“Determinants of credit risk: Empirical evidence from Indian commercial banks”

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DETERMINANTS OF CREDIT RISK: EMPIRICAL EVIDENCE FROM INDIAN COMMERCIAL BANKS

Abstract

Credit risk is a significant factor affecting the financial stability of banks. Keeping the credit risk under control is essential to maintain a bank's cash flow. This paper examines the various profitability, microeconomic and macroeconomic indicators that affect a bank's credit risk. The study uses the dataset of 31 banks from 2012 to 2021 and employs a panel data modelling approach to account for any variations in risk-taking behavior. The results revealed a statistically significant negative relationship between return on equity and credit risk when nonperforming loans proxy credit risk. This finding was consistent across fixed effect, random effect, and pooled OLS methods, at 1 percent significance (P value < 0.00), indicating that the extent of credit risk decreases as profitability increases. It was further found that bank age and ownership type positively affect a bank's credit risk, while factors such as bank size and operational efficiency negatively affect credit risk when nonperforming loans proxy credit risk. Further, macroeconomic variables showed that gross domestic product is positively associated with credit risk, while inflation negatively affects credit risk. Overall, the findings of this paper demonstrated that credit risk is affected by both micro and macroeconomic factors. The paper also addresses significant policy implications as it helps various stakeholders to examine the determinants of credit risk, make credit decisions, and ultimately lower their credit risk.

Keywords credit risk, nonperforming loans, loan loss provisions, fixed effect, random effect

JEL Classification G32, G21

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INTRODUCTION

A country's banking sector is the foundation of its economic and financial system. With the banks being regulated by the country's central bank, there is a huge amount of trust that investors and other stakeholders generally have in commercial banks as compared to unregulated financial institutions. Therefore, it becomes essential to protect the interest of these stakeholders and safeguard them from various risks that may arise in banks.

Risk management in banking has significantly advanced over the last decade, mainly due to regulations that have come in response to the global financial crisis (GFC) and its aftermath. Various risk elements still affect a bank's credibility and sustainability. The significant risks that may affect a bank comprise credit, liquidity, operational and market risk.

Credit risk (CR) refers to a bank's failure to fulfil contractual obligations. It is the risk of default in loan repayment and can be understood as an indicator of a borrower's creditworthiness. Here, the lender may not recover the unpaid principal and interest, resulting in cash flow disruptions as well as significant collection costs. Therefore, evaluating the extent of CR involved before issuing loans is necessary. Lenders

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may assess the borrower's ability to repay the debt to evaluate the extent of CR involved in issuing loans to borrowers. Here, borrowers with a low CR are generally imposed with lesser interest rates. Lenders, investors, and other stakeholders may also confer with rating agencies to evaluate the creditworthiness of their clients. Overall, credit risk management (CRM) can be understood as minimizing losses by periodically examining the extent of capital adequacy and loan loss reserves of banks. Effective CRM begins with a thorough assessment of the borrower's profile and continues throughout the recovery.

Though much research has been carried out in the area of CRM, an inadequate number of studies examine the determinants of CR, specifically in the Indian context. Therefore, it becomes pertinent to determine the various determinants of CR in the Indian context.

1. LITERATURE REVIEW

The review initially assesses the impact of profitability on CR. A research that examines the impact of CR on bank profitability in the USA and Asia revealed that, in both regions, CR significantly and positively affects profitability. Further, it was found that the effect of CR on profitability is higher in the USA than Asia. This might be because Asian banks usually have stringent credit policies and supervise loans more efficiently than the banks in the USA (Abbas et al., 2019). Studies also imply that CR's effect on profitability differs based on bank ownership type. Evidence from Ghana's banking sector indicated that CR positively affects a bank's profitability and that this effect is more intense for native banks than for foreign banks (Madugu et al., 2020). Aluko et al. (2019) showed that CRs positively affect bank profitability of systematically important Nigerian banks.

Even though many papers have illustrated a positive relationship between CR and profitability, there are contrary studies too. In Jordanian commercial banks, it was observed that CR has a significant negative effect on return on assets (ROA) and return on equity (ROE) (Al-Eitan & Bani-Khalid, 2019). An analysis of Turkish banks also revealed similar results and showed a negative association between CR and ROA and between CR and ROE (Ekinci & Poyraz, 2019). Further, Saleh and Abu Afifa (2020) revealed that CR negatively affects return on average assets and interest income to earning assets (NIM), whereas, CR does not have an effect on return on average equities of banks in Jordan. In addition, research that used the structural equation model (SEM) to assess the impact of CR on performance indicated that CR negatively impacts the financial performance (Gadzo et al., 2019). Additionally, the profitability of MENA countries' banks was also observed to be negatively impacted by a rise in CR (Abdelaziz et al., 2020).

Research has also revealed that CR has a negative impact on the profitability of large and medium-sized banks. However, this effect is insignificant for return on average assets in smaller banks (Abbas et al., 2019). Another comparison of the impact of CR on the profitability of large and small banks in South Africa indicated that the CR of smaller banks has a more significant effect on performance when proxied by ROA compared to larger banks. However, the CR of smaller banks exhibited a lesser impact on financial performance than larger banks, when measured by ROE during the period from 2008 to 2017 (Lawrence et al., 2020). Furthermore, research reveals that the profitability of the parent bank negatively affects the subsidiary's CR (Škrabić Perić et al., 2018).

Turning to the microeconomic determinants of CR, various studies have evaluated the effect of bank-specific factors like the type of ownership, size, diversification, capital structure, and efficiency.

Based on the type of ownership, varying across different countries, banks can be broadly categorized as the public sector, private sector, and foreign banks. It is pertinent to understand if there exists any association between the type of bank ownership and the extent of CR faced by banks. Various studies analyze and compare the CR of various banking groups, such as the public sector, private, and foreign banks. An examination of bank ownership in Chinese banks indicated that the type of ownership influences CR. Further, the concentration of ownership by the government

was observed to negatively affect CR, revealing that government ownership lowers risk, while private ownership increases CR (Liu et al., 2020). It was also found that deposits negatively correlate with CR in public but not private banks, as public banks tend to minimize their deposits as CR increases. This indicates that public banks adopt a conservative approach, in contrast to private banks, which are more concerned with earnings than depositor losses (Saha & Sensarma, 2013).

On the contrary, an analysis that checked the capabilities of public, private, and foreign banks in retaining the minimum capital requirements set by regulators during stressful times revealed that public sector banks have a higher vulnerability to negative economic shocks when compared to the private sector and foreign banks. It was also revealed that public sector banks could not sustain themselves during times of severe stress, since they have less capital and high-risk assets (Patra & Padhi, 2020). Moreover, Iannotta et al. (2007) examined the impact of alternative ownership models and ownership concentration on the risk of public sector banks among banks in Europe. The results revealed that public sector banks hold loans with lower quality and face greater insolvency risk as compared to other banks. Compared to private and public sector banks, mutual savings banks were found to have loans with greater loan quality and reduced asset risk. The study further revealed that, even though ownership concentration has no significant impact on bank profitability, greater ownership concentration is linked with greater loan quality, reduced asset risk, and lesser insolvency risk. Furthermore, research reveals that contrary to public financial institutions, private banks use their strong connections with borrowers to alleviate information disparities and enhance the quality of their loan portfolios (Belaid et al., 2017). Examination of the association between ownership structure and the number of risks undertaken by community banks before the crisis, during and after the GFC, revealed that small community public and private banks exhibited similar risk taking before the crisis and at the time of the crisis, but increased risk taking after the crisis. It was also found that after the recession, small community public banks could lessen their risks slower than private banks. Further, large community banks also exhibited a cyclical association between ownership structure and the risks undertaken, whereby public banks exhibited lesser risks before the recession. However, higher amounts of risks are undertaken during and after the recession (Balla & Rose, 2019). Further, there are also studies that have not found a statistically significant link between bank risk taking and ownership structure, even though ownership concentration has a negative association with banking risks (Siddika & Haron, 2019). Moreover, it was revealed that government banks have a negative correlation with total risk, and default risk, however, have a greater idiosyncratic risk compared to joint-stock banks (Chu et al., 2016). In the Indian scenario, public sector banks are found to perform better than private sector banks (Suresh & Krishnan, 2020), even though studies indicate manipulation and corruption in public entities (Suresh & Zimik, 2021). However, the impact of bank ownership on CR in India is an unexplored area and is examined in this paper.

An examination of the factors that influenced a bank's risks during the European financial crisis revealed that bank size significantly and negatively affects CR and insolvency risk, i.e., as bank size increases, CR decreases (Ben Jabra et al., 2017). Srairi (2019) and Alzoubi and Obeidat (2020) also indicated a negative association between bank size and CR. Furthermore, research reveals that a parent bank's size has a negative impact on the CR of its subsidiaries (Škrabić Perić et al., 2018).

Scholars have also considered the effect of bank diversification on the CR of banks. An examination of the association between risk and product diversification of banks in Europe indicated that banks that have diversified into non-interest income are exposed to more significant risks when compared to banks that provide traditional intermediation services (Lepetit et al., 2008). Similarly, examining the relationship between revenue diversification and bank risk in Vietnamese banks indicated that greater diversification leads to higher risks (Ngoc Nguyen, 2019). Further, if non-interest operations are classified as trading, commission and fee operations, then the positive link between risk and non-interest income is due to commission and fee activities. Findings also pointed out that the association between risk and product diversification is more accurate for smaller banks (Lepetit et al., 2008).

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Examining how capital structure affects CR has been another area of research. Studies revealed that bank capitalization negatively impacts insolvency and CR (Ben Jabra et al., 2017). Further, Alzoubi and Obeidat (2020) found a negative association between CR and capital-to-assets ratio. Siddika and Haron (2019) revealed that a rise in capital ratio lowers bank risk. Studies have also revealed that bank capital growth reduces default risk in the long term. Similarly, Majumder and Li (2018) indicated that bank capital negatively and significantly affects risk. Lee and Chih (2013) revealed that in the case of small banks, an increase in capital adequacy ratio (CAR) results in reduced risk, whereas CAR does not affect the risk of larger banks.

It is pertinent to comprehend the impact of bank efficiency on CR. Studies reveal that there exists an association between profit inefficiencies and the extent of risk taken by banks. It was further found that less efficient banks take higher risks while choosing their borrowers and that this high-risk-taking behavior is not compensated by increased interest rates (García-Alcober et al., 2019). Similarly, Twum et al. (2021) showed that operation efficiency was found to have an inverse association with CR in the case of Chinese banks. It is also necessary to understand if mergers or acquisitions have taken place in the bank during a given year and if that impacts its CR. Focarelli et al. (1995) argue that a bank that undergoes a merger or acquisition in a given year is anticipated to have a lower CR due to the possibility of more effective screening and monitoring, leading to a reduction in bad loans.

Studies have also examined the macroeconomic implications of CR, including the effect of inflation, Gross Domestic Product (GDP), and economic crisis on the extent of CR undertaken by banks. Studies reveal that stable macroeconomic conditions and institutional environment increase bank insolvency risk and reduce bank CR (Ben Jabra et al., 2017). Research conducted in Sub-Saharan Africa that investigated the effect of various macroeconomic determinants of CR revealed that a rise in GDP growth rate negatively affects the NPL ratio of banks. It was also found that the rate of credit to regional private banks as a percentage of GDP positively and significantly affects the amount of NPL (Mpofu &Nikolaidou, 2018). Country-level variables like GDP growth rate and depths of credit information significantly impact bank risk-taking (Srairi, 2019). However, an examination of macroeconomic variables on the CR of Jordanian banks showed that even though CR increased with a rise in the unemployment rate and crisis, CR has an insignificant impact on GDP growth and inflation (Kharabsheh, 2019). GDP and CR were also negatively and significantly associated (İncekara & Çetinkaya, 2019). It was also found that the extent of economic development influences the impact of regulation and supervision on bank risks. Compared to developing economies, banking regulation, and supervision have a more significant impact on the banking risk of emerging economies (Klomp & De Haan, 2014).

Furthermore, a parent bank's GDP growth negatively affects the CR of its subsidiaries, while its lending rate and liquidity positively impact the CR of its subsidiaries (Škrabić Perić et al., 2018). It was also found that CR has an adverse effect on economic growth indicating that CR issues need to be resolved to enhance growth (Inekwe, 2020).

The literature has also documented that inflation can increase CR. Studies have observed that a rise in the inflation rate, trade openness, and global volatility positively and significantly affects the extent of NPL (Mpofu & Nikolaidou, 2018). It was also found that while the variable growth rate brings down the CR of banks in the long run, foreign exchange rate, inflation rate, and interest rate increase the CR of banks. Further, it was observed that the extent of CR undertaken by banks is influenced by market factors (Cerrato et al., 2017) and also by factors such as construction activities, unemployment, and domestic lending rate, in the short and long term (Nikolaidou &Vogiazas, 2014).

The literature survey shows that though several studies have focused on determinants of a bank's CR, it still has some limitations. To date, the literature has not focused explicitly on the determinants of CR concerning Indian Banks. Further, the available evidence concerning the sources of the bank's CR is very sparse. Furthermore, the measures used to proxy the CR are not always appropriate. Based on these limitations, this study attempts to analyze the various determinants of CR in Indian banks.

2. METHODOLOGY

The study has used secondary data sourced from Database for Indian Economy maintained by the Reserve Bank of India. Data have been collected for a period of 10 years, ranging from 2012 to 2021. The sample universe includes all Indian commercial banks. There are 12 public sector and 21 private sector Indian commercial banks. Of these, two banks with insufficient information to construct all proxy measures were eliminated, and finally, 31 banks were used in the study.

The study has considered CR as a dependent variable, proxied by the nonperforming loans (NPL) ratio and loan loss provisions (LLP). The independent variables are categorized as profitability variables, microeconomic and macroeconomic determinants of the CR of banks, as exhibited in Table 1. Profitability is proxied by ROA and ROE. Microeconomic variables include the age of a bank (BAGE), bank size (BSIZE), operational efficiency (OE), capitalization (ETA), bank diversification (BD), bank ownership, and mergers and acquisitions. Macroeconomic variables include inflation and GDP.

For panel data analysis, fixed effects and random effects models are primary methods that can be utilized to analyze time series and cross-sectional data (Gujarati, 2003). In light of this, the research employed linear regression models using pooled OLS (POLS), fixed effect (FE), and random effects (RE) after examining the assumptions necessary to carry out linear regression.

The study has applied the panel data structure model employed by Chowdhury and Rasid (2017). It can be described as follows:

$$\gamma_{nt} = \alpha + \beta x_{nt} + \varepsilon_{nt}, \quad (1)$$

where γ_{nt} denotes the dependent variable (Credit Risk),α is the intercept term on the independent variables, β is a k × 1 vector of the to be estimated, and vector of observations is x_{nt}, which is 1 × k, t = 1,…, T; n = 1,…, N.

The practical and operational form, the aforementioned model can be described as follows:

$$Credit\ Risk = f\left(Profitability; Microeconomic\ variables; Macroeconomic\ variables\right) \quad (2)$$

Credit Risk is measured by NPL and LLP. Profitability is estimated by using ROA and ROE. Microeconomic variables include the age of a bank,

Table 1. Variables used in the study

Variables	Risk	Ratio	Paper
Risk Variables	Credit Risk 1(NPL)	Nonperforming loans/Total Loans	Al-Qudah et al. (2022), Naili and Lahrichi (2022), and Wang et al. (2021)
	Credit Risk 2(LLP)	Loan loss provisions/loans	Saleh and Abu Afifa (2020), Duho et al. (2020), Aluko et al. (2019), and Bikker and Vervliet (2017)
Profitability	ROE(ROE)	Net Profit / Total Equity	Gupta and Mahakud (2020) and Almaqtari et al. (2018)
	NIM(NIM)	Net interest income /Total Assets	Gupta and Mahakud (2020), and Menicucci and Paolucci (2016)
Control Variables – Micro	Age (BAGE)	Age of the bank	Misman and Bhatti (2020)
	Size (BSIZE)	Log (Total assets)	Saleh and Abu Afifa (2020), Brei et al. (2020), Misman and Bhatti (2020), and Otero et al. (2019)
	Efficiency (OE)	Operating expenses/ Operating Income	Naili and Lahrichi (2020), Otero et al. (2019), and Louzis et al. (2010)
	Capitalization (ETA)	Equity/Total Assets	N. Gupta and Mahakud (2020), Kharabsheh (2019), (Ghosh, 2017), and Ben Jabra et al. (2017)
	Bank diversification (BD)	Noninterest income/ Total income	(Naili&Lahrichi, 2020), (J. Gupta &Kashiramka, 2020), (N. Gupta &Mahakud, 2020), (Ghosh, 2017), and Louzis et al. (2010)
	Ownership (OWN)	Public /Private Sector Banks	(J. Gupta &Kashiramka, 2020), Sivasankaran et al. (2020), and Otero et al. (2019)
	Mergers & Acquisitions	Merger/Acquisition in a given year	J. Gupta and Kashiramka (2020), and Battaglia and Mazzuca (2014)
Macro	Inflation (INF)	Annual inflation rate	Brei et al. (2020), and Kharabsheh (2019)
	GDP (GDP)	Annual GDP growth rate	J. Gupta and Kashiramka (2020), (Brei et al., 2020), and Otero et al. (2019)

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bank size (BSIZE), operational efficiency (OE), capitalization (ETA), bank diversification (BD), bank ownership (OWN), and mergers and acquisitions. Macroeconomic variables include inflation and GDP. To investigate the factors that can influence CR in India, two models have been created by expanding the variables used in equation 2. The models hypothesize that the CR of Indian banks is influenced by certain microeconomic and macroeconomic factors that are as follows:

a) Model 1

$$NPL = \alpha_i + \beta_1 ROA_{it} + \beta_2 ROE_{it} + \\ + \beta_3 NIM_{it} + \beta_4 BAGE_{it} + \beta_5 BSIZE_{it} + \\ + \beta_6 OEI_{it} + \beta_7 ETA_{it} + \beta_8 BD_{it} + \\ + \beta_9 OWN_{it} + \beta_{10} INF_{it} + \beta_{11} GDP_{it} + \beta_{10} INF_{it}. \quad (3)$$

b) Model 2

$$LLP = \alpha_i + \beta_1 ROA_{it} + \beta_2 ROE_{it} + \\ + \beta_3 NIM_{it} + \beta_4 BAGE_{it} + \beta_5 BSIZE_{it} + \\ + \beta_6 OE_{it} + \beta_7 ETA_{it} + \beta_8 BD_{it} + \\ + \beta_9 OWN_{it} + \beta_{11} GDP + \beta_{10} INF_{it}, \quad (4)$$

Where i indicates an individual bank; t indicates year; β_1, ... β_{10} are the coefficients of dependent variables, and ε is the error term, and all other variables are exhibited in Table 1.

The models are evaluated using pooled, random, and fixed effect regression. Additionally, the Hausman test is used to decide between fixed effect estimates or random effect estimates. Consequently, for both models the Hausman test revealed that the FE model is preferable and more relevant in comparison to the RE model as the P value does not exceed 0.05 (P value = 0.00 < 0.01).

3. RESULTS AND DISCUSSION

The Indian banking sector is an interesting setting for examining the CR of banks. Over the past two decades, this industry has undergone significant transformation, with liberalization, privatization and globalization. The deregulation of banks and the demonetization has also spurred its development (Soundariya et al., 2021). As a result, a new, more competitive economic environment was established, within which the Indian banking sector has flourished. This calls for a constant and continuous evaluation of risks faced by banks.

3.1. Descriptive statistics

Table 2 exhibits descriptive statistics for micro and macro determinants of a bank's CR variables from 2012 to 2021. The mean value of CR1 and CR2 are 0.03 and 0.018. For microeconomic variables, the mean value of NIM, ROA, ROE, BAGE, BSIZE, OE, ETA, and BD are 0.026, 0.004, 0.038, 78.435, 5.168, 3.555, 0.077, and 0.123, respectively. The macroeconomic indicators GDP and INF have shown mean values of 5.086 and 6.55 (SD = 4.2 and 2.2), respectively.

The correlation matrix, as presented in Table 3, helps to determine the degree of correlation between the variables and assess the possibility of multicollinearity among the regressors. Additionally, it determines if the dependent and independent variables are positively or negatively correlated and examines the association among the various indicators of CR. Findings in Table 3 exhibit that there exists a weak correlation among the regressors and also show that multicollinearity is not present. The findings also indicate a negative association between CR and the profitability indicators (NIM and ROE). The association between CR variables and operational efficiency, capitalization and inflation was also negative.

Low correlation among the independent variables shows that multicollinearity problems are not present. For higher reliability, the Variance Inflation Factor (VIF) test is also carried out to detect multicollinearity problems. It was found that VIF was above the threshold of 10 for variables reflecting bank size and NIM. Therefore, these variables have been mean-centered. After applying mean centering to variables, the values fall to the levels reported in Table 4. Table 4 demonstrates that for all variables, VIF values do not surpass 7.38, demonstrating the absence of multicollinearity amongst independent variables. Therefore, it can be concluded that there is no multicollinearity in the dataset, and this is in agreement with the previous analyses based on correlation.

Table 2. Descriptive statistics

Variables	Observation	Mean	Std. dev	Min	Median	Max
Dependent Variable						
NPL	310	0.030	0.029	0.000	0.022	0.166
LLP	310	0.018	0.021	–0.020	0.010	0.162
Microeconomic Variables						
NIM	310	0.026	0.005	0.014	0.025	0.042
ROE	310	0.038	0.147	–0.833	0.079	0.227
BAGE	310	78.435	32.75	8	88	127
BSIZE	310	11.900	1.458	8.284	12.103	15.327
OE	310	3.555	43.886	–115.328	0.950	761.501
ETA	310	0.077	0.023	0.034	0.069	0.166
BD	310	0.123	0.045	0.042	0.114	0.312
OWN_PB.SEC	310	0.409	0.492	0	0	1
MERG_AQ	310	0.032	0.176	0	0	1
Macroeconomic Variables						
GDP	310	5.086	4.297	–7.251	6.459	8.256
INF	310	6.55	2.276	3.1	5.95	10.4

Table 3. Pearson correlation matrix

Variables	NPL	LLP	NIM	ROE	BAGE	BSIZE	OE	ETA	BD	OWN	M&A	GDP	INF
NPL	1	–	–	–	–	–	–	–	–	–	–	–	–
LLP	0.754	1	–	–	–	–	–	–	–	–	–	–	–
NIM	–0.518	–0.336	1	–	–	–	–	–	–	–	–	–	–
ROE	–0.728	–0.849	0.447	1	–	–	–	–	–	–	–	–	–
BAGE	0.301	0.095	–0.404	–0.197	1	–	–	–	–	–	–	–	–
BSIZE	0.258	0.251	–0.180	–0.090	–0.222	1	–	–	–	–	–	–	–
OE	–0.005	–0.011	–0.017	–0.180	0.020	–0.099	1	–	–	–	–	–	–
ETA	–0.399	–0.191	0.680	0.315	–0.577	–0.071	–0.087	1	–	–	–	–	–
BD	–0.024	0.200	0.254	0.003	–0.552	0.386	–0.082	0.541	1	–	–	–	–
OWN_PB.SEC	0.538	0.327	–0.626	–0.329	0.418	0.555	–0.047	–0.610	–0.224	1	–	–	–
MERG_AQ	0.024	0.007	0.007	0.024	0.038	0.213	–0.010	–0.044	0.049	0.144	1	–	–
GDP	0.060	–0.020	–0.136	–0.021	–0.043	–0.093	0.035	–0.13	–0.236	0.018	–0.241	1	–
INF	–0.436	–0.325	0.0125	0.307	–0.056	–0.132	–0.016	–0.070	–0.286	0.005	–0.049	0.053	1

Table 4. VIF test results

Features	VIF
NIM\n	2.444132
ROE\n	1.615504
BAGE	7.381024
CBSIZE	3.133257
OE	1.077472
ETA	2.924377
BD	2.127968
OWN_PB.SEC	7.113938
MERG_AQ	1.154902
GDP	2.377999
INF	6.069603

3.2. Determinants of NPL

As shown in Table 5, the results reveal a statistically insignificant association between profitability and CR when measured by NIM at any significance level. This result was similar across all three models, i.e., using POLS, FE, and RE. However, the findings reveal a negative association between profitability and NPL when ROE assesses profitability. This indicates that as profitability increases, the extent of CR decreases. An analysis of Turkish banks revealed similar results and showed that CR and ROE are negatively associated (Ekinci & Poyraz, 2019).

As per the fixed effect model, it was found that bank age (BAGE) has a positive impact on CR at 1 percent (P value < 0.01) significance, meaning that older banks tend to undertake higher CR. Further, bank size negatively affects CR, indicating that larger banks face lower CRs. However, these results were found to be accurate only in the case of fixed effects models. This finding supports the

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Table 5. Summary of model estimation results

Variables	POOLED OLS				FE				RE			
	Parameter	Std. err.	T-stat	P-value	Parameter	Std. err.	T-stat	P-value	Parameter	Std. err.	T-stat	P-value
const	0.046	0.005	8.900	0.000	–0.176	0.062	–2.826	0.005	0.0462	0.005	8.275	0.000
NIM	–0.32	0.237	–1.348	0.178	–0.448	0.337	–1.328	0.185	–0.341	0.252	–1.351	0.177
ROE	–0.101	0.007	–13.405	0.000***	–0.08	0.008	–9.064	0.000***	–0.098	0.007	–13.006	0.000***
BAGE	0.000	0.000	0.5154	0.606	0.002	0.000	3.576	0.000***	0.000	0.000	0.405	0.685
BSIZE	–0.000	0.001	–0.414	0.678	–0.015	0.004	–3.471	0.000***	–0.000	0.001	–0.686	0.493
OE	–0.000	0.000	–2.892	0.004***	–0.000	0.000	–2.084	0.038**	–0.000	0.000	–2.715	0.007***
ETA	–0.020	0.066	–0.307	0.758	–0.055	0.101	–0.546	0.585	–0.020	0.071	–0.292	0.770
BD	0.014	0.031	0.467	0.640	0.007	0.041	0.183	0.854	0.023	0.033	0.712	0.476
OWN_PB.SEC	0.019	0.003	5.101	0.000***	0.032	0.011	2.880	0.004***	0.020	0.004	4.817	0.000***
MERG_AQ	–0.001	0.005	–0.280	0.779	0.007	0.005	1.332	0.184	0.000	0.005	0.028	0.977
GDP	0.000	0.000	1.560	0.119	0.000	0.000	2.881	0.004***	0.000	0.000	1.668	0.096*
INF	–0.003	0.000	–7.833	0.000***	–0.003	0.000	–5.912	0.000***	–0.003	0.000	–8.052	0.000***
Adjusted R^2	0.715	–	–	–	0.607	–	–	–	0.6888	–	–	–
F-statistic	68.144	–	–	–	37.611	–	–	–	59.949	–	–	–
Prob. (F-statistic)	0.000	–	–	–	0.000	–	–	–	0.000	–	–	–
Hausman test	–	–	–	–	0.000	–	–	–	–	–	–	–

Note: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

results of Ben Jabra et al. (2017) and Alzoubi and Obeidat (2020), which revealed that an increase in bank size reduces CR. Furthermore, operational efficiency (OE) negatively affects CR at 1 percent significance using the POLS and RE model and a negative impact at 5 percent significance in the case of the FE model. This indicates that efficient operations lead to reduction in CR. This finding coincides with the findings of Twum et al. (2021). Further, the level of capitalization (ETA) and the extent of bank diversification (BD) were observed to have an insignificant impact on CR. The findings also revealed that government ownership has a positive impact on CR at 1 percent significance under all three models when measured by NPL. This reveals that public sector banks face higher CR when compared to private sector banks. Moreover, the bank undergoing a merger in a given year (*MERG_AQ*) does not affect CR at any significance level.

Further, GDP positively influenced CR at 1 percent (P value < 0.01) significance using the FE model and at 10 percent significance using the RE model. The level of inflation (INF) also exhibited a negative effect on CR at 1 percent (P value < 0.01) significance when employing the pooled FE and RE models, meaning that as inflation increases, the extent of CR undertaken by banks decreases. However, this finding contradicts the studies of Yurdakul (2014) and Mpofu and Nikolaidou (2018), which revealed that inflation increases a bank's CRs.

3.3. Determinants of LLP

The results shown in Table 6 reveal a positive relationship between profitability and LLP when measured by NIM at 5 percent (P value < 0.05) significance under POLS, FE, and RE models. This reveals that as profitability increases, CR decreases, as an increase in LLP results in a reduction in the extent of CR. This is consistent with the results of Saleh and Abu Afifa (2020), which indicated that CR negatively impacts the NIM of Jordanian banks. However, when measured by ROE, profitability was revealed to have a negative impact on LLP at 1 percent (P value < 0.01) significance under pooled OLS, FE, and RE models. This indicates that as profitability decreases, CR also decreases.

Studies have also shown that bank age positively affects LLP at 10 percent (P value < 0.10) significance, meaning that older banks tend to undertake lower CR. However, this was true only using the fixed effect model. Further, it was found that bank size positively affects LLP at 10 percent (P value < 0.10) significance, showing that larger banks face lower CRs. However, these results were true, only using POLS, and agree with the findings of Ben Jabra et al. (2017) and Alzoubi and Obeidat (2020), which revealed that as the bank grows, the extent of CR reduces. Using POLS, FE, and RE models, operational efficiency positively affected CR at 1 percent (P value <0.01) significance. This reveals that a rise in opera-

Table 6. Summary of model estimation results

Variables	POOLED OLS				FE				RE			
	Parameter	Std.err.	T-stat	P-value	Parameter	Std.err.	T-stat	P-value	Parameter	Std.err.	T-stat	P-value
const	0.018	0.003	5.655	0.000	–0.013	0.037	–0.363	0.716	0.016	0.003	4.431	0.000
NIM	0.324	0.144	2.249	0.025**	0.450	0.204	2.203	0.028**	0.363	0.159	2.276	0.023**
ROE	–0.125	0.004	–27.219	0.000***	–0.123	0.005	–23.12	0.000***	–0.126	0.004	–27.688	0.000***
BAGE	0.000	0.000	1.553	0.121	0.000	0.000	1.004	0.316	0.000	0.000	1.671	0.095*
CBSIZE	0.001	0.000	1.942	0.053*	–0.001	0.002	–0.529	0.597	0.001	0.000	1.575	0.116
OE	–0.000	0.000	–5.365	0.000***	–0.000	0.000	–4.237	0.000***	–0.000	0.000	–4.960	0.000***
ETA	–0.022	0.040	–0.561	0.574	–0.003	0.061	–0.048	0.961	–0.010	0.045	–0.230	0.817
BD	0.094	0.019	4.852	0.000***	0.115	0.024	4.633	0.000***	0.103	0.020	5.062	0.000***
OWN_ PB.SEC	0.001	0.002	0.818	0.413	–0.007	0.006	–1.107	0.268	0.001	0.002	0.664	0.507
MERG_AQ	–0.000	0.003	–0.137	0.890	0.002	0.003	0.821	0.412	0.000	0.003	0.218	0.827
GDP	0.000	0.000	1.125	0.261	0.000	0.000	2.116	0.035***	0.000	0.000	1.512	0.131
INF	0.000	0.000	0.294	0.768	0.000	0.000	0.891	0.373	0.000	0.000	0.641	0.521
R^2	0.799	–	–	–	0.7944	–	–	–	0.7947	–	–	–
F-statistic	107.93	–	–	–	93.765	–	–	–	104.88	–	–	–
Prob. (F-statistic)	0.000	–	–	–	0.000	–	–	–	0.000	–	–	–
Hausman test	–	–	–	–	0.000	–	–	–	–	–	–	–

Note: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

tional efficiency will reduce CR as measured by LLP. The extent of bank diversification was also found to positively affect LLP at 1 percent significance in the case of POLS, FE, and RE models, indicating that greater bank diversification will lead to a fall in CR. It was also found that the level of capitalization (ETA), the type of ownership (OWN), and the bank undergoing merger in a given year (MERG_AQ) do not have an impact on CR at any level of significance. Furthermore, the level of GDP was observed to positively affect CR at 1 percent significance using FE model, thereby signaling that a rise in GDP will result in reduced CR as measured by LLP. The rate of inflation (INF), however, did not appear to impact CR, using any of the models, and is consistent with the results of Kharabsheh (2019), which states that CR has an insignificant impact on inflation.

CONCLUSION AND LIMITATIONS

In the last decade, the Indian banking industry has encountered significant issues and challenges. Several recent changes, including various banking frauds and COVID-19, are some of the significant issues that have affected the credit risk of Indian banks. In addition, the upward trend of NPA over the past few years has raised serious questions regarding the extent of credit risk undertaken by Indian banks. Therefore, this study has assessed various factors influencing the credit risk of commercial banks in India from 2012 to 2021. Nonperforming loans and loan loss provisions were the dependent variables that proxied credit risk. Independent variables were categorized into profitability, micro, and macroeconomic variables, each represented by appropriate proxies.

Overall, the results show a statistically significant negative association between return on equity and credit risk when credit risk is measured by nonperforming loans, indicating that as profitability increases, the extent of credit risk decreases. However, return on equity was revealed to have a positive relationship with credit risk when loan loss provisions proxy credit risk, indicating that a rise in profitability elevates the amount of credit risk. The study also indicates a negative association between net interest margin and loan loss provisions, indicating that credit risk decreases as profitability increases. It was further found that bank age and ownership type positively affect credit risk, and bank size and opera-

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tional efficiency have a negative impact on credit risk when credit risk is proxied by the nonperforming loan ratio. It was also found that while gross domestic product is positively associated with credit risk, inflation negatively affects credit risk.

However, when credit is measured by the loan loss provisions ratio, bank size, and diversification were observed to have a positive effect on credit risk, and operational efficiency was revealed to negatively affect credit risk, as an increase in loan loss provisions results in reduced credit risk. It was also observed that gross domestic product negatively affects credit risk when credit risk is proxied by loan loss provisions. This indicates that measures that encourage economic growth can be adopted as they can bring considerable advantages in the banking sector by lowering the risk of loan defaults and, as a result, lowering credit risk for the industry. They could also lower the likelihood of banking crises and their adverse effects on the whole economy.

However, there are limitations to the study. This study has considered only selected profitability, microeconomic and macroeconomic variables and has not considered the effect of certain variables such as financial crisis and corporate governance on credit risk. Incorporating these aspects in analyses would benefit various stakeholders in decision making and framing of policies. These variables can also be considered for future research based on data availability and other aspects if required.

Nevertheless, this study's findings and contributions are expected to benefit stakeholders in framing various rules and policies in light of credit risk scenarios associated with the COVID-19 pandemic and economic crisis. The study also has significant implications for creditors, investors, bank managers, and researchers for making various decisions regarding the credit management of banks.

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