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Research Article

Analyzing Performance of Banks in India: A Robust Regression Analysis Approach

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This research aims to analyze the impact of bank performance determinants on bank performance by applying robust regression analysis. For this, the relationship between return on assets and net interest margin with bank performance determinants has been discussed using robust regression. Robust regression offers a better and more realistic analysis owing to reducing the impact of outliers and influential data, and it is recommended for more precise results.

1. Introduction

Modern banking borrowing and lending activities help in the economic development of the country. Accepting deposits and lending activities expose the banks to various financial risks that are "credit risk, liquidity risk, market risk, and operational risk." The efficient management of these risks is an important factor behind bank profitability. The capital requirement of banks also depends on the management of these risks by the banks. As banks are highly leveraged financial institutions, the depositors' money must be kept safe by the bank in any adverse situation, and therefore, risk management becomes paramount for banking institutions. Any adverse situation faced by the banks can affect other sectors of the economy as well. Therefore, regulators greatly emphasize the effectiveness and stability of risk management in the banking system of an economy. Recent technological developments have also made the banking system even riskier. Therefore, there is a need for the adoption of the best risk management practices by banks that offer different products and services to different customers across the globe.

Commercial banks are significant for the Indian economy and are considered the heart of the financial system. The RBI is the main regulator of commercial banks in India. Commercial banks are classified as "public sector, private, and foreign banks." Recognizing the significance of commercial banks in economic development, 14 banks were nationalized in 1969, followed by another 6 in 1980. Later reforms in the highly regulated banking sector began in 1991 in India as a part of the overall structured reforms.

Financial deregulation and innovation in banking products and services have increased the importance of credit risk management. The Indian banking system has entered into a transition phase, and financial stability has become a need of the hour due to rising nonperforming assets. Credit risk management practices in banks affect the bank's performance. The objective of the study is thus to assess the impact of bank performance determinants on bank performance. The present study aims to understand the role of bank-specific regulatory norms (Basel norms), macroeconomic factors, and financial crises on the public-sector banks' performance operating in India using robust regression techniques.

2. Review of the Literature

This section deals with reviewing the literature on the measures of bank performance, its determinants, and how bank-specific and macroeconomic factors affect bank performance.

2.1. Bank Performance Measures. Profitability. Many studies [1–12] have used "return on assets" as a performance measure for commercial banks, while other studies [13–15, 4, 16–21] employed return on equity as a bank performance measure. Other studies [4, 10, 17, 19, 22–25] have used net interest margin as bank performance measure.

2.2. Bank-Specific Factors. Bank size, bank capital, operating efficiency, liquidity, credit risk, productivity, and income diversification are recognized as bank-specific determinants of bank performance in previous studies.

2.2.1. Bank Size. Existing studies show a positive as well as a negative relationship between bank performance and bank size. Studies that showed a positive relationship [26, 13, 10, 4, 17, 18, 7, 19, 20, 11] suggested that banks become more profitable when they grow in size. However, some studies showed that when banks increase their size, the additional operating costs of banks decrease their profits [15, 27, 28, 5, 12, 9, 25, 29].

2.2.2. Bank Capital. Bank capital indicates banks' ability to meet deposit demand and to protect customer savings during any financial turmoil. Many existing studies [30, 26, 15, 13, 3, 27, 31] observed a positive relationship between bank capital and bank performance with reference to profitability, indicating banks with adequate capital better exploit market opportunities and improve earnings.

2.2.3. Operating Cost. Many previous studies including Salike & Ao [30]; Kosmidou [26]; Kohlscheen et al. [15]; Sarpong Kumankoma [27]; Petria et al. [10], Rahman et al [4] Alexiou & Sofoklis [18]; Mirzaei & Mirzaei [29]; Naifer [32]; Curak et al. [33]; and Athanasoglou et al. [20] have shown a significant inverse relation of "bank profitability" with "operating costs," indicating a negative relationship of cost with performance. A high cost-to-income ratio indicates management inefficiency and low profitability.

2.2.4. Liquidity. Both poor liquidity and high liquidity may lead to poor performance of banks. The poor liquidity position of a bank can expose banks to bankruptcy, while high liquidity indicates inefficient performance. Previous studies have reported both negative and positive relationship of liquidity with bank profitability. Albulescu [16]; Salike and Ao [30]; and Kohlscheen el at. [15] found a positive relationship between bank liquidity and bank profitability, while Naifar [32] and Tan and Floros [23] reported an insignificant relationship. Kosmidou et al. [25]; Mirzaei and Mirzaei [29]; Al-Jafari and Alchami [11]; and Islam and Nishiyama [21] found a negative relation of liquidity with bank profitability [34].

2.2.5. Credit Risk. The expected relation between credit risk and bank profitability is negative. Many previous studies, like Salike and Ao [30]; Petria et al. [10], Majumder and Li [3]; Brahmaiah [8]; Petria et al. [10]; Samad [35]; Kosmidou [26]; Sufian & Chong [28]; Menicucci & Paolucci [17]; Mirzaei & Mirzaei [29]; Athanasoglou et al. [20]; and Al-Jafari & Alchami [11] reported the negative impact of credit risk on bank profitability. Studies such as Chen et al. [13]; Abdullah et al. [5]; Alhassan et al. [6]; Tan & Floros [23]; Sufian & Habibullah [19]; Kosmidou et al. [25] showed a positive association between the two variables.

2.2.6. Productivity. "Higher productivity results in high profitability for the banks. Hence a positive relationship is anticipated between productivity and bank profitability [36]. Many studies like [3] reported a positive impact of productivity on bank profitability, while other studies [5, 18] reported a negative relationship.

2.2.7. Income Diversification. It is expected to impact bank profitability positively. However, a mixed relationship was reported in the empirical evidence. Many studies like Salike & Ao [30]; Majumder and Li [3]; Sarpong Kumankoma et al. [27]; Sufian & Chong [28]; Sufian [37]; Sufian & Habibullah [19] identified a positive relationship between income diversification and bank profitability. Studies-like Islam & Nishiyama [21]; Sufian & Habibullah [19] indicated an insignificant relation while Rahman et al [4]; Reddy [24]; and Sufian & Habibullah [19] reported a negative relationship between the two variables.

2.3. Banking Regulations

2.3.1. Basel Norms. Basel Accords are the guidelines by the BCBS to ensure adequate bank capital to absorb unexpected losses. The Basel I Accord issued in 1988, focusing on credit risk only, prescribed a capital adequacy ratio (CAR) of 8% with different weights for different types of credit exposure to calculate the risk-weighted asset (RWA). The market risk was later included in the computation of the minimum CAR of the bank during the 1990s. Due to the limitations of Basel I accord, Basel II Accord was issued in 2004. The three pillars of Basel II accord are as follows: (1) minimum capital requirement for credit, operational, and market risks; (2) supervisory review process; and (3) market discipline [40]. The 2008 financial crisis showed the inadequacy of Basel II Accords, and a long-term stricter requirement of capital standards known as Basel III was introduced in 2010-11, which also required a pair of liquidity ratios to be maintained by the banks. Many previous studies, like Rahman et al. [4] & Roy [39], used Basel norms as a dummy variable for finding the impact of banking regulation on bank performance [40].

2.4. Macroeconomic Variables. This section highlights the existing studies on the macroeconomic determinants of bank profitability.

2.4.1. Growth in GDP. "A positive association is expected between bank profitability and the growth in GDP during a period when the economy is relatively stable and growing [41]. A relatively stable and growing economy creates a conducive atmosphere for investment and bank profitability. Many studies like Salike and Ao [30]; Majumder and Li [3]; Yüksel et al. [14]; Kosmidou [26]; Chen et al. [13]; Curak et al. [33]; Alhassan et al. [6]; Reddy [24]; and Kosmidou et al. [25] highlighted a positive relation of growth in GDP with bank profitability." However, some studies like Kohlscheen et al. [15]; Rahman et al. [4]; Alexiou & Sofoklis [18]; Mirzaei & Mirzaei [29] found an insignificant relationship between the two variables while studies like Tan & Floros [12]; Brahmaiah [8]; Bouzgarrou et al. [9]; Al-Jafari & Alchami [11]; Islam & Nishiyama [21] reported negative relationship.

2.4.2. Inflation Rate. Existing literature shows heterogeneous results in relationship between inflation rate and bank profitability. Many previous research like Yüksel et al. [14]; Chen et al. [13]; Rahman et al. [4]; Abdullah et al. [5]; Brahmaiah [8]; Bouzgarrou et al. [9]; Kosmidou et al. [25]; Athanasoglou [20]; Al-Jafari & Alchami [11]; Islam & Nishiyama [21]; Tan & Floros [23] reported positive relationship, Sufian & Habibullah [19]; Sufian [37]; Kohlscheen el at. [15]; Alexiou & Sofoklis [18] indicated an insignificant relationship in their study, while Sufian & Chong [28]; Alhassan et al. [6]; Mirzaei & Mirzaei [29]; Salike & Ao [30]; Kosmidou [26] indicated negative relationship. The operating costs of banks may increase due to inflation, but the inflationary condition may increase productive activity, which is positive for bank profitability [42].

2.5. Financial Events

2.5.1. Financial Crises. A few studies attempted to find the impact of the financial crisis of 2008 on the bank's profitability. Yüksel et al. [14] reported a negative impact of the financial crisis, while Bouzgarrou et al. [9] found a positive impact of it. Derbali [43] found that Islamic banks were not affected by the financial crisis of 2007.

3. Objectives of the Study

The study aims to achieve the following objectives:

(i) To find the bank's performance determinants

(ii) To analyze the impact of bank-specific variables on the financial performance of public-sector banks using robust regression analysis

(iii) To study the impact of banking regulations on the performance of public-sector banks using robust regression analysis

4. Research Hypotheses

The following hypotheses have been framed to analyze the Impact of Basel Norms on the financial performance of public-sector banks in India:

(i) Bank-specific variables have a significant impact on financial performance of public-sector banks in India

(ii) Banking regulations have significantly impacted the financial performance of public-sector banks in India

5. Research Methodology

The present study is both descriptive as well as analytical in nature. This study concentrates on analyzing the impact of bank performance determinants on the financial performance of public-sector banks operating in India by applying robust regression analysis.

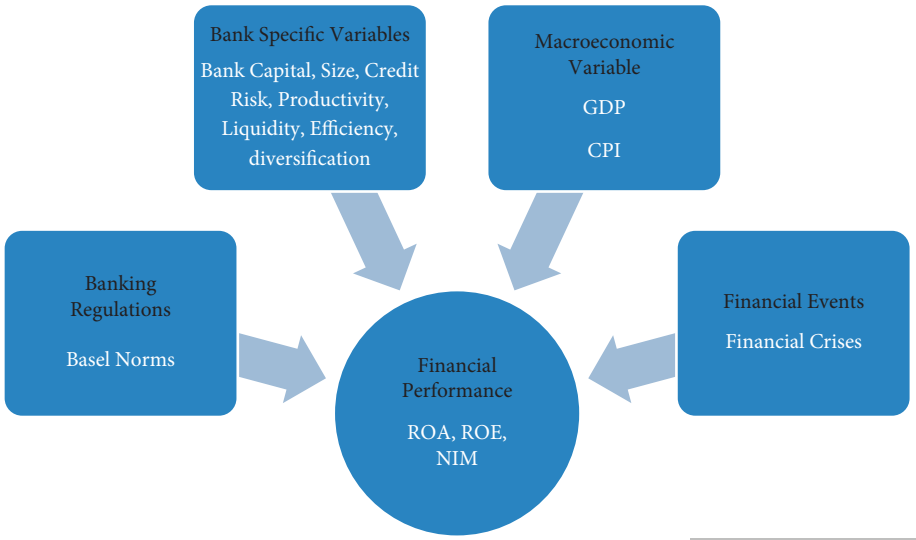
5.1. Data Source and Sample. The present study relies on secondary data on selected parameters of the public-sector banks operating in India. The RBI database has been used to extract data on selected parameters of the public sector for a period from 2005 to 2018. 21 banks were chosen as a sample of public-sector banks operating in India. All those government-owned banks that were operating in India during 2005–2018, and whose data were available for all the selected parameters, were selected for the present study.

5.2. Selected Variables for the Study. Table 1 highlights various financial parameters used in the study to analyze the impact of Basel norms on the financial performance of public-sector banks in India. These variables have been classified as "bank performance variables, bank-specific variables, macroeconomic variables, banking regulations, and financial events."

5.3. Framework of the Study. The framework of the study is shown as a flowchart, given by the authors.

Table 1: Description of variables of the study.

Parameters	Proxy measures	Acronym
Performance variables		
Profitability	Return on assets	ROA
	Net interest margin	NIM
Bank-specific variables		
Bank capital	Capital adequacy ratio	CAR
Credit risk	Net nonperforming assets to net advance	NNPANA
Liquidity	Liquid assets to total assets ratio	LATA
Bank size	Log of assets	LNA
Operating efficiency		OPEXTA
Productivity		PPE
Income diversification		NONIITI
Banking regulations		
Basel norms	Basel I era (dummy)	B1
	Basel II era (dummy)	B2
	Basel III era (dummy)	B3
Macroeconomic variables		
Economic growth	Gross domestic growth rate	GDP
Inflation	Consumer price index	CP
Financial events	Financial crises (dummy)	FC



5.4. Expected Relationship of Study Variables. The expected impact of the variables under study on financial performance of the bank has been summarised in Table 2.

5.5. Robust Regression Models. The study analysed the impact of bank-specific variables, banking regulations, financial crises, and macroeconomic variables on public-sector banks performance. For this purpose, the following models were developed based on previous literature:

(1) $\mathrm{ROA}_{it} = \beta_1 + \beta_2 \quad \mathrm{LNA}_{it} + \beta_3 \mathrm{NNPANA}_{it} + \beta_4 \mathrm{CAR}_{it} + \beta_5 \mathrm{LATA}_{it} + \beta_6 \mathrm{OPEXTA}_{it} + \beta_7 \mathrm{PPE}_{it} + \beta_8 \mathrm{NONIITI}_{it} + \beta_9 \mathrm{GDP}_{it} + \beta_{10} \mathrm{CPI}_{it} + \beta_{11} \mathrm{B2}_{it} + \beta_{12} \mathrm{B3}_{kit} + e_{it}$

(2) $\mathrm{NIM}_{it} = \beta_1 + \beta_2 \mathrm{LNA}_{it} + \beta_3 \quad \mathrm{NNPANA}_{it} + \beta_4 \mathrm{CAR}_{it} + \beta_5 \mathrm{LATA}_{it} + \beta_6 \mathrm{OPEXTA}_{it} + \beta_7 \mathrm{PPE}_{it} + \beta_8 \mathrm{NONIITI}_{it} + \beta_9 \mathrm{GDP}_{it} + \beta_{10} \mathrm{CPI}_{it} + \beta_{11} \mathrm{B2}_{it} + \beta_{12} \mathrm{B3}_{kit} + e_{it}$

In these equations, i shows cross-sectional dimension across the selected sample banks, t denotes the years, and ε is for the random error term. Pit denotes the financial performance of banks proxied by ROA and NIM. β_1 is the constant term. LNA is the bank size, NNPANA is for credit risk, and CAR is for capital adequacy. LATA is the liquidity, OPEXTA is management efficiency, PPE is productivity, and NONIITI is for income diversification. GDP is used for economic growth, while CPI is for inflation. B1, B2, and B3 are dummy variables used for Three Basel Eras.

6. Results of Empirical Analysis

6.1. Descriptive Analysis. Table 3 reports the descriptive analysis of variables under study. It is evident from Table 3 that mean values of NIM and ROA are 2.45% and 0.82%, respectively, while their maximum values are 3.78% and 2.46%, respectively, and their minimum values are 0.23%

Table 2: Expected relationship of study variables.

Variables	Bank performance
Capital adequacy ratio (CAR)	−/+
Basel norms (B1, B2, B3)	−/+
Bank size (LNA)	+
Credit risk (NNPANA)	—
Liquidity (LATA)	−/+
Productivity (PPE)	+
Cost inefficiency (OPEXTA)	—
Income diversification (NONIITI)	+
GDP growth rate (GDP)	−/+
Inflation (CPI)	−/+
Financial crises (FC)	—

Table 3: Descriptive statistics.

	NIM	ROA	PPE	CAR	NNPANA	GDP	CPI	LNA	LATA	NONIITI	OPEXTA
Mean	2.45	0.82	0.57	12.21	2.99	7.00	0.07	14.20	8.45	11.28	2.19
Median	2.43	0.76	0.48	12.17	1.72	7.54	0.06	14.29	7.93	10.99	1.54
Maximum	3.78	2.46	4.70	18.16	16.69	8.50	0.12	17.36	23.63	24.82	21.74
Minimum	0.23	0.07	0.04	8.69	0.15	3.09	0.02	10.53	2.80	2.07	0.56
Std. dev.	0.60	0.43	0.48	1.34	3.22	1.44	0.03	1.09	3.02	3.45	2.88
Observations	294	294	294	294	294	294	294	294	294	294	294

Source: authors' calculation.

Table 4: Correlation matrix for the dependent and independent variables.

	NIM	ROA	PPE	CAR	NNPANA	GDP	CPI	LNA	LATA	NONIITI	OPEXTA
NIM	1.00	0.28	−0.31	0.23	−0.39	0.05	0.01	0.28	−0.06	0.08	0.05
ROA	0.28	1.00	0.56	0.17	−0.03	−0.06	0.18	0.21	−0.13	0.34	−0.10
ROE	0.26	0.92	0.52	0.07	0.02	−0.05	0.18	0.18	−0.09	0.30	−0.08
PPE	−0.31	0.56	1.00	−0.13	0.49	−0.03	−0.02	−0.14	0.04	0.16	−0.07
CAR	0.23	0.17	−0.13	1.00	−0.49	−0.14	0.36	0.27	−0.10	0.21	0.03
NNPANA	−0.39	−0.03	0.49	−0.49	1.00	0.22	−0.58	−0.47	0.16	0.10	0.07
GDP	0.05	−0.06	−0.03	−0.14	0.22	1.00	−0.48	−0.07	0.06	0.11	0.02
CPI	0.01	0.18	−0.02	0.36	−0.58	−0.48	1.00	0.23	−0.23	−0.20	−0.02
LNA	0.28	0.21	−0.14	0.27	−0.47	−0.07	0.23	1.00	0.10	0.27	−0.51
LATA	−0.06	−0.13	0.04	−0.10	0.16	0.06	−0.23	0.10	1.00	−0.03	−0.10
NONIITI	0.08	0.34	0.16	0.21	0.10	0.11	−0.20	0.27	−0.03	1.00	0.12
OPEXTA	0.05	−0.10	−0.07	0.03	0.07	0.02	−0.02	−0.51	−0.10	0.12	1.00

Source: authors' calculations.

and 0.07%, respectively. The mean value of CAR during the study period (12.21%) has been higher than the required capital adequacy ratio of 10% in India. The mean value for NNPANA measures for credit risk for banks in the study is 2.99%. The maximum and minimum values for NNPANA are 16.69% and 0.15%. The average value of NIITI, a measure of business diversification, is 11.28%. Table 3 depicts that the average value of OPETA, a measure of inefficiency used in the study, is 2.19%. The table also shows the mean value of liquidity (LATA) as 8.45%. The maximum and minimum values of LATA vary from a maximum of 23.63% to 5.43%. Profit per employee (PPE), a measure for productivity, has an average value of 0.57 with a standard deviation of 0.48. GDP and CPI were used as macroeconomic variables in the study. The mean value of GDP is 7.0% during the study, while the average value of CPI was 0.07.

6.2. Correlation Analysis. Table 4 shows Pearson's correlation coefficients. If it is greater than 0.80, then there is an issue of multicollinearity. The table shows that dependent variables have no multicollinearity. It is shown in the table that CAR, GDP, CPI, LNA, NONIITI, and OPEXTA are positively associated while PPE, NNPANA, and LATA are negatively associated with NIM. In case of ROA, CAR, CPI, LNA, and NONIITI are positively associated, while NNPANA, GDP, LATA, and OPEXTA are inversely related to ROA. Furthermore, ROE has a positive association with PPE, CAR, NNPANA, CPI, LNA, and NONIITI while being negatively associated with GDP, LATA, and OPEXTA.

The correlation matrix depicts that "productivity, bank capital, bank size, and business diversification" has a positive impact on bank profitability while "credit risk, ownership structure, liquidity, nontraditional activity, and inefficiency" negatively impact bank profitability.

Table 5: Robust regression analysis with return on assets.

ROA as dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LNA	0.897 (−0.13)	0.152 (1.43)	0.45 (−0.74)	0.28 (−1.07)	0.220 (1.23)	0.492 (−0.69)	0.534 (−0.62)
NNPANA	0.000* (−6.62)	0.000* (−8.69)	0.0011* (−3.27)	0.024** (−2.24)	0.000* (−6.11)	0.000* (−5.30)	0.001* (−3.10)
CAR	0.0005* (3.50)	0.29(1.06)	0.07***(−1.81)	0.0004* (3.55)	0.136 (1.48)	0.221 (-1.22)	0.047** (1.98)
LATA	0.000* (−4.25)	0.0001* (−3.92)	0.056*** (−1.91)	0.0008* (−3.35)	0.0003* (−3.66)	0.007* (−2.67)	0.003* (−2.93)
OPEXTA	0.454 (−0.75)	0.37(0.89)	0.296 (−1.04)	0.08*** (−1.74)	0.479 (0.71)	0.29 (-1.05)	0.227 (−1.20)
PPE	0.000* (34.40)	0.000* (24.18)	0.000* (24.75)	0.000* (31.40)	0.000* (22.73)	0.000* (27.80)	0.000* (31.79)
NONIITI	0.000* (5.21)	0.000* (6.97)	0.000 (8.88)	0.000* (5.76)	0.000* (6.99)	0.000* (7.33)	0.0001* (3.92)
GDP				0.29 (−1.05)	0.565 (0.57)	0.467 (0.72)	0.496 (−0.68)
CPI				0.0001* (4.00)	0.044** (2.00)	0.000* (−4.71)	(0.34) (−0.95)
B1	0.000* (11.72)			0.000* (12.45)			0.008* (2.64)
B2		0.002* (−3.09)			0.002* (−3.06)		0.000* (−5.01)
B3			0.000* (−7.15)			0.000* (−9.03)	0.000* (−12.00)
Constant	0.355(−0.92)	0.356) (−0.92)	0.036** (2.09)	0.33(−0.95)	0.112(−1.58)	0.005* (2.77)	0.061*** (1.86)
Adjusted R^2	0.554	0.455	0506	0.570	0.457	0.527	0.575

Numbers in parentheses indicate z-statistics. ***,**,*Statistically significant at 10, 5, and 1 percent levels, respectively.

Table 6: Robust regression analysis with net interest margin.

NIM as dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LNA	0.883 (0.14)	0.690 (0.39)	0.747 (0.32)	0.404 (0.83)	0.435 (0.77)	0.022 (2.27)	0.075*** (1.77)
NNPANA	0.000* (−8.04)	0.000* (−8.79)	0.000* (−7.87)	0.000* (−8.71)	0.000* (−10.16)	0.000* (−4.17)	0.003* (−2.94)
CAR	0.0004* (3.54)	0.0002* (3.71)	0.0008* (3.38)	0.0003* (3.65)	0.020** (2.32)	0.066*** (1.83)	0.014** (2.43)
LATA	0.824 (0.22)	0.980 (−0.02)	0.910 (0.10)	0.621 (−0.49)	0.721 (−0.35)	0.249 (−1.15)	0.114 (−1.57)
OPEXTA	0.000* (136.10)	0.000* (139.16)	0.000* (139.36)	0.000* (134.19)	0.000* (136.81)	0.14(1.44)	0.549 (0.59)
PPE	0.000* (4.23)	0.000* (4.52)	0.000* (4.56)	0.000* (5.46)	0.000* (5.45)	0.390 (0.85)	0.590 (−0.53)
NONIITI	0.0016* (−3.14)	0.0006* (−3.42)	0.0009* (−3.33)	0.0003* (−3.62)	0.0006* (−3.41)	0.374 (−0.88)	0.134 (1.49)
GDP				0.996 (0.004)	0.69 (0.39)	0.48 (0.69)	0.260 (−1.12)
CPI				0.0006* (−3.43)	0.000* (−4.20)	0.000* (−8.77)	0.311 (−1.01)
B1	0.211(1.25)			0.687 (−0.40)			
FC							0.0000* (−5.38)
B2		0.118(−1.56)			0.017** (2.38)		0.029** (−2.17)
B3			0.49(0.68)			0.000* (−6.87)	0.0000* (−6.68)
Constant	0.214 (0.83)	−0.061 (0.95)	0.97 (−0.02)	0.580 (0.55)	0.178 (1.34)	0.0001* (3.84)	0.003* (2.92)
Adjusted R^2	0.437	0.439	0.437	0.448	0.456	0.394	0.433

Numbers in parentheses indicate z-statistics. ***,**,*Statistically significant at 10, 5, and 1 percent levels, respectively.

6.3. Robust Regression Analysis. A robust regression analysis was conducted to analyze the impact of bank performance determinants on the financial performance of public-sector banks in India. The results of robust regression analysis have been stated in Tables 5 and 6.

7. Results and Discussion

Table 5 gives the empirical findings of the seven models with ROA as a measure of bank performance. The robust regression analysis results depicts that Basel I norms had positively and significantly impacted ROA of public-sector banks, while Basel II and III had negatively and significantly affected public-sector banks' performance, implying that more stringent policies of Basel II and Basel III had adverse effects on public-sector bank performance.

Among the bank-specific variables, all the models (1–7) depict the same impact of bank size (LNA) and bank risk (NNPANA) on the bank performance (ROA). The findings show that bank size had no significance on the public-sector banks' performance across all the seven models, unlike earlier studies which showed a positive relationship [26, 13, 10, 4, 17, 18, 7, 19, 20, 11]. Bank risk had negatively and significantly impacted the bank's ROA during the study period, confirming that increasing nonperforming assets had negatively impacted the profitability of public-sector banks similar to many previous studies like Salike & Ao [30]; Petria et al. [10], Majumder and Li [3]; Brahmaiah [8]; Petria et al. [10]; Samad [35]; Kosmidou [26]; Sufian & Chong [28]; Menicucci & Paolucci [17]; Mirzaei & Mirzaei [29]; Athanasoglou et al. [20]; Al-Jafari & Alchami [11]. CAR shows positive and significant impact in three models (1, 4, and 7) like many existing studies, including Salike & Ao [30]; Kosmidou [26]; Kohlscheen et al. [15]; Chen et al. [13]; Majumder et al. [3]; Bansal et al. (2018), Sarpong Kumankoma [27]; Goddard et al. [31]. It is evident that CAR significantly and positively impact public-sector bank performance. Higher bank capital relates with higher bank profitability.

Cost inefficiency had not impacted ROA during the study period conforming the outcome of many previous Studies including Salike & Ao [30]; Kosmidou [26]; Kohlscheen et al. [15]; Sarpong Kumankoma [27]; Petria et al. [10], Rahman et al. [4] Alexiou & Sofoklis [18]; Mirzaei & Mirzaei [29]; Naifer [32]; Curak et al. [33]; and Athanasoglou et al. [20]. It was found that the measures of liquidity (LATA) across all the seven models had an inverse and significant relation with bank performance supporting the outcome of Kosmidou et al. [25]; Mirzaei and Mirzaei [29]; Al-Jafari and Alchami [11]; and Islam and Nishiyama [21] which indicates that banks earn more by lending more and maintaining lower liquid assets.

In all the seven models, Labour productivity (PPE) and income diversification (NONIITI) had a positive and significant relation with bank performance (ROA) similar results were found in Salike & Ao [30]; Majumder and Li [3]; Sarpong Kumankoma [27]; Sufian & Chong [28]; Sufian [37]; Sufian & Habibullah [19], implying that higher labour productivity and diversified income lead to higher profit for banks. Surprisingly, financial crises had a positive relation with the ROA of public-sector banks in India.

Among the macroeconomic variables, GDP growth rate had no significant impact on ROA of public-sector banks unlike Salike & Ao [30]; Majumder and Li [3]; Yüksel et al. [14]; Kosmidou [26]; Chen et al. [13]; Curak et al. [33]; Alhassan et al. [6]; Reddy [24]; Kosmidou et al. [25], which found positive impact. However, CPI affect the bank performance positively as indicated in the models 4 and 5 similar to Yüksel et al. [14]; Chen et al. [13]; Rahman et al. [4]; Abdullah et al. [5]; Brahmaiah [8]; Bouzgarrou et al. [9]; Kosmidou et al. [25]; Athanasoglou et al. [20]; Al-Jafari & Alchami [11]; Islam & Nishiyama [21]; Tan & Floros [23], while it shows negative impact in model 6 like Sufian & Chong [28]; Alhassan et al. [6]; Mirzaei & Mirzaei [29]; Salike & Ao [30]; Kosmidou [26] and no impact in model 7 like Sufian & Habibullah [19]; Sufian [37]; Kohlscheen et al. [15]; Alexiou & Sofoklis [18].

Table 6 empirically depicts the results of the seven models with NIM as a measure of bank performance. The robust regression analysis was employed and the empirical results of the study depict that Basel I norms had no significant impact on the NIM of public-sector banks, while Basel II and III negatively and significantly affected public-sector banks' performance, implying that the more stringent policies of Basel II and Basel III had adverse effects on public-sector bank performance.

Among the bank-specific variables, all the models (1–7) depict the same impact of bank size (LNA) and bank risk (NNPANA) on the bank performance (NIM), unlike [26, 13, 10, 4, 17, 18, 7, 19, 20, 11]. The findings show that bank size had no significance on the public-sector banks' performance across all the seven models. Bank Risk had negatively and significantly impacted NIM during the study period, supporting the outcomes of Salike & Ao [30]; Petria et al. [10], Majumder and Li [3]; Brahmaiah [8]; Samad [35]; Kosmidou [26]; Sufian & Chong [28]; Menicucci & Paolucci [17]; Mirzaei and Mirzaei [29]; Athanasoglou et al. [20]; Al-Jafari and Alchami [11] conforming that increasing nonperforming assets had negatively impacted Net Interest Margin of public-sector banks.

CAR shows a positive and significant impact in all models (except model 6) like Salike & Ao [30], Kosmidou [26]; Kohlscheen et al. [15]; Chen et al. [13]; Majumder and Li [3]; Bansal et al. (2018), Sarpong Kumankoma [27]; Goddard et al. [31]. It is evident that CAR on public sector positively impact bank performance. Higher bank capital relates with higher Net Interest Margin. Cost inefficiency had positively impacts Net Interest Margin during the study period. It was found that the measures of liquidity (LATA) across all the seven models had no significant relationship with NIM of public-sector banks unlike Albulescu [16]; Salike & Ao [30]; Kohlscheen et al. [15]; Kosmidou et al. [25]; Mirzaei & Mirzaei [29]; Al-Jafari & Alchami [11] and Islam & Nishiyama [21]. In the models (1–5), Labour productivity (PPE) had a positive and significant relationship with NIM of public-sector bank during study period like Majumder and Li [3] implying that higher labour productivity results in higher profit for banks. In the models (1–5), Income diversification (NONIITI) had a

negative and significant relationship with Net interest margin of public-sector banks like Rahman et el [4]; Reddy [24]; Sufian & Habibullah [19] implying that diversified income is related with lower NIM of banks. Financial crises had negatively impacted NIM of public-sector banks in India.

Among the macroeconomic variables, GDP growth rate had no significant impact on ROA of public-sector banks similar to Derbali & Lamouchi [44] but unlike Salike & Ao [30]; Majumder and Li [3]; Yüksel et al.[14]; Kosmidou [26]; Chen et al. [13]; Curak et al. [33]; Alhassan et al. [6]; Reddy [24]; Kosmidou et al. [25], while CPI affect the bank performance negatively as indicated in the models 4, 5, and 6 supporting results of Sufian & Chong [28]; Alhassan et al. [6]; Mirzaei & Mirzaei [29]; Salike & Ao [30]; Kosmidou [26] while it shows no impact in model 7 like Sufian & Habibullah [19]; Sufian [37]; Kohlscheen et al. [15]; Alexiou & Sofoklis [18]. It implies that during high inflation Net Interest Margin of Banks Reduces.

8. Conclusion

The robust regression analysis was employed to find the impact of bank performance determinants on the performance of the Indian banking sector. Empirical results depicts that Basel I norms had positively and significantly impacted ROA of public-sector banks while Basel II and III had negatively and significantly affected public-sector banks' performance, implying that more stringent policies of Basel II and Basel III had adverse effects on public-sector bank performance.

It can be concluded from the findings that bank size had no significance on the public-sector bank performance during the study period. Bank risk had negatively and significantly impacted bank performance of public-sector banks in India during the study period, confirming that increasing nonperforming assets had negatively impacted profitability of public-sector banks. CAR shows positive and significant impact in some models. Higher bank capital relates with higher bank profitability. Cost inefficiency had not impacted bank performance during the study period. It was found that the measures of liquidity (LATA) had an inverse and significant relationship with bank performance in most of the models, which indicates that banks earn more by lending more and maintaining lower liquid assets. However, cost inefficiency had positively impacted the net interest margin during the study period. It was found that the measures of liquidity (LATA) across all the seven models had no significant relationship with NIM. In almost all the models, labour productivity (PPE) and income diversification (NONIITI) had a positive and significant relationship with bank performance, implying that higher labour productivity and diversified income lead to higher profit for the banks. Income diversification (NONIITI) had a negative and significant relationship with the net interest margin of public-sector banks implying that diversified income is related to lower the NIM of banks. Surprisingly, financial crises had a positive relationship with bank performance in some models. Financial crises had negatively impacted NIM of public-sector banks in India.

8.1. Implications of the Study. Findings have implications for researchers, regulators, managers, and the government. Researchers can use robust regression analysis to analyze financial data. More vigilance is required by the RBI for high-risk portfolio banks, and the RBI should suggest higher provisioning requirements for such banks. [45] Banks should change their business model for complying with new banking regulations such as Basel III in a cost-efficient manner as considerable [46] cost may involve. Implementation of Basel III would require more capital. The government [47] is suggested to propose a plan for disinvestment in public-sector banks.

Data Availability

Data can be provided upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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