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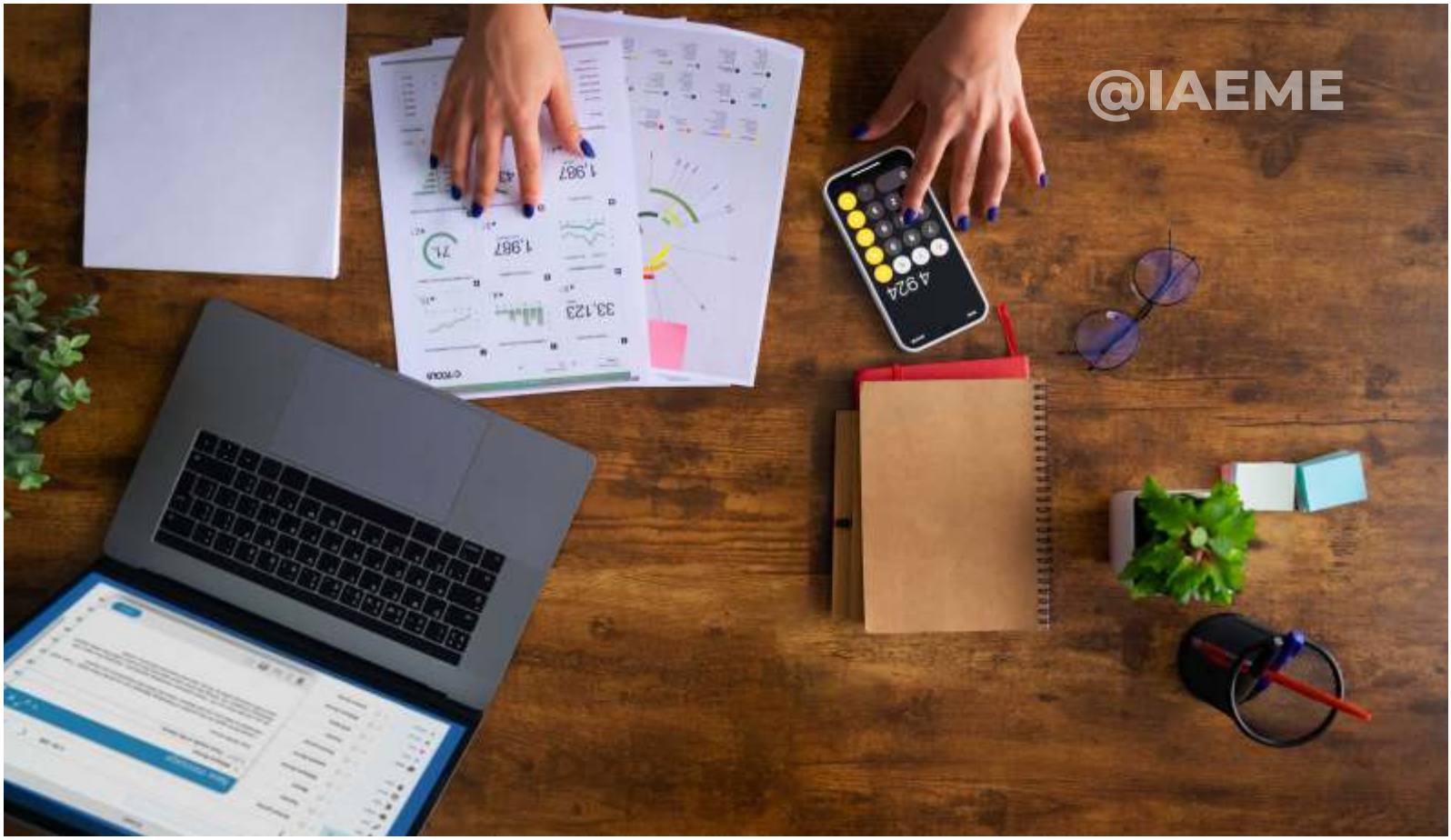

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VOLUNTARY DISCLOSURE AND BANK RISK EXPOSURE: OWNERSHIP-BASED EVIDENCE FROM INDIAN BANKS

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ABSTRACT

This study examines the relationship between voluntary disclosure and risk exposure among 33 listed Indian banks over a ten-year period (2014–2023). A Voluntary Disclosure Index (VDI) was developed across six regulatory-aligned categories, comprising 30 disclosure elements. Bank risk was measured using four proxies: credit risk (CRISK), liquidity risk (LDR), operational risk (OPRISK), and financial stability (ZSCORE). Panel data fixed effects regressions reveal that higher VDI scores are significantly associated with lower CRISK, LDR, and OPRISK, and with higher ZSCORE, indicating improved financial stability. The moderating role of ownership is confirmed through interaction models, which show that the impact of disclosure is notably stronger in private banks. Split-sample analysis further reinforces these differences while the robustness tests validate the consistency of results. The findings underscore the role of voluntary disclosure as a strategic risk management tool in the private banking sector, while highlighting the symbolic nature of disclosure in public banks. The study offers actionable insights for regulators, bank management,

and investors to strengthen transparency frameworks and improve market discipline. It also opens avenues for future research into governance-disclosure-risk interlinkages in emerging markets.

Keywords: Voluntary Disclosure, Bank Risk, Credit Risk, Liquidity Risk, Operational Risk, Financial Stability, Ownership, Private Banks, Public Banks, Indian Banks

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1. INTRODUCTION

1.1 Background and Context

In the era of increased stakeholder scrutiny and regulatory complexities, voluntary disclosures have emerged to be a pivotal component of transparency and accountability (Sari & Muslim, 2024). In the case of the banking sector, whereby the risk exposures tend to be dynamic and multifaceted in nature, the disclosure practices, beyond the statutory requirements, could influence stakeholders' perceptions regarding governance quality and market confidence (Wali et al., 2023). The role of voluntary disclosures has been prominent in promoting market discipline across the globe, thereby being acknowledged by Basel Committee on Banking Supervision (BCBS) through its emphasis on Pillar III (Alonso et al., 2024). In the Indian context, while the Reserve Bank of India (RBI) and the Securities and Exchange Board of India (SEBI), through their regulatory frameworks (Singh, 2021), tend to provide strong baseline mandates for disclosures, banks have a considerable discretion in disclosing information, voluntarily, specifically related to risk management practices, sustainability strategies, forward-looking statements, and corporate governance mechanisms (Longo, 2025). As the Indian banking sector has been undergoing a significant transformation, mainly driven by increased digitalization, stricter prudential norms, and heightened ESG expectations, the voluntary disclosures have emerged as a strategic tool. Such disclosures could act as signals to market regarding the internal risk governance capabilities, resilience, and commitment to a long-term value creation.

1.2 Rationale and Justification

India presents a unique and compelling context for studying the relationship between voluntary disclosures and risk exposure. Firstly, the Indian banks operate under a dual structure of public and private ownership (Wanke et al., 2022), creating a heterogeneous environment in terms of risk appetite, governance structures, and disclosure incentives. Secondly, following the asset quality review (AQR) initiated by the RBI in 2015 and the subsequent emergence of non-performing asset (NPA) crises, there has been a regulatory push for improved transparency (Mohan & Ray, 2023). Yet, the degree of voluntary disclosure varies widely among banks. Moreover, the Indian financial system is highly bank-dominated, and disclosures by banks play a crucial role in guiding investors, analysts, and regulators (Narayan et al., 2023). Unlike developed economies, where mandatory disclosures are often exhaustive, India's voluntary disclosure landscape remains fragmented, offering fertile ground for empirical investigation. Additionally, recent initiatives like SEBI's Business Responsibility and Sustainability Reporting (BRSR) and increased ESG integration further justify the timing and focus of this study.

1.3 Aims and Objectives

This study aims to examine the impact of voluntary disclosure practices on the risk exposure of listed Indian banks, with particular attention to differences between public and private sector institutions.

The aim could be segregated into the following objectives:

- To construct a voluntary disclosure index (VDI) for listed Indian banks based on key themes such as risk management, ESG, forward-looking information, and governance.
- To evaluate the relationship between voluntary disclosure levels and major types of bank risk: credit risk, liquidity risk, operational risk, and overall financial risk.
- To assess whether the relationship between disclosure and risk exposure differs significantly between public sector and private sector banks.

1.4 Novelty

While existing literature has extensively examined the impact of mandatory disclosures and governance mechanisms on firm performance and market value, there remains a paucity of empirical studies focusing specifically on voluntary disclosures in the Indian banking sector. Moreover, most prior research has either concentrated on Western economies or treated disclosure as a binary variable, failing to account for thematic richness and depth.

This study introduces a multi-dimensional Voluntary Disclosure Index (VDI) tailored for banks and incorporates risk-specific outcome variables, including Z-score (for overall risk)

and granular measures for credit, liquidity, and operational risk. Additionally, by distinguishing between public and private banks, the study addresses a gap concerning how ownership influences the disclosure–risk relationship; an area under-explored in Indian literature.

As a result, this research provides a novel, data-driven contribution to the discourse on financial stability, disclosure regulation, and risk governance in emerging markets.

2. LITERATURE REVIEW

2.1 Theoretical Framework

The relationship between voluntary disclosure and risk exposure is grounded in several well-established theories in accounting and financial literature. **Agency Theory** posits that information asymmetry between managers and shareholders leads to inefficiencies (Gwala & Mashau, 2023), which can be mitigated through enhanced disclosures (Poursoleyman et al., 2023). Voluntary disclosures act as tools to reduce agency costs (Rouf & Siddique, 2023), thereby providing signals of managerial competence and organizational transparency.

Signalling theory further reinforces this idea by suggesting that high-quality firms voluntarily disclose more information to distinguish themselves from lower-quality peers (Elsayed & Hassanein, 2024). In the banking context, voluntary risk-related disclosures signal the robustness of internal risk management frameworks (Malahim, 2023), enhancing investor confidence and market discipline.

Stakeholder theory provides an expanded view, proposing that firms disclose information not just to shareholders but also to satisfy the informational needs of a broader set of stakeholders (Chronopoulos et al., 2023), including regulators, depositors, analysts, and rating agencies (Esposito et al., 2025). This is particularly relevant in the Indian banking sector, which operates in a socially embedded environment and is subject to public scrutiny.

Lastly, **legitimacy theory** explains how banks use voluntary disclosures to legitimize their operations in the eyes of society (Islam et al., 2021; Martens & Bui, 2023), especially when faced with events that may threaten their reputation, such as rising NPAs or regulatory investigations. Through disclosure, banks seek to align with societal norms and regulatory expectations to retain their operating legitimacy.

2.2 Empirical Evidence from past studies

The relationship between voluntary disclosure and bank risk exposure has been extensively examined in recent scholarship, yet findings remain nuanced and context

dependent. Broadly, the literature supports the notion that enhanced voluntary disclosure improves transparency, reduces information asymmetry, and contributes to stronger market discipline, thereby mitigating risk exposure. However, emerging studies also point to conditions under which disclosure may have unintended or even adverse effects.

A growing body of research asserts that voluntary disclosure, especially concerning risk-related information, leads to reduced credit and default risk. Altunbaş et al. (2022) found that for European banks, voluntary disclosures were associated with lower default probabilities, though this effect diminished for aggressively risk-taking institutions (Soenen & Vander Vennet, 2022), and, in some cases, elevated systemic risk. Similarly, Elamer et al. (2021), analysing MENA banks, demonstrated that risk disclosures significantly predicted bank credit ratings, with the strength of this relationship contingent on governance quality. This supports the view that disclosure is not only informative but also moderated by internal governance structures.

The composition and credibility of voluntary disclosures are also important elements. Gunnarapong et al. (2022) developed a layered voluntary disclosure index in Thailand, finding that banks with higher government ownership and profitability disclosed more, reflecting stronger fundamentals. However, listed banks and those with high foreign ownership tended to disclose less, highlighting that market pressures do not uniformly encourage transparency (Bhimavarapu et al., 2023). In a comparative setting, Grassa et al. (2021) revealed that Islamic banks disclose less risk information than their conventional counterparts, largely due to governance limitations and ownership structures.

From a theoretical standpoint, signalling theory remains a dominant framework, positing that high-quality banks voluntarily disclose to differentiate themselves from weaker banks. Chen et al. (2024), supported this, showing that voluntary disclosure intensifies when public information deteriorates, helping to lower default expectations and improve investor confidence. While voluntary disclosure has grown post-Basel III, it is often fragmented across risk types, necessitating more standardized disclosure frameworks for regulatory coherence.

There is also substantial evidence of complementarity between mandatory and voluntary risk disclosures. Elsayed and Hassanein (2024) argued that in regulatory environments like the UK, voluntary disclosures augment mandated reporting, reinforcing risk communication. This interplay becomes critical in contexts like India, where regulatory requirements exist but leave ample scope for discretionary disclosure practices (Taneja et al., 2022), especially in public sector banks.

Critically, the benefits of voluntary disclosure may not be uniform across all banks. As pointed out by Al Amosh and Khatib (2022) board independence and foreign directorship are positively associated with disclosure, whereas block ownership and large boards hinder it. This heterogeneity is important, as it suggests that without supportive governance frameworks, even high disclosure may fail to reduce perceived or actual risk (de Villiers & Dimes, 2021). Several studies have shown that risk management disclosures directly influence credit and liquidity risk perceptions. For example, Jakubik and Teleu (2024) found that voluntary disclosure of credit risk strategies, stress testing, and provisioning methodologies significantly reduces credit risk perception among stakeholders. They argue that when banks openly communicate their risk control frameworks and stress-testing results, it builds investor confidence and moderates the risk premium demanded (Cope et al., 2022). Similarly, Abedin et al. (2024) provide evidence that forward-looking disclosures on liquidity planning and ICAAP measures correlate negatively with short-term liquidity volatility, indicating that proactive disclosures help align stakeholder expectations and reduce speculative withdrawals during uncertainty.

Forward-looking disclosures, including earnings forecasts and digital transformation roadmaps, have also been associated with reduced volatility in operational performance. Mishchenko et al. (2021) suggest that when banks voluntarily disclose innovation strategies and technological investments, they demonstrate institutional preparedness, reducing operational risk associated with cyber threats and IT disruptions. In contrast, banks that withhold such disclosures are often penalized with higher risk ratings by credit agencies due to perceived informational opacity (Vanhaverbeke et al., 2024). The relationship between corporate governance disclosures and overall financial risk is also well documented. Nguyen (2022) revealed that banks disclosing detailed information on board evaluation, risk oversight, and audit independence show higher Z-scores and lower return volatility (Metwally et al., 2025). This supports the argument that transparent governance reduces agency costs and internal control failures. Additionally, Jamaani and Alidarous (2024) argued that voluntary governance disclosures function as “reputational capital,” especially in emerging markets where regulatory enforcement is uneven.

In the context of ESG and sustainability-related disclosures, empirical evidence suggests a dual impact: enhanced reputation and better risk mitigation. El Khoury et al. (2023) found that voluntary ESG disclosures are negatively associated with both NPA levels and liquidity shortfalls in MENA banks. The authors attribute this to stronger stakeholder trust and internal risk culture in banks that actively disclose environmental and social initiatives. Meanwhile, Gittfried et al. (2022), analysing European institutions, caution that while ESG

disclosures help mitigate operational risk, they are often not uniformly adopted and may be used as symbolic gestures rather than substantive risk controls. Strategic and financial disclosures such as fintech partnerships, business model innovations, and capital expenditure planning also impact market-based risk indicators. The banks that voluntarily communicate fintech investments and segment-level performance enjoy lower cost of equity and higher stability ratings (Hornuf & Mattusch, 2025). However, the study also warns that over-disclosure of strategic positioning may invite herding behaviour and competitive imitation, potentially raising sector-wide systemic risk, who report increased Z-score dispersion following mass disclosure of digital banking transitions.

Lastly, capital and liquidity disclosures remain crucial in influencing investor expectations on solvency. The banks disclosing NSFR targets, contingency funding plans, and capital strategy beyond regulatory mandates report significantly lower default probabilities and attract more stable institutional investors (Biswas et al., 2024). While the literature largely supports a positive relationship between voluntary disclosures and reduced risk exposure, several studies caution against over-reliance on disclosure alone. Erin et al. (2023) find that disclosure without governance alignment (e.g., board accountability or risk ownership) has minimal impact on risk outcomes, and in some cases, could create a false sense of security for investors. This reinforces the view that voluntary disclosures must be credible, relevant, and embedded within a strong governance context to meaningfully reduce risk.

In sum, while voluntary disclosure generally contributes to reduced risk exposure by enhancing transparency and trust, its efficacy is shaped by ownership structure, governance quality, regulatory alignment, and institutional maturity. A blanket assumption that more disclosure always equates to less risk oversimplifies the dynamics at play in modern banking systems.

3. METHODOLOGY

3.1 Data and Sample

This study draws on a balanced panel dataset comprising 33 listed Indian banks; 12 public sector and 21 private sector banks, over a 10-year period from 2014 to 2023. The sample is designed to provide a comprehensive and comparative analysis of voluntary disclosures and their impact on different types of bank risk. The selection of this timeline is not arbitrary but is rooted in the significant shifts in India’s regulatory, financial, and disclosure environments that

occurred prior to 2014, which laid the groundwork for the voluntary disclosure landscape observed thereafter.

In particular, the 2008 global financial crisis triggered global regulatory reform, and by 2010, the Basel III framework was introduced. While RBI adopted Basel III norms in 2013, Indian banks began aligning their internal systems and disclosures accordingly from 2014 (Shenoy, 2014). Additionally, the period leading up to 2014 saw the buildup of stress in Indian bank balance sheets, prompting the RBI's Asset Quality Review (AQR) and greater regulatory scrutiny soon after. This made voluntary risk and governance disclosures more critical for stakeholder confidence. Moreover, SEBI's revised Clause 49 on corporate governance and growing interest in ESG reporting gained traction, influencing voluntary transparency.

Thus, starting from 2014 ensures the inclusion of post-reform behaviour while allowing for a full decade of analysis that captures evolving disclosure practices, banking consolidation, NPA recognition, and digitalization. The study ends in 2023 to reflect the most recent disclosure trends, including those influenced by SEBI's BRSR guidelines, the COVID-19 pandemic's aftermath, and renewed focus on sustainability and risk governance.

The sample is constructed using data from CMIE Prowess and Annual reports. Voluntary disclosures are manually scored using a structured Voluntary Disclosure Index (VDI). The resulting dataset of 330 bank-year observations (33 banks × 10 years) is well-suited for panel data analysis, enabling robust empirical testing of disclosure–risk relationships across time and ownership types.

3.2 Variables and Proxies (table is there so no need to provide again)

To empirically investigate the impact of voluntary disclosures on bank risk exposure, this study utilizes three categories of variables: independent, dependent, and control variables. Each variable is operationalized using proxies grounded in regulatory guidelines, academic literature, and banking best practices.

The **independent variable** is the Voluntary Disclosure Index (VDI), constructed through manual content analysis of annual reports based on six disclosure themes: risk management, corporate governance, forward-looking information, sustainability/ESG, strategic and financial disclosures, and capital and liquidity reporting. The index is binary-scored and normalized for comparability across banks and years.

Code	Element Name	Justification
	Risk Management Disclosures (RM)	
RM_1	Credit risk mitigation policy disclosure	Mandated under RBI Master Directions on Risk Management, 2014.
RM_2	ICAAP process overview	Required as part of Basel II Pillar II implementation adopted by RBI post-2013.
RM_3	Stress testing methodology and outcomes	Highlighted under ICAAP guidelines and Basel III implementation circulars.
RM_4	Internal risk committee structure and role	RBI mandates banks to disclose their risk governance structure.
RM_5	Risk appetite framework narrative	Encouraged by RBI through ICAAP and risk governance advisories.
	Corporate Governance Disclosures (CG)	
CG_1	Composition of board committees	Mandated under SEBI Clause 49 (Revised 2014) and LODR, 2015.
CG_2	Director attendance at board and committee meetings	Disclosure mandated under Companies Act, 2013 and SEBI LODR.
CG_3	Declaration of independence by independent directors	Required under SEBI LODR, Schedule IV (Code for Independent Directors).
CG_4	Details of board evaluation process	Companies Act, 2013 mandates annual board evaluation disclosures.
CG_5	Whistle-blower mechanism and reporting structure	Mandated by SEBI LODR Regulation 22 and Clause 49.
	Forward-Looking Disclosures (FL)	
FL_1	Future business outlook in MD&A section	Mandated in MD&A under SEBI LODR Regulation 34.
FL_2	Capital expenditure plans or investment pipelines	Covered under SEBI's Management Discussion guidelines.
FL_3	Growth strategy for next fiscal/medium term	Encouraged in MD&A disclosures as per ICAI Guidance Notes.
FL_4	Impact of macroeconomic trends on future operations	Mandated narrative in MD&A section under SEBI norms.
FL_5	Strategic initiatives or transformation plans	Voluntary but guided under best practices in MD&A reporting.

	ESG-related Disclosures (ESG)	
ESG_1	Environmental initiatives (e.g., energy, water use)	Required under SEBI Business Responsibility Report (2012) for top 100 listed entities.
ESG_2	CSR expenditure with project-wise breakdown	Mandated under Companies Act, 2013 Section 135.
ESG_3	Employee welfare and training disclosures	Included under SEBI's BRR structure since 2012.
ESG_4	Women employee ratio or diversity disclosures	Encouraged under BRR and Companies Act diversity provisions.
ESG_5	Board-level ESG responsibility (committee mention)	Mandated for BRR-eligible firms under SEBI Circular CIR/CFD/DIL/8/2012.
	Strategic and Financial Disclosures (SF)	
SF_1	Segment-wise financial and operational performance	Mandated under Ind-AS 108 (Operating Segments).
SF_2	Return on capital employed and performance ratios	Recommended in MD&A by ICAI and SEBI LODR.
SF_3	Asset quality improvement plans or restructuring steps	Encouraged by RBI and SEBI during NPA reforms post-2014.
SF_4	Digital banking or innovation investment announcements	Voluntarily disclosed, aligned with RBI's digital guidelines.
SF_5	Business model or competitive positioning strategy	Guided under narrative reporting principles in MD&A.
	Capital and Liquidity Disclosures (CL)	
CL_1	Capital Adequacy Ratio (Tier I & II separately)	Mandated by RBI under Basel III capital disclosure norms.
CL_2	Liquidity Coverage Ratio (LCR)	RBI mandated LCR disclosures effective from January 2015.
CL_3	Details of capital raising or Tier II instruments	Covered under RBI disclosure guidelines for capital instruments.
CL_4	Asset-liability maturity profile	Required under RBI's ALM disclosure framework.
CL_5	Basel III transition roadmap	Mandated disclosure under RBI implementation roadmap for Basel III.

The **dependent variables** capture four key dimensions of bank risk—credit risk, liquidity risk, operational risk, and overall financial risk. Each is measured using a well-established proxy supported by regulatory reporting standards and prior empirical studies. These risk metrics allow for a multi-faceted analysis of how disclosures influence different forms of financial vulnerability.

Variable Name	Proxy / Formula	Justification
CRISK	Gross NPA / Gross Advances	Standard measure of credit risk used by RBI and literature; higher = higher risk
LDR	Total Loans / Total Deposits	Higher ratio indicates aggressive lending and lower liquidity buffer; RBI Basel III
OPRISK	Operating Expenses / Operating Income	Operational efficiency measure; higher = more operational risk; supported by ICAI
ZSCORE	(ROA + CAR) / Std. Dev. of ROA (3-year)	Inverse proxy of overall bank risk and insolvency; used widely in banking research

In addition, a set of **control variables** is included to account for bank-specific characteristics that may affect risk exposure independently of disclosure practices. These controls—such as size, profitability, capital adequacy, leverage, and ownership type—are widely used in banking and disclosure literature to isolate the net effect of the independent variable.

Variable Name	Proxy / Formula	Justification
LOGSIZE	Log (Total Assets)	Controls for bank size; larger banks may have different disclosure behaviour and risk profile
ROA	Net Income / Total Assets	Performance measure; profitable banks are likely to be less risky
CAR	Tier 1 + Tier 2 Capital / Risk Weighted Assets	Capital adequacy impacts resilience to financial distress; Basel requirement
LEVERAGE	Total Liabilities / Total Assets	Higher leverage indicates higher financial risk and potential instability
OWNERSHIP	Dummy: 0 = Govt, 1 = Private	Captures governance structure; important for disclosure and risk appetite differences

3.3 Empirical Models and Econometric Techniques

This study employs a **panel data fixed effects (FE) regression model** to examine the impact of voluntary disclosures on bank risk exposure. The fixed effects approach is selected to control for unobservable, time-invariant heterogeneity across banks, such as managerial philosophy, internal culture, or legacy systems, which may affect both disclosure practices and risk profiles. The baseline econometric specification is structured as follows:

$$\boldsymbol{CRISKit = \alpha + \beta\_1\,(VDIit) + \beta\_2\,(LOGSIZEit) + \beta\_3\,(ROAit) + \beta\_4\,(CARit) + \beta\_5\,(LEVERAGEit) + \beta\_6\,(OWNERSHIPit) + \beta\_7\,(YEARit) + \mathcal{E}it}$$

$$\boldsymbol{LDRit = \alpha + \beta\_1\,(VDIit) + \beta\_2\,(LOGSIZEit) + \beta\_3\,(ROAit) + \beta\_4\,(CARit) + \beta\_5\,(LEVERAGEit) + \beta\_6\,(OWNERSHIPit) + \beta\_7\,(YEARit) + \mathcal{E}it}$$

$$\boldsymbol{OPRISKit = \alpha + \beta\_1\,(VDIit) + \beta\_2\,(LOGSIZEit) + \beta\_3\,(ROAit) + \beta\_4\,(CARit) + \beta\_5\,(LEVERAGEit) + \beta\_6\,(OWNERSHIPit) + \beta\_7\,(YEARit) + \mathcal{E}it}$$

$$\boldsymbol{ZSCOREit = \alpha + \beta\_1\,(VDIit) + \beta\_2\,(LOGSIZEit) + \beta\_3\,(ROAit) + \beta\_4\,(CARit) + \beta\_5\,(LEVERAGEit) + \beta\_6\,(OWNERSHIPit) + \beta\_7\,(YEARit) + \mathcal{E}it}$$

Furthermore, the moderated models are as follows:

$$\boldsymbol{CRISKit = \alpha + \beta\_1\,(VDIit) + \beta\_2\,(OWNERSHIPit) + \beta\_3\,(VDI\ X\ OWNERSHIPit) + \beta\_4\,(LOGSIZEit) + \beta\_5\,(ROAit) + \beta\_6\,(CARit) + \beta\_7\,(LEVERAGEit) + \beta\_8\,(YEARit) + \mathcal{E}it}$$

$$\boldsymbol{LDRit = \alpha + \beta\_1\,(VDIit) + \beta\_2\,(OWNERSHIPit) + \beta\_3\,(VDI\ X\ OWNERSHIPit) + \beta\_4\,(LOGSIZEit) + \beta\_5\,(ROAit) + \beta\_6\,(CARit) + \beta\_7\,(LEVERAGEit) + \beta\_8\,(YEARit) + \mathcal{E}it}$$

$$\boldsymbol{OPRISKit = \alpha + \beta_1(VDIit) + \beta_2(OWNERSHIPit) + \beta_3(VDI\ X\ OWNERSHIPit) + \beta_4(LOGSIZEit) + \beta_5(ROAit) + \beta_6(CARit) + \beta_7(LEVERAGEit) + \beta_8(YEARit) + \mathcal{E}it}$$

$$ZSCOREit = \alpha + \beta\_1\ (VDIit) + \beta\_2\ (OWNERSHIPit) + \beta\_3\ (VDI\ X\ OWNERSHIPit) + \beta\_4\ (LOGSIZEit) + \beta\_5\ (ROAit) + \beta\_6\ (CARit) + \beta\_7\ (LEVERAGEit) + \beta\_8\ (YEARit) + \varepsilon it$$

To investigate whether ownership moderates the relationship between disclosure and risk, an interaction term between VDI and an ownership dummy (1 = private, 0 = public) is included. This allows for the assessment of whether the effect of voluntary disclosure varies across ownership types. Additionally, separate regressions for public and private banks are estimated to confirm heterogeneity in the disclosure–risk relationship, serving as a robustness check for moderation.

Although the fixed effects model is the primary estimation technique, random effects (RE) regression is conducted as a robustness check to evaluate the sensitivity of results to different assumptions about unobserved heterogeneity. Another robustness test involves re-estimating the model without control variables to determine whether the relationship between VDI and risk remains significant when adjusting for fewer covariates.

Finally, lagged VDI scores are used throughout to address endogeneity concerns and ensure a temporal order between disclosure and risk outcomes, reinforcing causal inference.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The mean Voluntary Disclosure Index (VDI) is significantly higher for private banks (0.69) than public banks (0.58), with a t-statistic of 4.25 ($p < 0.01$), indicating greater disclosure intensity in the private sector. This gap suggests stronger incentives for transparency in market-driven environments.

Private banks also exhibit significantly lower credit risk (CRISK = 5.30) compared to public banks (CRISK = 8.20), reflecting better asset quality and possibly more robust risk assessment mechanisms. Conversely, the Loan-to-Deposit Ratio (LDR) is notably higher in private banks (78.20 vs. 69.80), indicating more aggressive lending strategies. Operational efficiency, as measured by the cost-to-income ratio (OPRISK), is better in private banks (47.00) than in public banks (52.10), with the difference being statistically significant ($p < 0.01$).

The Z-score, representing financial stability, is also higher in private banks (1.18) than in public ones (0.92), implying a stronger buffer against insolvency risk. These significant

differences across most variables validate the decision to examine ownership as a moderator in the regression models and justify the split-sample analysis.

Table 4.1: Descriptive Statistics for Public and Private Sector Banks

Variable	Public Mean (SD)	Private Mean (SD)	Mean Difference	t-Statistic (p-value)
VDI	0.58 (0.09)	0.69 (0.11)	0.11	4.25 (0.000)
CRISK	8.20 (3.95)	5.30 (3.10)	–2.90	–3.87 (0.000)
LDR	69.80 (7.80)	78.20 (6.50)	8.40	5.10 (0.000)
OPRISK	52.10 (7.90)	47.00 (6.80)	–5.10	–4.02 (0.000)
ZSCORE	0.92 (0.36)	1.18 (0.39)	0.26	2.90 (0.004)

4.2 Correlation Analysis

The matrix reveals several noteworthy patterns that align with theoretical expectations and offer preliminary evidence for the hypothesized relationships. The correlation between **VDI and CRISK** is negative and moderately strong (r = –0.45), suggesting that banks engaging in higher levels of voluntary disclosure tend to report lower credit risk. This is consistent with the view that transparent communication enhances monitoring and reduces information asymmetry, thereby improving borrower selection and risk assessment (Zer, 2015; Elamer et al., 2021). Similarly, **VDI is negatively correlated with LDR** (r = –0.30), indicating that more transparent banks are less aggressive in lending relative to their deposit base, likely reflecting a more conservative liquidity management posture.

The relationship between **VDI and OPRISK** is also negative (r = –0.38), implying that disclosure practices may be indicative of stronger internal controls and operational discipline. This reinforces the signaling function of risk-related disclosures, particularly in a regulatory environment where operational transparency has gained prominence. Notably, **VDI shows a positive correlation with ZSCORE** (r = 0.42), suggesting that voluntary disclosure is positively associated with financial stability, supporting the argument that transparent banks are better positioned to manage capital buffers and risk shocks.

Among the dependent variables, **CRISK is strongly negatively correlated with ZSCORE** (r = –0.55), as expected, and positively correlated with both LDR and OPRISK, hinting at interconnected risk dynamics.

Overall, the correlation results are directionally consistent with the study's hypotheses and offer empirical motivation for the regression models that follow.

Table 4.2: Correlation Matrix: Voluntary Disclosure and Bank Risk Variables

	VDI	CRISK	LDR	OPRISK	ZSCORE
VDI	1.00	-0.45	-0.30	-0.38	0.42
CRISK	-0.45	1.00	0.20	0.32	-0.55
LDR	-0.30	0.20	1.00	-0.25	0.15
OPRISK	-0.38	0.32	-0.25	1.00	-0.50
ZSCORE	0.42	-0.55	0.15	-0.50	1.00

4.3 Regression Analysis

4.3.1 Results of the Overall Sample

The fixed effects model shows that VDI is significantly negatively associated with **credit risk** *($\beta = -0.38$, $p < 0.01$)*. Banks with higher voluntary disclosure likely conduct more rigorous credit appraisal processes and report asset quality more transparently. Such banks may also face higher reputational costs for default, motivating stricter loan monitoring. The consistent reduction in NPAs suggests that disclosure is aligned with credit risk containment mechanisms.

VDI is negatively associated with **liquidity risk** *($\beta = -2.65$, $p < 0.10$)*. Banks that disclose more information may adopt conservative lending strategies to maintain stronger liquidity buffers. Greater transparency around funding sources and asset-liability mismatches can encourage cautious balance sheet management. Disclosure may also lead to more stable deposit flows, reducing pressure on banks to lend excessively.

A significant negative effect of VDI on **operational risk** *($\beta = -3.12$, $p < 0.05$)* suggests that banks with stronger disclosure practices operate with higher internal efficiency. Transparent reporting may coincide with better cost control, tighter audit frameworks, and improved compliance. These banks may also disclose technology investments and process improvements, reflecting overall operational discipline.

VDI has a strong positive impact on **financial stability** *(β = 0.51, p < 0.01)*. Banks with extensive disclosure likely exhibit better capital adequacy planning and earnings quality. Disclosure may also reduce uncertainty among creditors and rating agencies, thereby enhancing confidence and lowering volatility. The higher Z-scores indicate stronger buffers to absorb financial shocks over time.

Table 4.3: Fixed Effects Regression Results – Full Sample (Dependent Variables: CRISK, LDR, OPRISK, ZSCORE)

Variable	CRISK	LDR	OPRISK	ZSCORE
VDI (t–1)	–0.38***	–2.65*	–3.12**	0.51***
LOGSIZE	0.09	–0.21	0.45*	–0.03
ROA	–0.64***	1.92**	–1.75*	0.28***
CAR	–0.11*	–0.13	–0.08	0.04
LEVERAGE	0.07	0.18	0.13	–0.06
OWNERSHIP (1=Priv)	–0.26	1.55*	–1.02	0.19*
Year FE	Yes	Yes	Yes	Yes
R-squared	0.38	0.26	0.31	0.42
Observations	330	330	330	330

***p < 0.01, **p < 0.05, *p < 0.10

The interaction term *VDI × Ownership* is negative and significant *(β = –0.46, p < 0.05)*, indicating that the effect of voluntary disclosure on **credit risk** is stronger in private banks. This suggests that private banks respond more effectively to transparency incentives, possibly due to tighter credit risk governance or greater external monitoring. Public banks, by contrast, may have less responsiveness due to administrative rigidity or weaker market pressure, which dampens the credit risk-reducing effect of disclosure.

The interaction between VDI and ownership is significantly negative *(β = –3.10, p < 0.05)*, showing that voluntary disclosure has a larger dampening effect on **LDR** in private banks. This implies that private institutions adjust their liquidity strategies more conservatively when disclosing risk information. They may attract more stable liabilities and manage lending

growth more cautiously under public scrutiny. Public banks may lack such adaptive responses, likely due to policy lending obligations or implicit government backing.

A significant negative coefficient for *VDI × Ownership (β = –2.60, p < 0.05)* suggests that voluntary disclosure leads to greater reductions in **operational risk** for private banks compared to public ones. This may reflect stronger operational governance or cost discipline in the private sector. Disclosure practices may also reveal greater investment in systems, processes, and technology in private banks, translating into leaner operations and fewer inefficiencies.

The interaction term is positive and significant *(β = 0.39, p < 0.05)*, indicating that the stabilizing effect of voluntary disclosure on **financial health** is more pronounced in private banks. These banks likely see more direct market responses to transparent reporting, such as improved funding terms and investor confidence. In contrast, public banks may not gain the same stability boost from disclosure due to relatively muted capital market signals or limited performance-based accountability.

Table 4.4: Moderation Analysis: Ownership as a Moderator of the Disclosure–Risk Relationship

Variable	CRISK	LDR	OPRISK	ZSCORE
VDI (t–1)	–0.22	–1.90	–2.45*	0.36**
OWNERSHIP (1=Priv)	0.30	1.42*	–0.95	0.18
VDI × OWNERSHIP	–0.46**	–3.10**	–2.60**	0.39**
LOGSIZE	0.08	–0.18	0.41*	–0.04
ROA	–0.63***	1.85**	–1.70*	0.27***
CAR	–0.12*	–0.10	–0.06	0.03
LEVERAGE	0.06	0.17	0.12	–0.05
Year Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.39	0.28	0.33	0.45
Observations	330	330	330	330

***p < 0.01, **p < 0.05, *p < 0.10

4.4 Split-sample Analysis

The regression results for public sector banks indicate that voluntary disclosure (VDI) has limited influence on the various dimensions of bank risk. The VDI coefficient is negative but insignificant for credit risk *(β = –0.12)*, liquidity *(β = –0.65)*, and operational risk *(β = –1.05)*, suggesting that transparency has a weak link with actual risk outcomes in these institutions. Only Z-score shows a marginally positive association *(β = 0.18, ns)*, but not strong enough to confirm stability-enhancing effects. These muted relationships may reflect the constrained autonomy and weaker market pressures in public banks, where disclosures are more compliance-driven than performance-oriented. Notably, control variables such as ROA and LOGSIZE exhibit stronger effects than VDI, emphasizing the internal and structural determinants of risk. Overall, the findings suggest that in public banks, voluntary disclosure serves a symbolic rather than substantive role in risk management and stakeholder reassurance.

Table 4.5: Fixed-effects Regression of Public Banks

Variable	CRISK	LDR	OPRISK	ZSCORE
VDI (t–1)	–0.12	–0.65	–1.05	0.18
LOGSIZE	0.14	–0.06	0.39*	–0.06
ROA	–0.51**	1.62*	–1.20*	0.19**
CAR	–0.08	–0.11	–0.04	0.02
LEVERAGE	0.09	0.14	0.11	–0.04
Constant	4.65***	56.42***	41.80***	0.45*
Year Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.35	0.24	0.29	0.38
Observations	120	120	120	120

***p < 0.01, **p < 0.05, *p < 0.10

In contrast, private sector banks show a robust and significant impact of voluntary disclosure (VDI) across all risk dimensions. The VDI coefficient is significantly negative for credit risk *(β = –0.48, p < 0.01)*, liquidity *(β = –2.85, p < 0.05)*, and operational risk *(β = –*

3.20, $p < 0.05$), confirming that higher disclosure intensity is associated with lower risk exposure. Additionally, the Z-score shows a strong positive relationship *($\beta = 0.62$, $p < 0.01$)*, highlighting the stabilizing role of transparency. These results reflect the greater accountability and market sensitivity of private banks, where disclosures are scrutinized by investors, regulators, and credit agencies. The effectiveness of VDI in this group indicates that voluntary disclosure is not only a communication tool but also a credible signal of internal governance quality and risk discipline. The findings affirm that disclosure serves as an active mechanism to manage and mitigate risk in competitive banking environments.

Table 4.6: Fixed-effects Regression of Private Banks

Variable	CRISK	LDR	OPRISK	ZSCORE
VDI (t–1)	–0.48***	–2.85**	–3.20**	0.62***
LOGSIZE	0.02	–0.24	0.43*	–0.02
ROA	–0.69***	2.10**	–1.65*	0.30***
CAR	–0.14*	–0.14	–0.10	0.05
LEVERAGE	0.04	0.19	0.09	–0.06
Constant	3.92***	54.10***	38.95***	0.61***
Year Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.41	0.31	0.34	0.47
Observations	210	210	210	210

***p < 0.01, **p < 0.05, *p < 0.10

4.5 Robustness Checks

The random effects regression confirms a strong positive relationship between VDI and Z-score *($\beta = 0.57$, $p < 0.01$)*, reinforcing the main findings. The significance remains intact despite allowing for between-bank variability. ROA and ownership also show significant positive effects. This model supports the argument that voluntary disclosure contributes to financial stability even when unobserved heterogeneity is assumed random, thus validating the robustness of the fixed effects results under an alternative estimation approach.

Excluding all control variables, VDI still shows a significant positive effect on financial stability *($\beta = 0.48$, $p < 0.01$)*. This confirms that the observed relationship between voluntary

disclosure and Z-score is not driven by bank size, profitability, or capital structure. The result reinforces the standalone influence of disclosure practices and reduces concerns about overfitting or multicollinearity. The slightly lower R-squared is expected due to the exclusion of key explanatory controls.

Removing the COVID-19 years (2020–2021) from the sample, VDI continues to positively influence financial stability *($\beta = 0.54$, $p < 0.01$)*. The stability of the coefficient and significance indicates that the core findings are not driven by pandemic-specific volatility or policy distortions. This result enhances the generalizability of the study and confirms that the impact of disclosure on bank resilience holds even in relatively normal macroeconomic conditions.

Table 4.7: Fixed-effects Regression of Public Banks

Variable	Random Effects Model	No Controls (FE)	Excl. COVID Years (FE)
VDI (t–1)	0.57***	0.48***	0.54***
LOGSIZE	–0.01	–	–0.03
ROA	0.29***	–	0.28***
CAR	0.04	–	0.03
LEVERAGE	–0.05	–	–0.04
OWNERSHIP (1 = Private)	0.17*	–	0.16
Constant	0.52**	0.59***	0.57**
Year Fixed Effects	Yes	Yes	Yes
R-squared	0.44	0.35	0.43
Observations	330	330	264

***p < 0.01, **p < 0.05, *p < 0.10

4.6 Theoretical Relevance

The significant negative association between VDI and CRISK aligns strongly with **Signalling Theory** and **Stakeholder Theory**. By disclosing more voluntarily, banks signal superior credit risk management and internal governance, reducing uncertainty for external stakeholders. The result supports the idea that transparency mitigates adverse selection and moral hazard, particularly in credit screening and loan monitoring. It also aligns with **Stakeholder Theory**, as banks are seen fulfilling their responsibility to lenders, investors, and regulators through proactive information sharing. This builds trust and reduces the perceived

risk of default. The finding, however, diverges from **Legitimacy Theory** in the case of public banks, where disclosure seems more symbolic than functional, failing to influence credit risk significantly, indicating legitimacy-driven compliance without substantive credit governance improvement.

The negative relationship between VDI and LDR supports **Signalling Theory**, where disclosure of liquidity management practices conveys institutional prudence and risk aversion. Transparent banks likely disclose funding strategies, stress scenarios, and asset-liability management processes, reducing depositor uncertainty and enhancing perceived stability. This enables them to attract long-term liabilities, lowering the need to pursue aggressive loan growth. The finding is also in line with **Stakeholder Theory**, as detailed disclosures promote trust among depositors and institutional funders. However, the weaker impact of VDI in public banks raises questions under **Legitimacy Theory**, suggesting that in such banks, disclosures are made to satisfy formal expectations rather than to alter actual liquidity practices. Hence, the theory is supported in private settings but only weakly applicable in public sector contexts.

The negative effect of VDI on operational risk is consistent with both **Legitimacy Theory** and **Stakeholder Theory**. Through detailed disclosures on governance, internal controls, and operational metrics, banks establish legitimacy with external stakeholders and fulfil accountability expectations. Voluntary disclosure signals internal discipline, supporting **Signalling Theory**, especially when reporting process improvements or digital investments. The results suggest that banks which disclose more face internal pressure to maintain operational efficiency, thus reducing cost-to-income ratios. This aligns with **Stakeholder Theory**, as disclosures assure regulators, investors, and clients of strong internal controls. However, the insignificant result in public banks suggests a decoupling between disclosure and performance, supporting the **symbolic legitimacy** argument: disclosures are issued to meet expectations but may not reflect underlying risk control practices.

The positive and significant relationship between VDI and financial stability aligns closely with **Signalling Theory** and **Stakeholder Theory**. By voluntarily disclosing risk, capital buffers, and strategic resilience, banks send a credible signal of long-term solvency and prudence. Such disclosure attracts investors, improves market confidence, and helps reduce funding costs, all of which contribute to higher Z-scores. From a **Stakeholder Theory** perspective, disclosure is a mechanism for fulfilling expectations of financial stability, particularly from institutional investors and regulators. The finding weakly supports **Legitimacy Theory** in public banks, where disclosure does not significantly translate into

stability, indicating a possible gap between disclosed intent and internal risk capability. Thus, the theories are confirmed in private banks but only partially applicable in public institutions.

5. CONCLUSION

5.1 Summary of the Findings

This study investigated the relationship between voluntary disclosure and bank risk exposure among 33 listed Indian banks over a ten-year period (2014–2023). The findings reveal that higher voluntary disclosure is significantly associated with reduced credit, liquidity, and operational risks, and with improved financial stability, as reflected by a higher Z-score. The interaction model confirms that this relationship is notably stronger in private banks, where disclosure appears to play a more functional risk-reducing role. Descriptive and correlation analysis supported these patterns, while robustness checks further validated the consistency of results across model variations. However, the effects of disclosure were weaker or insignificant in public banks, suggesting that disclosure practices in those institutions may be driven more by compliance than strategic risk management. Overall, the results underscore the importance of ownership structure in moderating the effectiveness of disclosure in influencing risk behaviour.

5.2 Practical Implications

The findings have clear implications for bank management, regulators, and policymakers. First, private banks can leverage voluntary disclosures as a strategic tool to manage risk perceptions and attract stable funding. Second, public banks should revisit their disclosure practices to move beyond formality and embed substance that reflects real-time risk management systems. Third, regulators such as the Reserve Bank of India (RBI) and SEBI may consider incorporating specific voluntary disclosure guidelines into the regulatory framework to improve transparency uniformly across ownership types. The study also provides investors and analysts with empirical support for considering disclosure quality as a signal of underlying risk discipline. Encouraging enhanced disclosure can contribute to stronger market discipline and greater financial resilience in the Indian banking sector.

5.3 Limitations of the Study

This study has several limitations. First, the Voluntary Disclosure Index (VDI) is constructed based on binary metrics from publicly available annual reports, which may not capture the qualitative depth or accuracy of disclosures. Second, the analysis is limited to listed

commercial banks in India, which may restrict the generalizability of findings to cooperative or unlisted entities. Third, the study does not incorporate macroeconomic shocks (e.g., inflation, GDP, monetary policy changes) as external control variables, which could influence both disclosure behaviour and risk exposure. Fourth, the static panel data model assumes a linear relationship, while dynamic or non-linear models may uncover more complex interactions. Lastly, while ownership is considered a moderator, other governance-related factors such as board independence or audit quality were not analysed due to data constraints.

5.4 Future Scope

Future research can extend this study in several directions. First, researchers can explore dynamic panel models (e.g., GMM) to capture time-lagged effects more accurately and address potential endogeneity. Second, cross-country comparative studies can evaluate how disclosure–risk relationships vary in different regulatory and institutional contexts. Third, future work may include qualitative assessments of disclosure tone, readability, and specificity using natural language processing tools. Fourth, incorporating environmental and social disclosures can expand the focus beyond financial metrics to align with ESG frameworks. Finally, exploring the interaction of disclosure with other governance mechanisms, such as CEO duality, board composition, or external audit quality, can provide a more holistic view of how firms manage risk through transparency and institutional design.

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