t+1}$	9,290	0.005	0.008	0.001	0.002	0.006
Chg. in Non-performing Loans$_{i,t-1}$	9,290	0.001	0.013	-0.003	0.000	0.003
Chg. in Non-performing Loans$_{i,t}$	9,290	0.001	0.014	-0.003	0.000	0.004
$1_{Size=Middle}$	9,290	0.289	0.453	0.000	0.000	1.000
$1_{Size=Large}$	9,290	0.283	0.451	0.000	0.000	1.000
Chg. in Total Loans$_{i,t}$	9,290	0.114	0.184	0.018	0.079	0.163
Earnings Before Provision$_{i,t}$	9,290	0.025	0.016	0.017	0.024	0.032
Tier 1 Capital Ratio$_{i,t-1}$	9,290	0.121	0.035	0.099	0.117	0.138
Loan Loss Reserve$_{i,t-1}$	9,290	0.014	0.008	0.010	0.013	0.017

Empirical Model and Results: Bank Sentiment and LLP

- Regression model:

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

- Bank controls $X_{i,t}$ include **future charge-offs**, growth of non-performing loans, growth of total loans, earnings before provisions, tier 1 capital ratio, lagged loan loss reserves.
- Bank fixed effects and year fixed effects.
- Standard errors are clustered at the bank- and year-level, based on bootstrap methods.
- **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$_t$	0.043***	0.028***	0.023***	0.018***
	(<0.000)	(<0.000)	(<0.000)	(<0.000)
Net Charge-offs$_{t+1}$		0.442***	0.433***	0.407***
		(<0.000)	(<0.000)	(<0.000)
Chg. in Non-performing Loans$_{t-1}$		0.110***	0.107***	0.109***
		(0.002)	(<0.000)	(0.001)
Chg. in Non-performing Loans$_t$		0.034	0.040	0.061*
		(0.219)	(0.156)	(0.050)
$1_{Size=Middle}$			0.000	0.000
			(0.352)	(0.293)
$1_{Size=Large}$			0.001	0.001**
			(0.134)	(0.040)
Chg. in Total Loans$_t$			-0.001	-0.001
			(0.227)	(0.266)
Earnings Before Provision$_t$			-0.044***	-0.039***
			(0.006)	(0.008)
Tier 1 Capital Ratio$_{t-1}$			-0.005	-0.006
			(0.260)	(0.184)
Loan Loss Reserve$_{t-1}$				0.154***
				(0.009)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	9,290	9,290	9,290	9,290

The Impact of Sentiment during Recessions

	(1)	(2)	(3)	(4)
		Dep. Variable = *Loan Loss Provision$_t$*		
Neg-BankSentiment$_t$ × Recessions$_t$	0.052*	0.029*	0.024*	0.026*
	(0.090)	(0.062)	(0.079)	(0.056)
Neg-BankSentiment$_t$	0.035***	0.024***	0.019***	0.014***
	(<0.000)	(<0.000)	(<0.000)	(<0.000)
Net Charge-offs$_{t+1}$		0.441***	0.432***	0.406***
		(<0.000)	(<0.000)	(<0.000)
Chg. in Non-performing Loans$_{t-1}$		0.109***	0.106***	0.108***
		(0.003)	(<0.000)	(0.001)
Chg. in Non-performing Loans$_t$		0.033	0.040	0.060*
		(0.222)	(0.162)	(0.051)
$1_{Size=Middle}$			0.000	0.000
			(0.337)	(0.278)
$1_{Size=Large}$			0.001	0.001**
			(0.129)	(0.036)
Chg. in Total Loans$_t$			-0.001	-0.001
			(0.234)	(0.275)
Earnings Before Provision$_t$			-0.043***	-0.038**
			(0.006)	(0.010)
Tier 1 Capital Ratio$_{t-1}$			-0.005	-0.006
			(0.265)	(0.189)
Loan Loss Reserve$_{t-1}$				0.154***
				(0.008)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	9,290	9,290	9,290	9,290

Instrumental Variable Analysis

- IV: exogenous local weather conditions near the bank headquarters
  - **(Relevance)** Weather has a long-lasting effect on emotional state (Cuningham (1979), Kamstra et al. (2003), Lerner et al. (2015)).
  - **(Exclusion)** The local weather is not likely to influence the LLP.
- Data Source: the National Oceanic and Atmospheric Administration
  - Weather data: hourly air temperature, dew point, sea level pressure, wind speed, cloud coverage, and precipitation
- We focus on prolonged cloudy days, extreme heat days, and rainy days, which are de-seasonalized over the past year (46 possible instrumental variables).
- LASSO procedure to avoid overfitting and data-mining concerns (Belloni et al. (2011), Gilchrist and Sands (2016))
- **Chosen IV: Prolonged cloud days**

Instrumental Variable Analysis

Dep. Variable =	(1) Neg-BankSentiment$_t$	(2) Loan Loss Provision$_t$
Cloud Coverage$_t$	0.005***	
	(0.003)	
Neg-BankSentiment$_t$		0.237*
		(0.077)
Net Charge-offs$_{t+1}$	0.178***	0.354***
	(<0.000)	(<0.000)
Chg. in Non-performing Loans$_{t-1}$	0.023	0.102***
	(0.224)	(<0.000)
Chg. in Non-performing Loans$_t$	0.021	0.057*
	(0.327)	(0.082)
$1_{Size=Middle}$	0.003	-0.000
	(0.141)	(0.319)
$1_{Size=Large}$	0.003	0.000
	(0.249)	(0.806)
Chg. in Total Loans$_t$	-0.010***	0.002
	(<0.000)	(0.100)
Earnings Before Provision$_t$	-0.188***	-0.004
	(<0.000)	(0.884)
Tier 1 Capital Ratio$_{t-1}$	0.018	-0.013***
	(0.202)	(0.009)
Loan Loss Reserve$_{t-1}$	0.443***	0.028
	(0.001)	(0.711)
F-statistic	15.50	
Bank F.E.	YES	YES
Year F.E.	YES	YES
Observations	6,416	6,416

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)	(4)
		Dep. Variable = $Loan\ Growth_{t+1}$		
Sentiment-Driven LLP_t	-9.954***	-9.299***	-10.042***	-9.657***
	(<0.000)	(<0.000)	(<0.000)	(<0.000)
Neg-BankSentiment$_t$	-0.424***	-0.368**	-0.324**	-0.358**
	(0.005)	(0.013)	(0.024)	(0.012)
Deposits$_{t-1}$		0.148**	0.111	0.143**
		(0.036)	(0.103)	(0.030)
Net Income$_{t-1}$		1.742***	1.743***	1.458***
		(<0.000)	(<0.000)	(<0.000)
Chg. in Non-performing Loans$_{t-1}$			0.730**	0.714**
			(0.015)	(0.021)
Chg. in Non-performing Loans$_t$			-0.082	-0.120
			(0.663)	(0.537)
$1_{Size=Middle}$			-0.036**	-0.032**
			(0.022)	(0.039)
$1_{Size=Large}$			-0.088***	-0.080***
			(0.001)	(0.001)
Tier 1 Capital Ratio$_{t-1}$				0.559***
				(0.002)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	9,290	9,290	9,290	9,290

Sentiment-Driven LLP and Bank Lending: Intensive Margin

	(1)	(2)	(3)	(4)
	Dep. Variable = $Credit\ Spread_{i,j,t+1}$			
$Sentiment\text{-}Driven\ LLP_{i,t}$	2012.646*	1956.949*	2041.702*	1992.697*
	(0.073)	(0.085)	(0.083)	(0.091)
$Neg\text{-}BankSentiment_{i,t}$	152.935	124.229	124.087	115.173
	(0.118)	(0.219)	(0.221)	(0.265)
$Maturity_{i,j,t+1}$		-0.027	-0.028	-0.021
		(0.850)	(0.844)	(0.889)
$1_{LoanType=Line\ of\ Credit}$		-49.468***	-49.472***	-48.526***
		(0.001)	(<0.000)	(0.001)
$Facility\ Amount_{i,j,t+1}$		-0.014**	-0.014**	-0.014**
		(0.014)	(0.015)	(0.014)
$Tier\ 1\ Capital\ Ratio_{i,t-1}$			176.420	158.369
			(0.391)	(0.424)
$Borrower's\ Cash_{j,t}$				9.221
				(0.659)
$Borrower's\ Long\text{-}term\ Debt_{j,t}$				71.876***
				(0.007)
$Borrower's\ Tangible\ Asset_{j,t}$				41.033**
				(0.039)
Bank F.E.	YES	YES	YES	YES
Firm F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	17,122	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
- Instrumental variable analysis using exogenous weather shocks

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