Asset-Based Lending as a Leading Indicator of Systemic Crises

Hao Ding[1] April Goulding[2]

[1]University of Oxford

[2]Bayes Business School & Goldman Sachs

3 June 2026
Bank of Finland, Helsinki

Views are the authors' own; do not represent Goldman Sachs or SFNet. Thanks to SFNet for data access.

Introduction

Asset-Based Lending (ABL): $320 bn U.S. market; credit secured against receivables, inventory, equipment. Lenders observe private signals (covenant monitoring, field exams) months before secondary-market prices move.

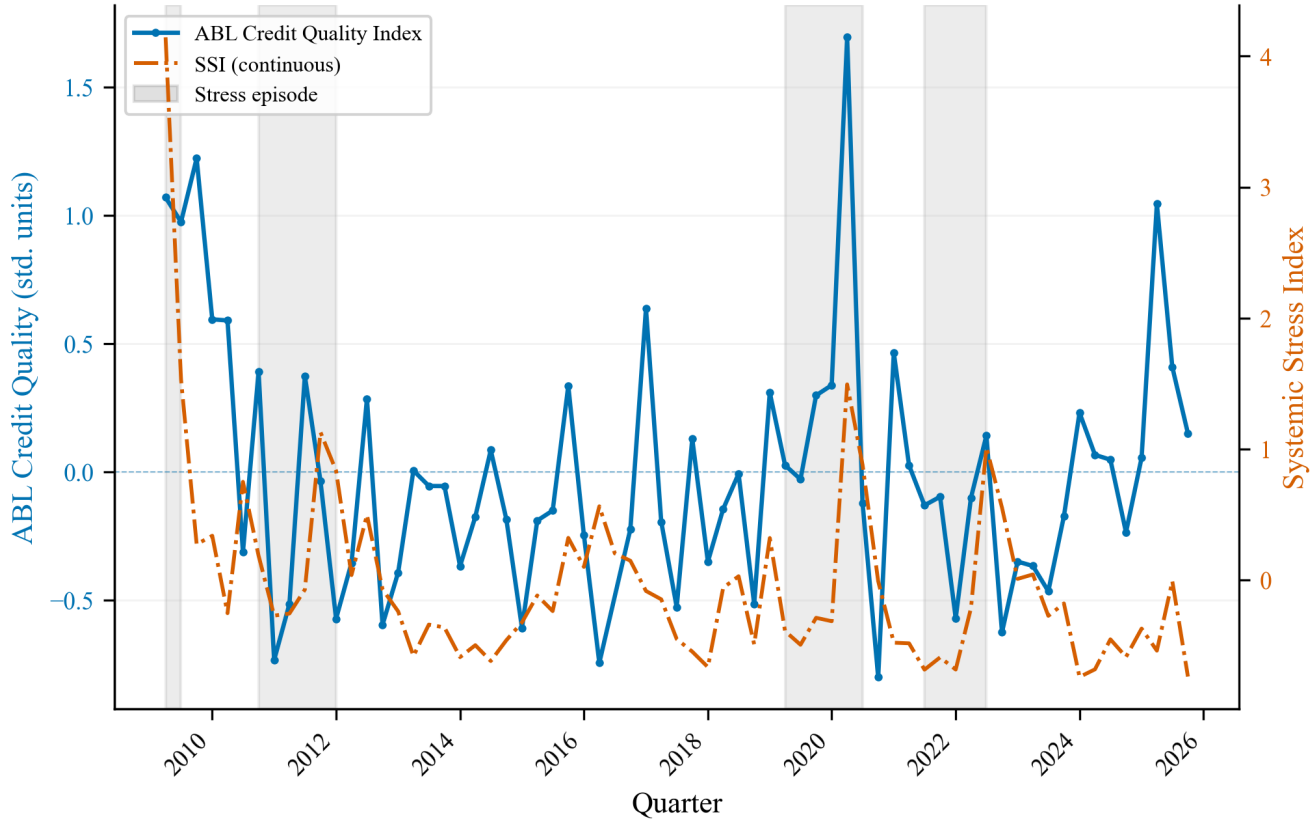
Key findings

Parsimonious logit with ABL credit-quality indicators predicts crises within 12 months at AUROC 0.732 vs 0.670 macro-only (**+6.2 pp**). SFNet beats TRACE by **1.4 pp** at the 24-month horizon (0.856 vs 0.842) — a *horizon-dependent* edge that reverses at 12 months.

Key contributions:

- ABL lender-survey indicators as a new systemic-stress channel.
- *Horizon-dependent* private-information premium (SFNet vs TRACE).

The Signal: ABL Credit Quality Leads Systemic Stress



The standardised ABL Credit-Quality composite typically **leads the Systemic Stress Index by 1–4 quarters** into the shaded stress episodes.

Suggestive motivation — formal evidence is the OOS ablation; noisy quarter-to-quarter at $n = 66$.

Why ABL?

Motivation

Need a leading indicator that captures lending-supply stress *before* it materialises in market prices.

- Macro EWS (Holopainen & Sarlin 2017; Bluwstein et al. 2023) — **miss the lending-supply channel**.
- Securitisation lit (Gorton & Metrick 2012; Battaglia et al. 2021; Dou et al. 2025) — **contemporaneous, not forward-looking**.

Three transmission channels from ABL stress to systemic risk → **motivate H1–H3:**

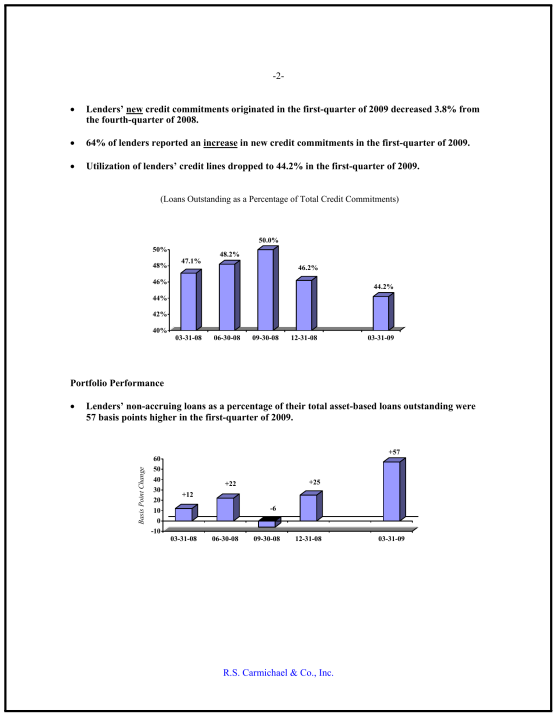
1. Credit-deterioration: write-downs → balance-sheet impairment *(H1)*
2. Funding/liquidity: covenant breach → fire sales (Brunnermeier & Pedersen 2009) *(H2)*
3. Network contagion: overlapping ABL exposure → parallel deleveraging *(H3)*

Related Literature

- **Securitisation + systemic risk** (Gorton & Metrick 2012; Battaglia et al. 2021; Dou et al. 2025) — securitisation linked to crash risk; **contemporaneous, not predictive**.
- **Spillovers + networks** (Diebold & Yilmaz 2009, 2014; Adrian & Brunnermeier 2016; Kundu 2023) — spillovers spike around crises; **ABL-specific exposures unexamined**.
- **Private information in opaque credit** (Coval et al. 2009; Gorton & Metrick 2012) — prices do not impound all lender-side information; **lender surveys never tested as predictors**.
- **ML for systemic risk** (Lim et al. 2021 TFT; Veličković et al. 2018 GAT; Gonon et al. 2024 GNN) — toolkit established; **ABL channel + small-sample EWS under-explored**.

Our paper: first ABL-lender-survey EWS, framed as *complementary* to the macro literature (Holopainen & Sarlin 2017; Bluwstein et al. 2023).

The Raw Material: Two Surveys, Two Formats



-2-

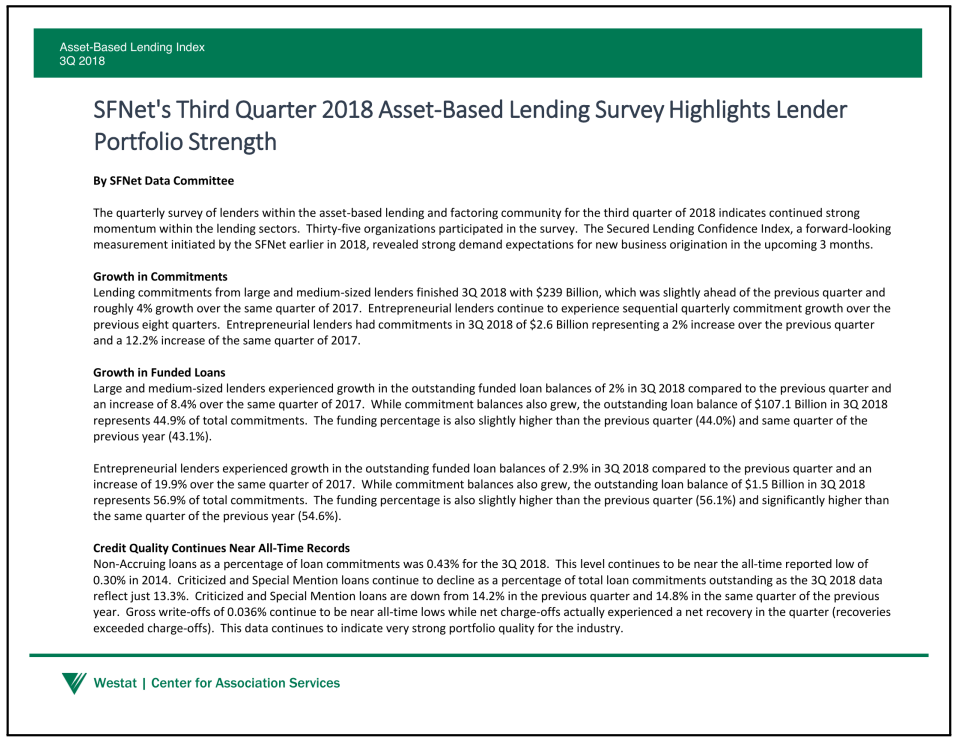
- Lenders' new credit commitments originated in the first-quarter of 2009 decreased 3.8% from the fourth-quarter of 2008.
- 64% of lenders reported an increase in new credit commitments in the first-quarter of 2009.
- Utilization of lenders' credit lines dropped to 44.2% in the first-quarter of 2009.

(Loans Outstanding as a Percentage of Total Credit Commitments)

Portfolio Performance

- Lenders' non-accruing loans as a percentage of their total asset-based loans outstanding were 57 basis points higher in the first-quarter of 2009.

R.S. Carmichael & Co., Inc.



Asset-Based Lending Index
3Q 2018

SFNet's Third Quarter 2018 Asset-Based Lending Survey Highlights Lender Portfolio Strength

By SFNet Data Committee

The quarterly survey of lenders within the asset-based lending and factoring community for the third quarter of 2018 indicates continued strong momentum within the lending sectors. Thirty-five organizations participated in the survey. The Secured Lending Confidence Index, a forward-looking measurement initiated by the SFNet earlier in 2018, revealed strong demand expectations for new business origination in the upcoming 3 months.

Growth in Commitments
Lending commitments from large and medium-sized lenders finished 3Q 2018 with $239 Billion, which was slightly ahead of the previous quarter and roughly 4% growth over the same quarter of 2017. Entrepreneurial lenders continue to experience sequential quarterly commitment growth over the previous eight quarters. Entrepreneurial lenders had commitments in 3Q 2018 of $2.6 Billion representing a 2% increase over the previous quarter and a 12.2% increase of the same quarter of 2017.

Growth in Funded Loans
Large and medium-sized lenders experienced growth in the outstanding funded loan balances of 2% in 3Q 2018 compared to the previous quarter and an increase of 8.4% over the same quarter of 2017. While commitment balances also grew, the outstanding loan balance of $107.1 Billion in 3Q 2018 represents 44.9% of total commitments. The funding percentage is also slightly higher than the previous quarter (44.0%) and same quarter of the previous year (43.1%).

Entrepreneurial lenders experienced growth in the outstanding funded loan balances of 2.9% in 3Q 2018 compared to the previous quarter and an increase of 19.9% over the same quarter of 2017. While commitment balances also grew, the outstanding loan balance of $1.5 Billion in 3Q 2018 represents 56.9% of total commitments. The funding percentage is also slightly higher than the previous quarter (56.1%) and significantly higher than the same quarter of the previous year (54.6%).

Credit Quality Continues Near All-Time Records
Non-Accruing loans as a percentage of loan commitments was 0.43% for the 3Q 2018. This level continues to be near the all-time reported low of 0.30% in 2014. Criticized and Special Mention loans continue to decline as a percentage of total loan commitments outstanding as the 3Q 2018 data reflect just 13.3%. Criticized and Special Mention loans are down from 14.2% in the previous quarter and 14.8% in the same quarter of the previous year. Gross write-offs of 0.036% continue to be near all-time lows while net charge-offs actually experienced a net recovery in the quarter (recoveries exceeded charge-offs). This data continues to indicate very strong portfolio quality for the industry.

Westat | Center for Association Services

2009Q1 (GFC): non-accruals **+57 bps**, utilisation falls to 44.2% — *signal firing*.

Old R.S. Carmichael format.

2018Q3 (calm): "near all-time-record" credit quality, non-accruals 0.43%. New Westat format.

Format **evolves across the 66 surveys** (2009–2025) — charts, prose, shifting tables — defeating rule-based parsing. We extract the credit-quality fields (non-accruals, write-offs, criticised, utilisation, commitments) with an **LLM** (Gemini 3.1 Pro) → the **ABL Credit Quality** composite.

Data: SFNet Quarterly ABL Index

Secured Finance Network (SFNet) — trade association for U.S. secured lenders; publishes a quarterly survey of major ABL lenders since 2009.

Coverage: 66 quarterly surveys, 2009Q1–2025Q3 (2016Q2 unavailable).

Variables (selection):

- Total ABL commitments + QoQ growth
- Utilisation rate
- Non-accrual ratios, gross write-offs
- Portfolio watch upgrades / downgrades
- Credit-line approvals, criticised loans

Extraction: Indicators appear as text and tables in PDF surveys. We extract them with **Google Gemini 3.1 Pro** and validate against cross-document consistency checks.

Companion sources: FINRA TRACE ABL-tagged ABS prices; FR Y-9C call reports for 989 BHCs; FRED macro controls.

Crisis Definition

Systemic Stress Index (SSI) — equally-weighted mean of five z-scored components: VIX, HY OAS, TED spread, STLFSI, and the value-weighted bank-equity drawdown.

A quarter is classified as **stress** when SSI exceeds its 90th percentile.

7 stress quarters in 4 clusters (10.4% prevalence)

- **2009Q1–Q2** (GFC tail)
- **2011Q3–Q4** (European sovereign + U.S. debt-ceiling)
- **2020Q1–Q2** (COVID-19)
- **2022Q3** (inflation / rate-shock)

Targets: y_h = stress within next h quarters, for $h \in \{1, 2, 4, 8\}$.
Main: window-4 (within twelve months). **Robustness:** window-8 (long-horizon).

At $h = 1$ there are only 6 positive events because the earliest stress quarter (2009Q1) requires an input at 2008Q4, outside the panel.

Key Hypotheses (1 of 2)

Hypothesis 1 (H1) — Credit-Deterioration Channel

Deterioration in ABL credit conditions predicts higher future systemic stress.

- Tested via in-sample logit significance + out-of-sample AUROC ablation + cross-check from XGBoost SHAP and TFT variable selection.

Hypothesis 2 (H2) — Funding/Liquidity Channel

The predictive content of ABL stress is amplified when option-implied volatility (VIX) is elevated.

- Tested via logit ABL×VIX interaction + 20-quarter rolling coefficient on ABL Credit Quality.

Key Hypotheses (2 of 2)

Hypothesis 3 (H3) — Network-Contagion Channel

Institution-level credit-quality co-movement across bank holding companies carries predictive content beyond aggregate ABL indicators (long horizon).

- Tested via Dynamic Graph Attention Network on the top-30 BHCs by total assets.

Hypothesis 4 (H4) — Information Source

ABL predictive content is driven by private lender assessments (SFNet) rather than secondary-market ABS prices (TRACE).

- Tested via SFNet-only vs TRACE-only ablations on a common right-edge OOS panel.

Three-Tier ML Stack

Sample is small (67-quarter panel, 66 SFNet surveys; 7 stress quarters, 6 positive events at $h = 1$). Architecture choices dictated by sample size, not maximalism.

Tier 1 — Linear baseline (headline H1, H4)

Predictive logit, parsimonious ABL + 9 macro controls. Interpretable coefficients + AUROC ablation benchmark.

Tier 2 — Temporal Fusion Transformer (cross-check H1)

Attention-based (Lim et al. 2021) with variable-selection networks. Read for **variable-importance ranking**, not raw AUROC (sample too small).

Tier 3 — Dynamic Graph Attention Network (H3)

Institution-level (Veličković et al. 2018) over BHCs. Dynamic adjacency from rolling 4Q C&I non-accrual correlation.

XGBoost + SHAP runs in parallel as a methodology cross-check.

H1: In-Sample Logit ($h = 1$, p90 target)

Table 1: **ABL feature block, parsimonious 4-variable logit**

Variable	Coef.	SE	z	p
TRACE price-discount proxy	-0.006	0.233	-0.028	0.978
ABL Credit Quality composite	**1.324**	0.343	3.86	$<$**0.001**
TRACE log trade volume	-0.132	0.449	-0.295	0.768
Commitments QoQ %	**0.860**	0.366	2.35	**0.019**

9 macro-financial controls not shown. $N = 66$, robust SE.

Economic magnitude (partial-effect sweep on ABL_CQ, other vars at means):

50th pctile	3.4%	95th	42.4%
90th	18.5%	99th	66.2%

Actual fitted probability at the 6 pre-stress quarters: mean 46% vs 3.1% median elsewhere.

H1: OOS Ablation — Headline Parsimonious

Table 2: **Strict right-edge OOS AUROC, parsimonious ABL block**

Target	ABL+ctrls	Ctrls only	Gain	N_{OOS}	Pos.
Window-4 (12 months)	**0.732**	0.670	**+6.2 pp**	43	9
Window-8 (24 months)	0.861	0.826	+3.5 pp	39	17

Strict right-edge OOS: forecast origins whose look-ahead window extends past 2025Q3 are dropped from evaluation.

Why window-4 is the headline: 9 OOS positives (vs only 3 at $h = 1$ p90) gives tighter inference; preserves a 12-month policy horizon.

Why window-8 gain is smaller: the controls-only specification already attains 0.826 at the wider window — the macro block captures most long-window predictive content; the marginal ABL signal lives at the shorter target.

H1: When the Model Fires

In-sample fitted probability $P(\text{stress}_{t+1} \mid \mathbf{x}_t)$ at the 6 pre-stress forecast-origin quarters ($h = 1$, p90 target):

Origin	Predicts stress at	$\hat{P}$
2009Q1	2009Q2	**74%**
2011Q2	2011Q3	12%
2011Q3	2011Q4	46%
2019Q4	2020Q1	19%
2020Q1	2020Q2	**92%**
2022Q2	2022Q3	33%
Mean		**46%**
Median across 60 tranquil quarters		3.1%

Pattern: the model fires *strongly* on *cluster continuation* (74%, 92%) and *more weakly* when predicting the *first* quarter of an unexpected shock (12%, 19%) — the pattern a leading-indicator framework predicts.

H1: ML Variable-Importance Diagnostics

A non-circular cross-check: we feed the ML models the **five raw SFNet credit-quality flows individually** (not the composite, to avoid collinearity) + 2 TRACE + 9 macro = 16 features, and ask which the algorithms use. AUROC is uninformative at $n = 66$ (overfitting); we read *rankings*.

XGBoost SHAP (deterministic)

QoQ non-accrual change ranks 2nd of 16 — top ABL indicator, ahead of fed funds, realised vol, yield curve, VIX (behind only credit-to-GDP gap).

TFT Variable-Selection Network (10-seed average)

Near-uniform weights (weak separation at $n = 66$), but ABL flows — **commitments QoQ & write-off diffusion** — take the top two of the top four.

Honest read: both ML methods, given the *raw* indicators, independently point to the ABL credit-quality (non-accrual) channel — a methodology-independent corroboration of H1. Discrimination is weak at $n = 66$; the headline still rests on the logit (1.324) + ablation (+6.2 pp).

H2: State-Dependent Amplification (mixed evidence)

Conjecture: ABL stress is a stronger predictor when VIX is elevated (Brunnermeier–Pedersen amplification).

In-sample interaction test:

- ABL_CQ $\times$ VIX^z coefficient: $\hat{\beta}_3 = -15.0$ at $h = 1$; $\sim 2{\times}10^4$ at $h = 4$ (near-perfect separation, no usable SE)
- Signs disagree across horizons. OOS AUROC of augmented model = no-interaction baseline (0.744 at $h = 1$; 0.525 at $h = 4$).
- Read as **statistically uninformative** at $n = 66$.

Rolling-coefficient analysis (20-quarter window):

- Peak ABL_CQ coefficient ~ 230 at **2022Q3**
- Small and unstable in tranquil 2015–2016 windows
- Unconditional $\rho = +0.17$ between rolling coefficient and contemporaneous VIX

Honest read: interaction test is uninformative; rolling-coefficient is directionally consistent with H2 but the 20-quarter window is too small for formal inference.

H3: Dynamic Graph Attention Network

Setup: Approach A = top-30 BHCs + Y-9C features, adjacency from rolling 4Q non-accrual correlation. Approach B = 3 aggregate nodes (ABL Credit / Market Stress / Macro).

D-GAT vs. logit AUROC (p90)	A (inst.)	B (aggr.)	Logit
$h = 1$	0.287	0.674	**0.783**
$h = 2$	0.286	**0.571**	0.508
$h = 4$	0.400	0.342	**0.517**
$h = 8$	**0.491**	0.454	0.463

At $h = 8$ Approach A edges the logit by 2.8 pp (0.491 vs 0.463) — within sampling noise on 3 OOS positives. At shorter horizons, aggregate D-GAT (B) and logit dominate: real-time SFNet sentiment beats lagged call-report data.

Honest read: at most weak directional support for H3.

H4: SFNet vs TRACE (horizon-dependent)

Table 3: **SFNet vs TRACE OOS AUROC, extension panel**

Horizon	SFNet-only	TRACE-only
window-4 ($N_{\text{OOS}} = 43$)	0.683	0.699
window-8 ($N_{\text{OOS}} = 39$)	**0.856**	0.842

Window-8 (red): SFNet beats TRACE by $+1.4$ pp — private survey assessments contain forward-looking signal that the secondary market has not yet priced.

Window-4 (blue): the comparison reverses by 1.6 pp — at short horizons, market prices and lender surveys are largely co-incident.

Honest framing: H4 evidence is restricted to the long-horizon design.

H4: Why Private Signals Lead at the Long Horizon

What lenders observe vs. what the secondary market observes:

SFNet (private lender side)	**TRACE (secondary market)**
Monthly borrowing-base certificates	Deal-level performance reports (lagged)
Quarterly on-site field exams	Ratings actions (lagging)
Real-time portfolio-watch up/downgrades	Prepayment data

Window-8 (24 months, SFNet wins by +1.4 pp): the slow-build private signals — gradual rise in non-accrual diffusion, persistent portfolio-watch downgrades — carry forward information that has not yet been priced. Lender monitoring leads the market by months to quarters.

Window-4 (12 months, TRACE wins by 1.6 pp): information sets converge as crisis approaches. Market prices have caught up to lender assessments; TRACE's price signal is modestly sharper.

Connects to: Coval et al. (2009) and Gorton & Metrick (2012) on private information in opaque credit markets — but specifically for ABL, where the asymmetry is starkest.

Long-History Bank-Channel Baseline

Concern: 66-quarter SFNet is short. **Response:** long-history FR Y-9C bank-channel analogue, **2000Q1–2025Q4, 50,031 BHC-quarter obs / 1,238 BHCs**.

OOS AUROC	$h = 1$	$h = 4$	$h = 8$	w4	w8
BHC + CTRL	0.815	**0.833**	**0.956**	**0.878**	**0.942**
BHC only	**0.835**	0.816	0.822	0.833	0.892
CTRL only	0.764	0.805	0.947	0.803	0.860

Bluwstein et al. (2023): logit baseline AUROC **0.79**; ML frontier 0.86–0.87.

BHC-only attains **0.82–0.89** — at or above Bluwstein's logit. BHC + CTRL spans **0.82–0.96**, comparable to Bluwstein's ML benchmark.
Caveat: our SSI target $\neq$ Bluwstein's historical crisis dates; comparison is informal.

Robustness

- **Alternative crisis definitions:** window-4 (main) and window-8 (long horizon). p85 and p80 sweeps were tried and hurt discrimination — consistent with the 7-quarter p90 set being the natural cluster.
- **Control set:** canonical 9 macro-financial controls — VIX, HY OAS, TED spread, STLFSI, realised volatility, yield-curve slope, credit-to-GDP gap, fed funds rate, IP growth.
- **Strict right-edge OOS:** no information from $t \geq t^*$ leaks into the model fit at t^*. Window-4 $N_{\text{OOS}} = 43$, window-8 $N_{\text{OOS}} = 39$.
- **Extension panel:** adds SLOOS bank-lending-standards survey, NFCI/ANFCI Chicago Fed financial-conditions indices, and FRED C&I delinquency/charge-off series.

Limitations

The binding constraint throughout is **sample size**: 67 quarters, 7 stress quarters in 4 clustered episodes.

- Power is insufficient for formal two-sided AUROC tests on most ablations; **bootstrap CIs are wide** even at the best specifications.
- ML architectures (XGBoost, TFT, D-GAT) **underperform the well-specified logit by design** — parameter counts dwarf the positive-event count (a documented small-sample regime, Bluwstein et al. 2023).
- Comparisons span many targets, feature blocks, and models. We **pre-commit to the parsimonious window-4 logit as the headline** and report the rest as transparent diagnostics — limiting specification search.
- **Securitized Loans and Leases by WRDS**:
  Asset-level constituents of Asset-Backed Securities (ABS), including auto loans, leases, and other securitized debt.

Conclusion

Findings

- ABL lender-survey indicators predict systemic stress within twelve months at AUROC 0.732 vs 0.670 macro-only.
- Private SFNet assessments beat TRACE secondary-market prices at the two-year horizon (0.856 vs 0.842); the comparison reverses at twelve months.
- Bank-channel analogue achieves AUROC **0.82–0.96** across horizons on 50,031 BHC-quarter observations.
- H2 (state-dependent amplification) and H3 (institution-level network) receive only **weak / directional** support at this sample size — reported transparently.

Practitioner takeaway: ABL credit-quality indicators belong in the systemic-risk monitoring toolkit, alongside macro-financial aggregates and not as a substitute for them.