Asset Quality and Equity-Market Monitoring in Indian Public-Sector Banks: Evidence from FY2016-FY2025

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Abstract

This study examines whether equity prices monitor disclosed bank risk in banks under majority government ownership. Using a balanced panel of 12 listed Indian public-sector banks and annual financial and price data for FY2016-FY2025, it relates price returns in the following financial year to lagged changes in capital adequacy, gross non-performing assets (GNPA), the cost-to-income ratio, return on average assets, and liquidity. Annual log price returns are constructed from corporate-action-adjusted financial-year-end prices and exclude cash dividends. The preferred two-way fixed-effects model uses 96 bank-year observations and controls for bank size, loan growth, deposit growth, book capitalisation, and post-amalgamation periods. A one-standard-deviation increase in lagged GNPA change (about 2.94 percentage points) is associated with an annual log return lower by 0.1078 log points. The coefficient is statistically significant under bank-clustered inference ($p = 0.007$), an enumerated 4,096-pattern bank-cluster sign-randomisation test ($p = 0.011$), a 9,999-replication within-year permutation placebo ($p = 0.028$), and Benjamini-Hochberg adjustment across the five CAMEL coefficients (adjusted $p = 0.036$). It is not significant when standard errors are clustered by year ($p = 0.168$) or jointly by bank and year ($p = 0.111$), and its magnitude declines when influential return years are excluded. Quantile point estimates are more negative in the lower tail, although bank-block bootstrap intervals include zero. The findings therefore support a qualified, time-sensitive association, not a causal conclusion. Because every sampled bank is government-owned, the design cannot identify the effect of state ownership or implicit public support.

Keywords: asset quality; equity-market monitoring; public-sector banks; non-performing assets; panel data; India

Introduction

Government ownership makes equity-market monitoring theoretically ambiguous. State support can reduce expected creditor losses and stabilise funding, but it does not necessarily protect listed shareholders from dilution, restricted distributions, recapitalisation conditions, or weaker residual cash flows. This study examines the pricing, or monitoring, component of market discipline: whether equity returns covary with

disclosed bank risk. It does not test the influence component, which concerns whether market signals change managerial behaviour.

Asset quality provides a direct test of market monitoring. Non-performing assets reduce interest income, increase expected provisions, absorb capital, and create uncertainty about future loss recognition. In a privately owned bank, these channels would generally reduce equity value. In a government-owned bank, anticipated recapitalisation or regulatory forbearance may weaken the response, but support for institutional continuity does not guarantee a particular shareholder payoff. Government support is therefore a theoretical motivation for the analysis, not a variable measured in the study.

Indian public-sector banks provide an informative but institutionally specific setting. The sample comprises the 12 listed public-sector banks that remained separately observable over the estimation window. The period covers stressed-asset recognition and resolution, recapitalisation, large-scale amalgamations, the COVID-19 shock, and a later improvement in system-level asset quality. These events created substantial variation in bank fundamentals and investor uncertainty. They also produced common policy and macroeconomic shocks that pooled regressions would not adequately separate from bank-specific information.

Much of the CAMEL literature evaluates bank soundness or accounting performance rather than equity pricing. Studies of bank share prices often use price levels, contemporaneous ratios, overlapping indicators, and conventional standard errors. These choices can introduce non-stationarity, ambiguous information timing, multiple-testing problems, and unreliable inference in short panels. They also make bank-specific information difficult to distinguish from common annual market movements.

This paper asks a narrower question: is deterioration in asset quality associated with lower returns in the following financial year for listed public-sector banks after other CAMEL changes and common year conditions are controlled? The analysis focuses on a theory-led asset-quality mechanism, reconstructs price returns and key ratio definitions, applies two-way fixed effects and small-panel diagnostics, and reports dependence-sensitive, influence, and distributional evidence, including results that do not confirm the main association. The leave-one-out PSB return is used as a sector-demeaned transformation, not as an independent market-factor test.

The central estimate is economically material but inference-dependent. In the fully controlled mean regression, a one-standard-deviation increase in lagged GNPA change is associated with an annual log return lower by 0.1078 log points. The coefficient is significant under bank-clustered, enumerated bank-cluster, permutation, and false-discovery-rate procedures and is stable across the reported outlier treatments. It is not significant under year or two-way clustering, loses significance when merger-affected banks are excluded, and is sensitive to several individual return years. Quantile point estimates are more negative in the lower tail, but cluster-block intervals include zero.

These findings do not show whether sovereign backing weakens or preserves market discipline relative to private banks. Within the sampled public-sector banks, changes in GNPA are associated with subsequent price returns under several, but not all, reasonable inference procedures. The result is an in-sample association; it is neither a causal estimate nor an out-of-sample forecasting claim.

The remainder of the paper proceeds as follows. Section 2 describes the institutional setting. Section 3 develops the theoretical framework and hypotheses. Section 4 explains the data and empirical strategy. Section 5 presents the results. Section 6 discusses implications. Section 7 concludes.

Institutional Setting

Public ownership, listing and market discipline

Indian public-sector banks are commercial banks in which the central government retains majority ownership while minority shares trade publicly. This structure combines policy and political influences with market valuation. Government control may weaken some external governance channels without making equity-price information irrelevant (Laeven & Levine, 2009).

International evidence documents differences between state-owned and private banks in lending behaviour, performance, political responsiveness, and risk (Cornett et al., 2010; Dinç, 2005; Iannotta et al., 2007, 2013; Micco et al., 2007; Sapienza, 2004). Safety nets and bailout expectations may reduce creditors' incentives to monitor risk (Dam & Koetter, 2012; Demirgüç-Kunt & Huizinga, 2004; Gropp et al., 2011). Equity investors, however, remain exposed to weaker earnings, dilution, and opportunity costs. Stock

returns can therefore contain evidence of the market-monitoring component of discipline for residual claimants.

Stressed assets, recapitalisation and amalgamation

The sample period follows the regulatory asset-quality review that intensified recognition of stressed loans and spans a broad decline in reported non-performing assets. It also includes government capital support and the consolidation of several public-sector banks. Bank of Baroda absorbed Vijaya Bank and Dena Bank from April 2019. Canara Bank, Indian Bank, Punjab National Bank, and Union Bank of India absorbed other public-sector banks from April 2020. These transactions changed balance-sheet scale, inherited asset-quality profiles, and operating structures (Government of India, 2019, 2020; Reserve Bank of India, 2025).

The empirical design addresses this setting in three ways. Year fixed effects absorb policy and macroeconomic shocks common to the sampled banks. A post-amalgamation indicator captures the main timing of structural changes in affected banks. A separate robustness test excludes every merger-affected bank. These procedures cannot reconstruct pro forma pre-merger financial statements, but they reduce the likelihood that consolidation mechanically drives the principal result.

Why the setting has broader relevance

The institutional question is not unique to India, although the present design does not estimate a cross-country or ownership effect. Many economies have listed banks with public backing. The broader issue is whether safety nets redistribute risk sensitivity across claimants. The Indian sample provides a case study of how equity prices behave in such institutions.

Theory, Literature and Hypotheses

Market discipline under public support

Market discipline has two commonly distinguished components: monitoring and influence. Monitoring requires investors to observe and price risk; influence requires the resulting price signal to change bank behaviour. Evidence from subordinated debt and other claims suggests that market prices can contain useful risk information, although disclosure, safety nets, and expected intervention affect their sensitivity (Flannery, 1998; Flannery & Sorescu, 1996; Goyal, 2005; Nier & Baumann, 2006; Sironi, 2003). Basel Pillar 3 likewise treats disclosure and market discipline as complements to capital regulation (Basel Committee on Banking Supervision, 2015). This paper tests monitoring, not influence.

Government guarantees complicate monitoring. When investors expect the state to prevent default, liability spreads may become less sensitive to risk, while political incentives may affect intervention and lending (Brown & Dinç, 2005; Dinç, 2005). Support for continuity, however, does not assure a particular equity payoff. Recapitalisation may dilute shareholders, regulatory intervention may restrict dividends, and impaired assets may reduce residual franchise value. These mechanisms motivate the analysis, but the sample contains neither a direct measure of expected government support nor counterfactual variation in that support.

Asset quality as a value-relevant signal

Loan quality is central to bank valuation because accounting earnings and regulatory capital depend on the recognition and provisioning of credit losses. Loan-loss disclosures can convey information about expected future losses, although managerial discretion and economic conditions affect their interpretation (Beatty & Liao, 2014; Bushman & Williams, 2012; Hegde & Kozlowski, 2021; Wahlen, 1994). Gross NPA is a relatively direct measure because it records the share of gross advances classified as non-performing before accumulated provisions are considered.

An increase in GNPA may reduce expected net interest income, raise credit costs, constrain loan growth, and increase the likelihood of capital support. Research on NPL dynamics links market structure to changes in NPL ratios (Karadima & Louri, 2020), while evidence from NPL sales shows that investors respond to resolution transactions (Pirgaip & Uysal, 2023). In India, bank accounting and regulatory variables have

been linked to share prices (Sharma et al., 2023), and market power has been linked to market-based default risk (Khan & Ahmad, 2022).

State contingency and distributional asymmetry

The return response to deteriorating asset quality may vary across market conditions. When uncertainty, recognition risk, or expected losses are high, a given increase in GNPA may be associated with a larger downward revision in returns. Mean regressions can conceal this heterogeneity. Quantile regression is therefore used as an exploratory extension, although the short panel and fixed effects make distributional inference uncertain (Koenker & Bassett, 1978; Koenker, 2004).

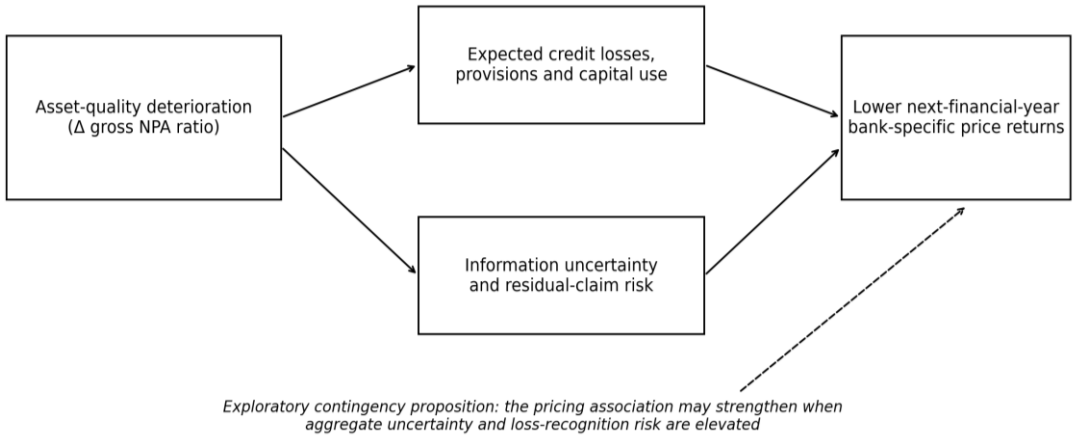


Figure 1. Conceptual mechanism linking asset-quality deterioration to equity-market monitoring

Hypotheses

H1. An increase in the gross non-performing asset ratio is associated with lower raw and PSB-demeaned price returns in the following financial year.

P1 (exploratory). The negative association between GNPA and returns is more pronounced at lower conditional quantiles of the PSB-demeaned return distribution.

The remaining CAMEL changes—capital adequacy, cost efficiency, profitability, and liquidity—are retained as theoretically motivated covariates rather than central hypotheses. Their expected associations are ambiguous in state-owned banks: capital may reflect recapitalisation or balance-sheet contraction, efficiency may reflect restructuring, and liquidity may provide resilience while imposing opportunity costs (Acharya & Naqvi, 2012; Beltratti & Stulz, 2012; Berger & Bouwman, 2009; Liang & Wei, 2012; Thota & Subrahmanyam, 2020).

Data and Empirical Strategy

Sample and sources

The sample contains the 12 listed public-sector banks for which continuous price and annual financial data are available in the research archive for FY2016-FY2025. The adjusted price panel contains 29,696 bank-day observations. Lagging the annual changes and controls yields a balanced estimation sample of 96 bank-years covering return years FY2018-FY2025. The bank-year is the unit of analysis.

Table 1. Sample banks

Code	Bank
BOBB	Bank of Baroda
BOIB	Bank of India
BOMB	Bank of Maharashtra
CANB	Canara Bank

Code	Bank
CBIB	Central Bank of India
INDB	Indian Bank
IOBB	Indian Overseas Bank
PNBB	Punjab National Bank
PSBB	Punjab & Sind Bank
SBIB	State Bank of India
UBIB	Union Bank of India
UCOB	UCO Bank

Annual financial-statement line items were assembled from publicly available historical statements and checked through formula reconstruction and basic accounting-consistency tests. Daily NSE prices were adjusted for documented stock splits and rights issues recorded in the archive's corporate-action register. Because part of the financial dataset comes from a third-party interface, each line item should be reconciled directly with audited annual reports and RBI or institutional databases before external submission.

Return measures

The primary outcome is the annual log price return calculated from corporate-action-adjusted closing prices. Because cash dividends are excluded, this measure is not a total shareholder return. For the estimation years, aggregating daily returns reconciles exactly to the corresponding financial-year price ratio:

$$R_{it} = ln(P_{it} / P_{i,t-1}) \quad (1)$$

A second outcome expresses each bank's performance relative to the sampled public-sector-bank group by subtracting the contemporaneous return of the other banks. For bank i in year t, the leave-one-out PSB benchmark is the equal-weighted mean daily log return of the remaining banks; the daily differences are then summed within the financial year:

$$AR_{it} = \Sigma d\ [\ r_i d_t - (1/(N_t - 1))\ \Sigma j \neq i\ r_j d_t\ ] \quad (2)$$

The focal bank is excluded from its own benchmark. In a balanced cross-section, however, the PSB-demeaned return is algebraically proportional to that bank's deviation from the same-year PSB mean. With year fixed effects, it is therefore a rescaled version of the raw-return specification rather than an independent robustness test. It is retained for interpretation and for the exploratory quantile analysis.

CAMEL variables and controls

Table 2. Variables and operational definitions

Variable	Construct	Definition	Expected role
ΔCRAR	Capital adequacy	Annual change in reported total capital adequacy ratio	Ambiguous/positive
ΔGNPA	Asset quality	Annual change in gross NPA / gross advances (%)	Negative
ΔCTI	Management efficiency	Annual change in operating expenses / net operating revenue (%)	Negative

Variable	Construct	Definition	Expected role
ΔROAA	Earnings	Annual change in net profit / average total assets (%)	Positive
ΔLIQTA	Liquidity	Annual change in cash, RBI balances, interbank balances and investments / total assets (%)	Ambiguous/positive
SIZE	Scale	Lagged natural log of total assets	Control
LOAN_GROWTH	Business growth	Lagged annual growth in gross advances	Control
DEPOSIT_GROWTH	Funding growth	Lagged annual growth in deposits	Control
CAPTA	Book capitalisation	Lagged equity capital and reserves / total assets (%)	Control
MERGER_POST	Structural change	Indicator for post-amalgamation observations of affected banks	Control

Note. Δ indicates an annual first difference. All continuous right-hand-side variables are lagged one financial year in the regression equations.

Two accounting measures were reconstructed. The cost-to-income ratio uses net operating revenue rather than total income, and ROAA uses average rather than closing total assets. Continuous predictors are winsorised at the pooled 1st and 99th percentiles and standardised over the estimation sample. Pooled transformations avoid mechanically altering approximately two observations in each bank's short ten-observation series and preserve absolute cross-bank variation before fixed effects are applied.

Mean regression design

The preferred mean specification is:

$$Y_{it} = \beta_1 \Delta CRAR_{i,t-1} + \beta_2 \Delta GNPA_{i,t-1} + \beta_3 \Delta CTI_{i,t-1} + \beta_4 \Delta ROAA_{i,t-1} + \beta_5 \Delta LIQTA_{i,t-1} + \Gamma X_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

Y is either the raw annual log price return or its PSB-demeaned transformation; X contains size, loan growth, deposit growth, capital-to-assets, and the merger indicator. Bank effects absorb time-invariant bank characteristics, while year effects absorb conditions common to all banks in a given year. The model therefore estimates within-bank associations relative to common annual movements. A dynamic specification adds lagged return only as a sensitivity check because the short time dimension can generate Nickell-type bias.

Exploratory distributional specification

To explore P1, conditional quantile models are estimated for τ = 0.10, 0.25, 0.50, 0.75 and 0.90 using the same covariates and indicator structure:

$$Q_\tau(AR_{it} \mid Z_{it}) = Z_{it}'\beta(\tau) \quad (4)$$

The quantile coefficients are descriptive and are not interpreted causally. Conventional heteroskedasticity-robust standard errors are reported for comparability, but they do not resolve the few-cluster problem. Bank-block bootstrap intervals are therefore used as the more conservative sensitivity check. Their width, together with the short time dimension, precludes a confirmatory distributional claim.

Inference, multiplicity and falsification

The principal standard errors are clustered by bank, allowing arbitrary heteroskedasticity and within-bank dependence. Because the panel contains only 12 banks and eight return years, the analysis also reports year-clustered and two-way bank-and-year-clustered inference. The GNPA coefficient is assessed through enumerated Rademacher sign randomisation over all 2^12 = 4,096 bank patterns and, as a time-cluster

sensitivity check, all 2^8 = 256 year patterns (Arellano, 1987; Cameron et al., 2008; Cameron & Miller, 2015; MacKinnon & Webb, 2017; Petersen, 2009; White, 1980).

A 9,999-replication within-year permutation placebo randomly reassigns GNPA changes across banks while preserving the year structure. The Benjamini-Hochberg procedure controls the false-discovery rate across the five CAMEL coefficients in the fully controlled model (Benjamini & Hochberg, 1995). Leave-one-bank-out and leave-one-year-out estimates assess influence. Other checks vary winsorisation, remove highly collinear growth controls, exclude merger-affected banks, and compare alternative asset-quality measures. The permutation diagnostic assumes within-year exchangeability and is not an exact causal randomisation test.

Empirical Results

Descriptive evidence

Table 3. Descriptive statistics

Variable	N	Mean	SD	P25	Median	P75	Min	Max
Annual log return	96	0.0097	0.5750	-0.3205	0.0320	0.4107	-1.8716	0.9909
PSB-demeaned annual return	96	0.0000	0.2652	-0.1534	-0.0078	0.1847	-0.9659	0.6016
ΔCRAR (pp)	96	0.6621	1.3871	-0.0250	0.5400	1.3200	-2.8895	5.2570
ΔGNPA (pp)	96	-0.8216	2.9380	-2.6600	-1.0150	0.0000	-7.0500	8.0000
ΔCost-to-income (pp)	96	-0.0613	6.0198	-3.4943	0.0391	2.7995	-13.7969	17.5980
ΔROAA (pp)	96	0.1520	0.8657	-0.1270	0.1526	0.3716	-1.8645	3.4962
ΔLiquidity/assets (pp)	96	-0.0746	3.2654	-2.2413	-0.0825	2.2529	-7.7992	7.1308
Log total assets	96	13.1981	0.9655	12.4640	13.2479	13.9032	11.5160	15.5290
Loan growth	96	0.0910	0.1314	0.0224	0.0901	0.1444	-0.1735	0.6105
Deposit growth	96	0.0892	0.1280	0.0323	0.0722	0.1069	-0.0949	0.7182
Capital/assets (%)	96	6.4736	1.2249	5.7601	6.1767	7.1251	4.4945	11.0972

Note. CAMEL changes are shown in percentage points before standardisation. Growth rates are decimals. Statistics reflect the pooled-winsorised estimation sample where applicable.

The mean raw annual log return is close to zero, with substantial dispersion across bank-years. The mean PSB-demeaned return is zero by construction. GNPA declines by an average of 0.82 percentage points, but the standard deviation is 2.94 percentage points and the range remains wide.

Correlation and model diagnostics

Table 4. Correlation matrix for principal regressors

Variable	ΔCRAR	ΔGNPA	ΔCTI	ΔROAA	ΔLIQTA	SIZE	LOAN GR.	DEP. GR.	CAP/TA
ΔCRAR	1.000								
ΔGNPA	-0.208	1.000							
ΔCTI	-0.107	0.255	1.000						
ΔROAA	0.324	-0.344	-0.606	1.000					

Variable	ΔCRAR	ΔGNPA	ΔCTI	ΔROAA	ΔLIQTA	SIZE	LOAN GR.	DEP. GR.	CAP/TA
ΔLIQTA	0.038	0.295	-0.109	0.055	1.000				
SIZE	-0.131	-0.096	0.028	0.040	-0.122	1.000			
LOAN GR.	-0.068	-0.251	0.032	0.170	-0.315	0.322	1.000		
DEP. GR.	-0.117	-0.021	-0.002	0.133	0.198	0.301	0.828	1.000	
CAP/TA	0.051	-0.418	-0.029	0.278	-0.203	-0.192	0.212	-0.002	1.000

Note. Pairwise Pearson correlations. Loan and deposit growth are highly correlated (0.828). Their variance inflation factors are approximately 17.5 and 16.0, respectively; dropping either or both leaves the GNPA coefficient virtually unchanged.

Among the five CAMEL changes, the largest pairwise correlation is -0.606 between ΔCTI and ΔROAA. The high correlation between loan and deposit growth increases uncertainty around those control coefficients, so reduced-control specifications are reported as robustness checks. The high overall R^2 in the raw-return models mainly reflects common annual movements and should not be read as the explanatory power of the CAMEL variables.

Mean return regressions

Table 5. CAMEL changes and subsequent bank equity returns

Predictor	(1) Raw return CAMEL	(2) Raw return full	(3) Raw return dynamic	(4) PSB-demeaned return
ΔCRAR (t−1)	0.0092 (0.0259)	0.0160 (0.0359)	0.0169 (0.0354)	0.0169 (0.0391)
ΔGNPA (t−1)	-0.0992*** (0.0255)	-0.1078*** (0.0327)	-0.1116*** (0.0311)	-0.1173*** (0.0357)
ΔCTI (t−1)	-0.0035 (0.0405)	-0.0006 (0.0398)	0.0014 (0.0374)	-0.0001 (0.0433)
ΔROAA (t−1)	-0.0039 (0.0318)	-0.0057 (0.0318)	-0.0043 (0.0297)	-0.0054 (0.0345)
ΔLIQTA (t−1)	0.0405 (0.0490)	0.0260 (0.0848)	0.0305 (0.0850)	0.0278 (0.0928)
Size (t−1)	—	0.1158 (0.2847)	0.1406 (0.3137)	0.1225 (0.3082)
Loan growth (t−1)	—	-0.0167 (0.1807)	-0.0098 (0.1868)	-0.0191 (0.1976)
Deposit growth (t−1)	—	0.0244 (0.1794)	0.0188 (0.1850)	0.0271 (0.1960)

Predictor	(1) Raw return CAMEL	(2) Raw return full	(3) Raw return dynamic	(4) PSB-demeaned return
Capital/assets (t−1)	—	0.0313 (0.0469)	0.0323 (0.0491)	0.0337 (0.0511)
Merger-post	—	0.1054 (0.2027)	0.0882 (0.2149)	0.1143 (0.2212)
Lagged return	—	—	-0.0259 (0.0584)	—
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	96	96	96	96
R^2	0.847	0.851	0.852	0.168
Adjusted R^2	0.798	0.789	0.786	-0.180

Note. Bank-clustered standard errors are reported in parentheses. Continuous predictors are standardised; coefficients therefore correspond to a one-standard-deviation change. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Model (4) is a sector-demeaned rescaling of the raw outcome when the panel is balanced and year effects are included; it is not an independent robustness test.

The central estimate in model (2) is -0.1078 (bank-clustered $p = 0.007$). The standard deviation of the winsorised GNPA change is 2.94 percentage points. A one-standard-deviation increase in lagged GNPA change is therefore associated with an annual log return lower by 0.1078 log points. In multiplicative terms, the gross return factor is about 10.2% lower, conditional on the other variables and fixed effects. The enumerated bank-cluster p-value is 0.011. In contrast, the year-clustered p-value is 0.168 and the two-way-clustered p-value is 0.111. H1 therefore receives qualified, dependence-sensitive support; the null is not rejected under every reasonable dependence structure.

No other CAMEL change is statistically significant in the fully controlled models. The evidence therefore supports a specific asset-quality association under selected inference procedures, not a claim that equity markets price every CAMEL component uniformly.

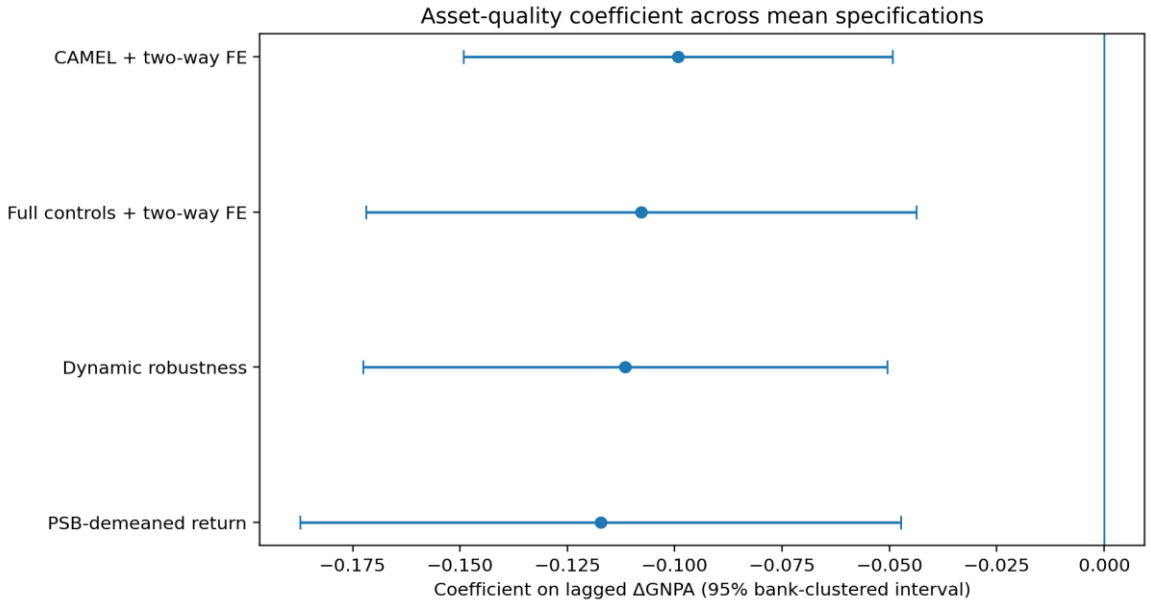


Figure 2. Stability of the lagged GNPA coefficient across mean specifications

Small-cluster inference, permutation and multiplicity

Table 6. Alternative inference for the asset-quality coefficient

Inference method	Raw coef.	Raw p	PSB-demeaned coef.	PSB-demeaned p
Bank-clustered t-test (12 clusters)	-0.1078	0.007	-0.1173	0.007
Enumerated bank-cluster sign test (4,096 patterns)	-0.1078	0.011	-0.1173	0.012
Year-clustered t-test (8 clusters)	-0.1078	0.168	-0.1173	0.168
Two-way bank-year-clustered test	-0.1078	0.111	-0.1173	0.111
Enumerated year-cluster sign test (256 patterns)	-0.1078	0.250	-0.1173	0.250
Within-year permutation placebo (9,999)	-0.1078	0.028	-0.1173	0.029
Benjamini-Hochberg adjusted p (5 CAMEL)	-0.1078	0.036	-0.1173	0.036

The inference results are mixed. The bank-clustered asymptotic test, the enumerated bank-cluster test, the within-year permutation placebo, and the false-discovery-rate adjustment reject the null. The year-clustered, enumerated year-cluster, and two-way-clustered procedures do not. This divergence, combined with the leave-one-year sensitivity, is a central limitation. It cannot be resolved by selecting the smallest p-value.

Distributional evidence

Table 7. Quantile estimates for PSB-demeaned annual returns

Quantile	ΔGNPA coefficient	Robust SE	95% lower	95% upper	p-value
0.10	-0.2215**	0.0904	-0.3986	-0.0444	0.017
0.25	-0.1189***	0.0430	-0.2032	-0.0347	0.007
0.50	-0.0841**	0.0385	-0.1596	-0.0086	0.032
0.75	-0.0389	0.0486	-0.1341	0.0563	0.426
0.90	-0.0194	0.0696	-0.1557	0.1170	0.781

Note. The quantile regressions include the full CAMEL set, controls, bank indicators and year indicators. The displayed intervals use conventional heteroskedasticity-robust quantile standard errors. Bank-block percentile intervals at the 10th and 25th quantiles include zero; the estimates are therefore exploratory.

The GNPA point estimate is -0.222 at the 10th percentile, -0.119 at the 25th percentile, and -0.084 at the median; its magnitude declines toward the upper tail. Conventional robust intervals exclude zero at the lower three quantiles. Bank-block bootstrap intervals for the 10th and 25th quantiles, however, include zero. The pattern is consistent with P1 but does not confirm quantile asymmetry.

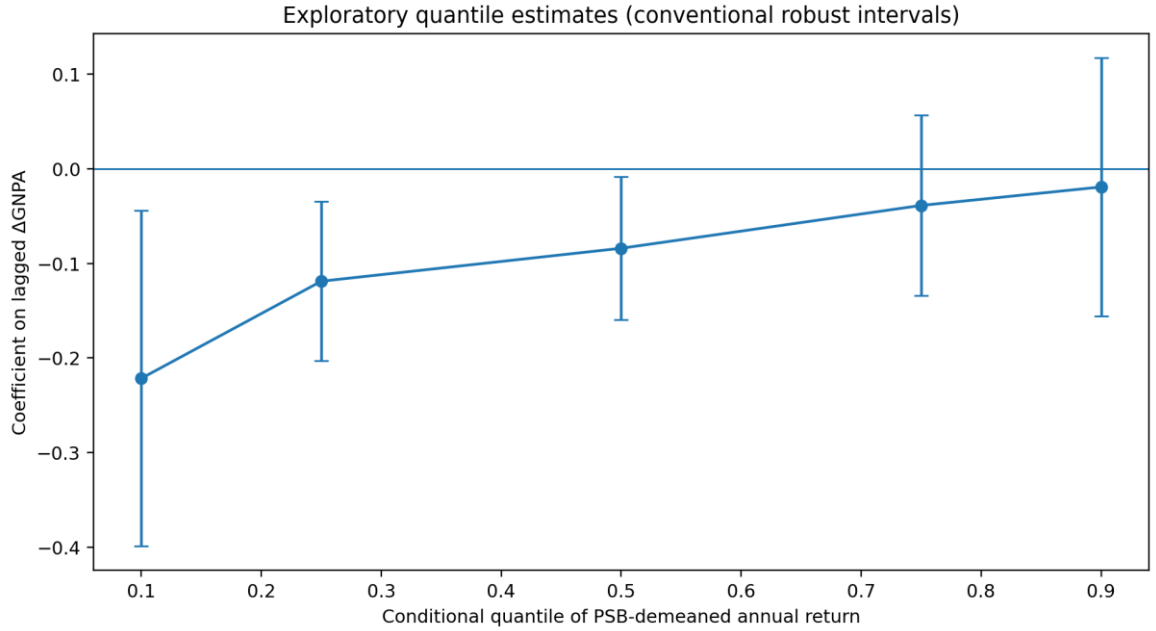


Figure 3. Lagged GNPA coefficient across the conditional distribution of PSB-demeaned returns

5.6 Robustness, influence and boundary conditions

Table 8. Robustness and scope of the asset-quality result

Specification	N	Asset-quality coefficient	Bank-cluster p
Baseline fully controlled model	96	-0.1078	0.007
No winsorisation	96	-0.1197	0.009
5th/95th percentile winsorisation	96	-0.1040	0.003
Drop deposit growth	96	-0.1073	0.007

Specification	N	Asset-quality coefficient	Bank-cluster p
Drop loan and deposit growth	96	-0.1066	0.005
Exclude merger-affected banks	56	-0.1015	0.123
Exclude FY2020-FY2021	72	-0.0339	0.584
Exclude FY2018	84	-0.0708	0.144
Exclude FY2020	84	-0.0468	0.202
Exclude FY2021	84	-0.0839	0.138
Replace GNPA with net NPA	96	-0.1049	0.109
Replace with GNPA/total assets	96	0.0198	0.602
Replace with provision-coverage change	94	-0.0455	0.016

Note. All specifications retain bank and year effects and the applicable fully controlled covariates. P-values are bank-clustered unless the inference method is stated separately. Alternative asset-quality variables are standardised independently.

The coefficient is stable across the reported outlier rules and after removing one or both highly collinear growth controls. It remains negative but is not statistically significant when all merger-affected banks are excluded. In the fully controlled model, leave-one-bank-out estimates range from -0.124 to -0.091 and remain significant under bank-clustered inference, indicating that no single bank drives the result. Time-period influence is more important: the coefficient loses bank-clustered significance when FY2018, FY2020, or FY2021 is removed and declines sharply when FY2020-FY2021 are excluded together.

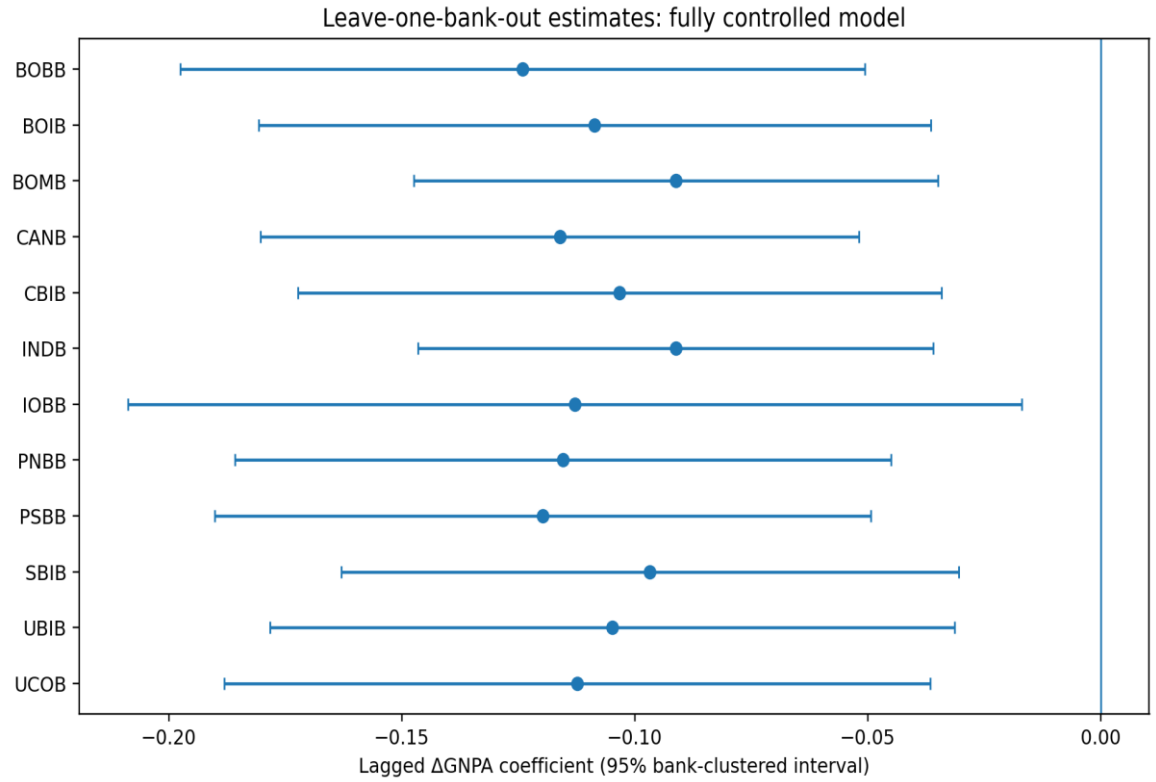


Figure 4. Leave-one-bank-out estimates of the lagged GNPA coefficient

Non-results and falsification outcomes

The direct downside outcomes—idiosyncratic volatility, downside semivariance, maximum drawdown, negative-return skewness, and down-to-up volatility—do not produce stable, statistically significant GNPA coefficients. Results for alternative asset-quality proxies are also mixed: net NPA is weak, GNPA-to-total-assets is null, and the change in provision coverage has a significant negative coefficient that is difficult to interpret causally because provisioning responds endogenously to stress. These results narrow the conclusion and show that it is sensitive to the asset-quality proxy.

Discussion

Equity returns remain associated with credit risk

Under several inference procedures, the negative GNPA-return coefficient indicates an association between bank-specific credit risk and the equity returns of the sampled government-owned banks. It does not demonstrate the influence component of market discipline and does not compare the strength of monitoring with private banks. The proposition that safety nets redistribute monitoring incentives across claimants remains plausible but untested in this design.

Asset quality provides the clearest annual CAMEL association

The null coefficients on CRAR, CTI, ROAA, and broad liquidity are theoretically plausible. Capital ratios combine loss-absorbing capacity with recapitalisation, changes in risk weights, and balance-sheet contraction. Efficiency changes may be obscured by restructuring and integration costs. Profitability is jointly determined with provisioning and may already be anticipated by investors. Broad liquidity combines resilience benefits with the cost of holding lower-yield assets. Within this specification, GNPA is the only CAMEL change that shows a consistent negative association under bank-clustered inference; this does not establish that it is a universally superior market signal.

State-contingent pricing

The more negative lower-tail point estimates and the attenuation outside FY2020-FY2021 are consistent with, but do not establish, state-contingent pricing. The year-clustered and leave-one-year results show that the association is temporally fragile. It should therefore be described as a pattern concentrated in high-uncertainty years that requires replication, not as a stable structural regime effect.

Implications

For bank managers, the results suggest that investors may respond more to deterioration in recognised asset quality than to mechanical changes in several headline CAMEL ratios. This interpretation is limited to the sampled banks and years. Delayed recognition may temporarily support reported performance while increasing uncertainty about future losses.

For investors, changes in GNPA should be interpreted alongside the loss-recognition regime, the credibility of provisioning, and aggregate financial stress. A decline from a high NPA base may convey different information from a fresh deterioration of the same size.

For regulators and public owners, the findings are consistent with transparent asset classification and resolution disclosure helping market participants interpret credit risk. The study does not test whether public support changes this monitoring process or how losses should be allocated among claimants.

For researchers, the results caution against treating CAMEL as a checklist of independently significant predictors. A theory-led focal mechanism, explicit reporting of null results, and inference adapted to a small number of clusters produce a narrower but better-supported contribution.

Conclusion

This study examines equity-market monitoring in 12 listed Indian public-sector banks using corporate-action-adjusted annual price returns and financial data through FY2025. It replaces price-level regressions with lagged return specifications, reconstructs key ratio definitions, includes bank and year effects, and reports enumerated small-cluster tests, permutation diagnostics, and sensitivity analyses.

The main result is narrow and inference-dependent. Deterioration in gross non-performing assets is associated with lower returns in the following financial year under bank-clustered, enumerated bank-cluster sign-randomisation, permutation, and false-discovery-rate procedures. The estimate is not significant under year or two-way clustering, is not robust to excluding merger-affected banks, and is influenced by several return years. Quantile estimates are more negative in the lower tail, but cluster-block intervals include zero. The other CAMEL changes do not provide robust incremental information in the reported models.

The paper therefore provides suggestive evidence that equity markets monitor changes in asset quality within listed public-sector banks. It does not identify the causal effect of asset-quality deterioration, the effect of government ownership, or the extent of implicit sovereign support. Its most defensible contribution is to show transparently the conditions under which the negative association between GNPA and returns appears.

Limitations

1. The effective sample contains 96 observations, 12 bank clusters, and only eight return years. Enumerated bank-cluster and permutation procedures strengthen inference along one dimension, but year and two-way clustering show that the short time dimension materially limits precision.
2. Annual fundamentals cannot be aligned precisely with every disclosure date. Investors may anticipate reported changes in asset quality, and annual returns may partly overlap the period in which prior-year results become public.
3. The leave-one-out PSB benchmark removes the sampled sector mean, but in the balanced panel it is algebraically related to the raw return when year effects are included. It is neither a broad-market factor model nor an independent validation outcome.
4. The data archive relies partly on a third-party financial-statement interface. Although the analytical panel can be rebuilt exactly from the archived workbooks, every line item should be reconciled with audited annual reports, RBI DBIE, CMIE Prowess, Capitaline, or an equivalent institutional database.

5. Merger indicators and exclusion tests cannot reconstruct the pro forma histories of the amalgamated institutions. The sample also omits the separate pre-merger market histories of absorbed banks and is therefore subject to survivorship and aggregation limitations.
6. Quantile inference is especially uncertain because the fixed-effects quantile models use only 12 banks and eight return years. Conventional robust intervals are narrower than the bank-block bootstrap intervals; the asymmetry result remains exploratory.
7. The design is predictive only in calendar ordering and associational in interpretation. Annual returns partly overlap the period in which prior-year financial results become public, investors may anticipate GNPA changes, and the study identifies no exogenous asset-quality shock.
8. The dependent variable is a price return and excludes cash dividends. It therefore understates total shareholder return when dividend yields differ across banks or years.
9. All sampled banks are majority government-owned. Without a private-bank comparison or a time-varying measure of expected public support, the design cannot estimate how ownership affects the strength of market monitoring.

Future research

1. Use quarterly disclosures and exact earnings-announcement dates to isolate unanticipated asset-quality information.
2. Compare public- and private-sector banks and interact asset-quality shocks with government ownership and expected support.
3. Exploit recapitalisation or recognition-policy discontinuities using event-study or quasi-experimental designs.
4. Construct expected-versus-unexpected NPA changes from analyst forecasts or supervisory stress indicators.
5. Extend the distributional analysis to cross-country panels of listed state-owned banks and apply cluster-robust quantile methods.
6. Test whether transparent resolution and provisioning disclosures moderate the equity penalty associated with deteriorating asset quality.

Declarations

Funding. No external funding was received for this study.

Competing interests. The authors declare that they have no competing interests.

Ethics approval. Not applicable. The study uses secondary financial and market data and involves no human participants.

Data and code availability. The final analytical panel, variable dictionary, verification scripts, and output logs are included in the accompanying reproducibility package, subject to the licensing and redistribution terms of the underlying price and financial-statement sources.

CRediT author statement. Saifali Abdul Latif Gadiwale: conceptualisation, methodology, data curation, formal analysis, investigation, visualisation and writing—original draft. Sakshi Desai, Nagaraj Yatnalli, Omkar Dhamnekar, Pankaj Shamanewadi and Pruthvi Naik: data curation, validation, investigation and writing—review and editing. Rahul Mailcontractor and Savitha Kulkarni: conceptualisation, supervision, validation, project administration and writing—review and editing. All authors approved the manuscript and take responsibility for the integrity of the work.

Acknowledgements. The authors acknowledge institutional support from Karnatak Law Society's Institute of Management Education and Research (Autonomous), Belagavi. They remain solely responsible for the analysis, interpretation and conclusions.

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Online Appendix

Appendix A. Data-construction audit

Component	Earlier treatment	Revised treatment	Rationale
Outcome	Standardised price level	Corporate-action-adjusted annual log price return and PSB-demeaned transformation	Avoids price-level non-stationarity; the sector-demeaned outcome is interpretive, not independent.
Cost efficiency	Operating expenses / total income	Operating expenses / net operating revenue	Uses the conventional banking cost-to-income denominator.
Profitability	Net profit / ending assets	Net profit / average assets	Aligns flow earnings with an average stock denominator.
Outliers	Within-bank 1%/99% winsorisation	Pooled 1%/99% winsorisation	Avoids mechanically replacing about two observations in every ten-point bank series.
Scaling	Bank-wise z-scores	Pooled-sample standardisation	Preserves cross-bank information before fixed effects.
Timing	Contemporaneous ratios and price	Lagged annual CAMEL changes and controls	Improves information timing and reduces simultaneity risk.
Specification	Separate pooled pillar regressions	Joint two-way fixed-effects model	Controls common shocks, limits multiple testing and estimates incremental associations.
Inference	Single robust covariance option	Bank, year and two-way clustering; enumerated sign tests; permutation and FDR	Shows that statistical significance depends on the assumed dependence structure.

Appendix B. Leave-one-bank-out estimates

Excluded bank	Coefficient	Clustered SE	p-value	N
BOBB	-0.1241	0.0375	0.008	88
BOIB	-0.1086	0.0368	0.015	88
BOMB	-0.0912	0.0287	0.010	88
CANB	-0.1161	0.0328	0.005	88
CBIB	-0.1032	0.0352	0.015	88

Excluded bank	Coefficient	Clustered SE	p-value	N
INDB	-0.0912	0.0282	0.009	88
IOBB	-0.1128	0.0489	0.044	88
PNBB	-0.1154	0.0359	0.009	88
PSBB	-0.1197	0.0359	0.008	88
SBIB	-0.0967	0.0338	0.017	88
UBIB	-0.1048	0.0375	0.019	88
UCOB	-0.1123	0.0387	0.016	88

Note. Dependent variable: raw annual log return. The specification is the fully controlled two-way fixed-effects model.

Appendix C. Direct downside-risk outcomes

Outcome	ΔGNPA coefficient	Clustered SE	p-value	N
Idio Vol	-0.0026	0.0063	0.692	96
Downside Risk	0.0061	0.0042	0.174	96
Abn Max Drawdown	-0.0218	0.0137	0.140	96
Ncskew Daily	0.3724	0.2871	0.221	96
Ncskew Weekly	0.1023	0.1448	0.495	96
Duvol	-0.0049	0.0929	0.959	96

Note. These outcomes do not provide consistent evidence that lagged deterioration in GNPA is associated with volatility, drawdown, or return-asymmetry measures. They are retained as transparent null tests.

Appendix D. Quantile block-bootstrap sensitivity

Quantile	Replications	Mean coefficient	Bootstrap SE	P2.5	P97.5	Share negative
0.10	299	-0.1576	0.1069	-0.3549	0.0295	94.3%
0.25	149	-0.1432	0.0898	-0.3301	0.0209	94.6%

Note. Banks are resampled as blocks. Percentile intervals include zero at the reported lower quantiles, which reflects the small-cluster uncertainty of the distributional extension. The limited number of successful bootstrap replications is an additional constraint.