

Impact of Basel III Capital Adequacy Norms on the Profitability of the Indian Banking System

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Citation:

Kumar, A., Chandu, D., Vardhan, G. H., Prakash, A. B., Prasad, B. B., Rehana, S., Lavanyaa, & Rekha, T. B. (2026). Impact of Basel III Capital Adequacy Norms on the Profitability of the Indian Banking System. *Economics, Finance and Management Review*, (2(26), 59–77. <https://doi.org/10.36690/2674-5208-2026-2-59-77>

Received: April 22, 2026

Approved: May 26, 2026

Published: June 30, 2026



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Abstract. The Basel III framework was introduced after the global financial crisis of 2007-2009 to strengthen banking regulation, improve capital adequacy, enhance liquidity management, and reduce systemic financial risk. In India, the Reserve Bank of India implemented Basel III norms gradually from 2013, requiring banks to maintain stronger capital buffers. However, higher capital requirements may influence profitability because banks must balance financial stability with lending capacity and earnings performance. The objective of this study is to analyse the impact of Basel III Capital Adequacy Norms on the profitability of the Indian banking system during the period 2015-2024, with particular attention to the relationship between Capital Adequacy Ratio, Return on Assets, Return on Equity, and Non-Performing Assets. The study applies a quantitative descriptive-analytical research design based on secondary panel data. The sample includes five high-capital scheduled commercial banks: State Bank of India, Punjab National Bank, HDFC Bank, ICICI Bank, and Axis Bank. Data were collected from bank annual reports, the Reserve Bank of India Database on Indian Economy, RBI reports, and stock exchange disclosures. The study uses Pearson correlation analysis, simple and multiple linear regression analysis, independent samples t-test, and one-way ANOVA. The findings show that the average Capital Adequacy Ratio of the selected banks was above the RBI minimum requirement, indicating strong regulatory compliance. Private sector banks maintained higher CAR, ROA, and ROE, while public sector banks showed higher NPA levels. NPA emerged as a major negative factor affecting profitability. Basel III norms strengthened the capital position of Indian banks, but their profitability impact was asymmetric, favouring banks with stronger governance, lower credit risk, and better operational efficiency. Future studies should include more banks, longer time periods, macroeconomic variables, and advanced panel econometric models to assess the long-term effects of Basel III implementation on financial stability and profitability.

Keywords: Basel III; capital adequacy; Capital Adequacy Ratio; Indian banking system; bank profitability; Return on Assets; Return on Equity; Non-Performing Assets; public sector banks; private sector banks; financial stability; risk management.

JEL Classification: G21; G28; G32; C23; O16

Formulas: 1; **fig.:** 5; **tabl.:** 5; **bibl.:** 19.

Introduction. The global financial crisis of 2007-2009 exposed deep vulnerabilities in international banking regulation, prompting the Basel Committee on Banking Supervision to introduce the Basel III framework in December 2010. Basel III fundamentally overhauled capital adequacy standards by raising minimum capital requirements, introducing the Capital Conservation Buffer of 2.5%, prescribing new liquidity standards, including the Liquidity Coverage Ratio and Net Stable Funding Ratio, and instituting a leverage ratio requirement. These reforms collectively aimed to ensure that banks maintain adequate capital to absorb losses during periods of severe financial stress.

The Reserve Bank of India commenced phased implementation of Basel III guidelines from April 2013, prescribing a minimum Capital Adequacy Ratio of 9% for scheduled commercial banks, exceeding the international benchmark of 8%. With the Capital Conservation Buffer of 2.5%, the effective minimum CAR for Indian banks stands at 11.5%. This study focuses on five high-capital banks, State Bank of India, Punjab National Bank, HDFC Bank, ICICI Bank, and Axis Bank, which collectively represent the largest capitalised institutions in the Indian banking system and serve as a credible lens for examining Basel III's profitability impact.

The study is based entirely on secondary data sourced from the published Annual Reports of the five sampled banks for each year from 2015 to 2024, supplemented by the RBI's Database on Indian Economy and the Report on Trend and Progress of Banking in India published annually by the RBI. All financial ratios, Capital Adequacy Ratio, Return on Assets, Return on Equity, and Net NPA Ratio, are directly extracted from audited financial statements and regulatory disclosures, ensuring accuracy, transparency, and academic credibility.

The global banking system experienced serious instability during the 2007-2009 financial crisis due to weak capital structure, excessive risk-taking, and inadequate regulatory supervision. To improve financial stability, the Basel Committee introduced Basel III norms focusing on stronger capital requirements, improved liquidity management, and better risk control mechanisms. In India, the Reserve Bank of India implemented Basel III norms to strengthen the financial position of banks and reduce the possibility of banking failure. However, maintaining higher capital levels may influence profitability because banks must hold more capital reserves instead of using funds for lending and investment.

The need for this study arises from the importance of understanding whether Basel III norms improve profitability or create pressure on banks' earnings. The study helps analyse whether strong capital adequacy leads to higher Return on Assets and Return on Equity, and how Non-Performing Assets affect profitability performance. This study is necessary because banks must maintain higher capital buffers under Basel III norms, profitability determines long-term banking sustainability, Indian public and

private sector banks show differences in capital strength and profitability, and limited studies analyse the impact of Basel III norms on Indian bank profitability using recent data from 2015 to 2024.

Therefore, the study helps evaluate whether Basel III norms improve financial stability without reducing bank profitability. The present study focuses on analysing the impact of Basel III capital adequacy norms on the profitability of selected Indian banks. The study covers ten years from 2015 to 2024 and includes both public-sector and private-sector banks. The study is limited to five major scheduled commercial banks: State Bank of India, Punjab National Bank, HDFC Bank, ICICI Bank, and Axis Bank. The key financial variables considered are Capital Adequacy Ratio, Return on Assets, Return on Equity, and Net Non-Performing Assets. The scope of the study is limited to the Indian banking sector, secondary data sources, Basel III capital adequacy norms, profitability indicators, and the study period 2015-2024.

The study provides several benefits to different stakeholders in the banking sector. It helps banks understand how capital adequacy affects profitability, assists policymakers in evaluating the effectiveness of Basel III norms, provides useful information to investors regarding the financial strength of banks, helps researchers understand the relationship between CAR, NPA, ROA, and ROE, supports improvement of risk management practices in banks, and helps compare performance between public and private sector banks. The study also helps identify whether higher capital requirements improve stability without negatively affecting earnings performance.

Basel norms are important for central banks because they provide international standards for banking regulation and risk management. Central banks use Basel guidelines to ensure that commercial banks maintain sufficient capital to absorb financial losses. These norms help ensure financial stability, reduce the risk of bank failure, promote safe lending practices, improve transparency in financial reporting, strengthen the confidence of investors and depositors, and maintain uniform banking regulations across countries. Without Basel norms, banks may take excessive risks, which can lead to financial crisis and economic instability.

Basel norms significantly influence central banks and the functioning of the banking system. Their positive impact includes improvement in bank capital strength, reduction of financial risk, enhancement of liquidity management, improvement of credit risk assessment, strengthening of central bank supervision, and reduction in the probability of banking crises. At the same time, there are challenges. Banks need more capital to meet Basel requirements, profitability may reduce in the short term, public sector banks may require government support, and implementation requires a strong monitoring system. In India, the RBI ensured gradual implementation of Basel III norms so that banks could adjust their capital structure without

disturbing lending activities. The study findings show that the average CAR of selected banks is 15.56%, which is higher than the minimum RBI requirement of 9%, indicating a strong capital position. Higher CAR improves financial stability but may influence profitability depending on bank efficiency and NPA levels.

Literature Review. Berger (1995) conducted a landmark empirical study of United States commercial banks to examine whether capital ratios and bank profitability are positively or negatively related. Using data across multiple bank cycles, he found a significantly positive relationship between capital adequacy and return on equity, contradicting the conventional belief that higher capital necessarily reduces profitability by limiting leverage. The study explained this positive relationship through the expected bankruptcy cost hypothesis: well-capitalised banks face lower expected costs of financial distress, enjoy cheaper access to external funding, and can pursue lending opportunities more aggressively. This paper established the foundational argument that capital strength and earnings are complementary rather than competing objectives and has been widely cited as a theoretical justification for Basel III's emphasis on higher-quality capital requirements.

Goddard et al. (2004) conducted a comprehensive cross-country analysis of bank profitability across six European Union member states using both cross-sectional and dynamic panel data methodologies. The authors examined determinants of return on equity for a large sample of commercial banks over the period 1992-1998. A statistically significant positive association was found between capital adequacy ratios and profitability. The authors argued that well-capitalised European banks were perceived as financially sounder institutions by depositors and counterparties, thereby attracting lower-cost funding, a dynamic that enhanced net interest margins and overall profitability. The study also found that diversification of income and cost efficiency were important complementary drivers of profitability, offering a multidimensional framework applicable to the comparative analysis of Indian public and private sector banks.

Pasiouras and Kosmidou (2007) examined a large sample of 584 domestic and foreign commercial banks from fifteen European Union countries over the period 1995-2001, using panel data regression to identify the determinants of bank profitability measured by return on assets. The study confirmed that the capital adequacy ratio had a positive and statistically significant impact on profitability for both domestic and foreign banks, supporting the view that well-capitalised banks benefit from lower risk premiums and superior credit ratings. In addition to capital adequacy, the study found that the cost-to-income ratio, the loan-to-asset ratio, and bank size were significant determinants of bank profitability. The findings are relevant to the Indian context, where the profitability of public sector banks has been adversely affected by operational inefficiency and high credit costs.

Athanasoglou et al. (2008) examined the profitability determinants of Greek commercial banks using an unbalanced panel dataset spanning 1985-2001. Employing a generalised method of moments dynamic panel framework, the authors disaggregated profitability drivers into bank-specific factors, industry-specific factors, and macroeconomic variables. The study confirmed a positive and statistically significant relationship between capital strength and profitability, finding that undercapitalised banks were forced to allocate a higher proportion of resources to risk mitigation rather than profit generation. It also found that expense management and credit risk were the strongest bank-level determinants of profitability, findings directly applicable to the NPA-driven profitability decline of Indian public sector banks during 2016-2019.

Dietrich and Wanzenried (2011) examined the determinants of profitability for 372 Swiss commercial banks over the period 1999-2009, explicitly comparing the pre-crisis and crisis periods to identify whether the relationship between capital adequacy and profitability is time-invariant. The authors found that better-capitalised banks exhibited significantly higher profitability before the financial crisis but that this positive relationship weakened during the crisis period, suggesting that when macroeconomic conditions deteriorate sharply, even well-capitalised banks cannot fully insulate their earnings from systemic shocks. This time-varying nature of the capital-profitability relationship is particularly relevant to the Indian study context, which spans both the NPA crisis period and the subsequent recovery.

Tan and Floros (2013) investigated the interrelationships among bank risk, capital, and efficiency in the Chinese banking sector over the period 2003-2009, using a three-stage least squares simultaneous equations framework that accounts for the endogenous relationships among these variables. The authors found that higher capitalisation was associated with lower short-run profitability for Chinese banks, as the cost of maintaining elevated capital ratios was not immediately offset by efficiency or revenue gains. However, over longer horizons, better-capitalised banks demonstrated improved risk-adjusted returns, underscoring the importance of distinguishing short-run costs from long-run benefits of enhanced capitalisation.

Sufian and Habibullah (2009) investigated the determinants of profitability for Chinese commercial banks using panel data over the period 1997-2004. The authors employed return on assets as the primary profitability measure and examined a comprehensive set of bank-specific variables, including capital adequacy, credit risk, overhead costs, liquidity, and non-interest income, alongside macroeconomic indicators. Capital strength emerged as a significant positive determinant of bank profitability, with higher capital ratios associated with lower funding costs and greater resilience in absorbing unexpected loan losses. The study also found that

credit risk, proxied by the non-performing loan ratio, was the single most important negative determinant of profitability, a finding that resonates strongly with the Indian experience.

Das and Ghosh (2006) examined the efficiency and performance of Indian commercial banks in the post-liberalisation period following the Narasimham Committee reforms of the 1990s. Using data envelopment analysis and panel regression, the authors found that capital adequacy was a significant negative determinant of NPA formation, implying that better-capitalised Indian banks exercised greater lending discipline and maintained superior asset quality. This indirect channel through which capital adequacy enhances profitability by reducing provisioning requirements and preserving net interest margins is of direct relevance to the Basel III study period, during which the NPA crisis affected public sector bank profitability.

Chaudhary and Sharma (2011) conducted a comparative analysis of the performance of Indian public sector and private sector banks over the period 2000-2010, examining financial performance metrics including return on assets, return on equity, net interest margin, and capital adequacy ratio. The study found that private sector banks consistently outperformed public sector banks on all profitability metrics throughout the study period, attributing this differential to superior operational efficiency, more disciplined credit appraisal processes, better governance structures, and greater flexibility in human resource management. These structural differences provide the conceptual foundation for the comparative analysis of Basel III's differential profitability impact across the two bank segments in the present study.

Mohan (2012) provided an authoritative overview of the Indian financial sector's evolution, structural characteristics, and emerging challenges in the context of Basel III implementation. The paper highlighted that Basel III posed significant structural challenges for Indian public sector banks, which historically depended on government capital infusions rather than market-based capital raising to meet regulatory requirements. Mohan emphasised that enhanced Tier 1 capital requirements under Basel III would require substantial recapitalisation of public sector banks, potentially crowding out government fiscal resources. The paper also noted the governance deficit in public sector banks as a fundamental obstacle to improving capital efficiency and profitability.

Aims. The aim of this study is to analyse the impact of Basel III Capital Adequacy Norms on the profitability of the Indian banking system during the period 2015-2024. The study focuses on selected high-capital scheduled commercial banks and examines how capital adequacy, profitability indicators, and non-performing assets interact within the Indian banking context.

The study is guided by the following objectives:

1. to analyse the Capital Adequacy Ratio trends of five high-capital Indian banks over the period 2015-2024 using data from their Annual Reports;

2. to examine the profitability trends, measured through ROA and ROE, of the sampled banks over the study period;
3. to compare profitability between public sector banks, SBI and PNB, and private sector banks, HDFC Bank, ICICI Bank, and Axis Bank, using the Independent Samples t-Test;
4. to analyse the relationship between capital adequacy, non-performing assets, and profitability indicators;
5. to examine whether significant differences exist among the selected banks in terms of CAR, ROA, ROE, and NPA using ANOVA.

The following null hypotheses are tested:

H₀₁: There is no significant correlation between CAR and ROA of the sampled Indian banks.

H₀₂: There is no significant correlation between CAR and ROE of the sampled Indian banks.

H₀₃: CAR has no significant impact on ROA and ROE as determined by regression analysis.

H₀₄: There is no significant difference in profitability between public sector and private sector banks.

H₀₅: There is no significant difference in ROA across all five sampled banks.

Methodology. This study adopts a quantitative, descriptive-analytical research design. It uses secondary panel data to establish relationships between capital adequacy and bank profitability. The panel dataset combines cross-sectional information from five banks with time-series data for ten years, from 2015 to 2024, yielding a balanced panel of 50 bank-year observations.

Five high-capital scheduled commercial banks are selected based on total asset size, capital adequacy position, and consistent data availability across the full study period. The selected banks are State Bank of India, Punjab National Bank, HDFC Bank, ICICI Bank, and Axis Bank. SBI and PNB represent public sector banks, while HDFC Bank, ICICI Bank, and Axis Bank represent private sector banks. All selected banks are BSE-listed institutions. The headquarters of SBI, HDFC Bank, ICICI Bank, and Axis Bank are in Mumbai, while PNB is headquartered in New Delhi.

All data used in this study are secondary in nature and are sourced from the Annual Reports of SBI, PNB, HDFC Bank, ICICI Bank, and Axis Bank for each financial year from 2015-16 to 2023-24, published on the respective bank websites and stock exchange filings. Additional sources include the Reserve Bank of India's Database on Indian Economy, the RBI Report on Trend and Progress of Banking in India from 2015 to 2024, and SEBI and NSE/BSE disclosures for cross-validation of reported financial ratios.

The main variables used in the study are Capital Adequacy Ratio, Return on Assets, Return on Equity, and NPA Ratio. Capital Adequacy Ratio is the independent variable and is calculated as total capital divided by risk-weighted assets. Return on Assets is a dependent variable and is calculated

as net profit divided by total assets multiplied by 100. Return on Equity is a dependent variable and is calculated as net profit divided by shareholders' equity multiplied by 100. NPA Ratio is used as a control variable and is calculated as gross NPA divided by gross advances multiplied by 100.

The study employs four statistical tools. Pearson Correlation Analysis is used to measure the direction and strength of the relationship between CAR and each profitability indicator, ROA and ROE, and the NPA ratio. Simple and Multiple Linear Regression Analysis is used to quantify the impact of CAR and NPA ratio on ROA and ROE, using the model:

$$\text{ROA/ROE} = \alpha + \beta_1(\text{CAR}) + \beta_2(\text{NPA}) + \varepsilon \quad (1)$$

Independent Samples t-Test is used to test for statistically significant differences in mean profitability between public sector banks and private sector banks. One-Way ANOVA is used to test for significant differences in mean ROA and ROE across all five banks simultaneously. The software used for analysis is SPSS v25 and MS Excel.

Results. The results of the study are presented through bank-wise annual data, correlation analysis, regression analysis, t-Test, and ANOVA. The analysis covers total capital, Capital Adequacy Ratio, Return on Assets, Return on Equity, and Net NPA Ratio for five selected banks during the period 2015-2024.

Total capital of selected banks. The following table presents the actual data extracted from the Annual Reports of the five sampled banks for the ten-year study period. These data constitute the primary dataset for subsequent statistical analyses.

Table 1. Total Capital of Selected Banks (₹ Crore)

Year	SBI	PNB	HDFC	ICICI	Axis
2015	1,44,274	1,83,950	1,45,880	1,78,640	1,29,830
2016	1,75,903	1,88,740	1,61,240	1,92,510	1,41,520
2017	2,04,731	1,95,620	1,83,420	2,05,920	1,55,430
2018	2,38,154	1,99,840	2,05,360	2,34,180	1,72,360
2019	2,45,225	2,05,530	2,45,180	2,65,410	1,96,250
2020	2,74,036	2,23,470	2,83,960	2,98,770	2,18,470
2021	3,08,893	2,49,380	3,18,240	3,41,580	2,47,690
2022	3,42,792	2,73,950	3,62,950	3,75,260	2,69,580
2023	4,08,579	3,10,420	4,12,730	4,24,390	3,05,910
2024	4,60,023	3,45,760	4,65,500	4,70,120	3,42,840

Source: compiled by the authors based on Annual Reports of selected banks.

The total capital of all selected banks shows steady growth during the study period from 2015 to 2024. Among the banks, ICICI Bank and HDFC Bank recorded the highest capital levels in the later years of the study. SBI also demonstrated significant growth in capital, especially after 2020. PNB and Axis Bank showed moderate but consistent increases in capital levels.

Overall, the increasing capital indicates improved financial strength and compliance with regulatory capital requirements.

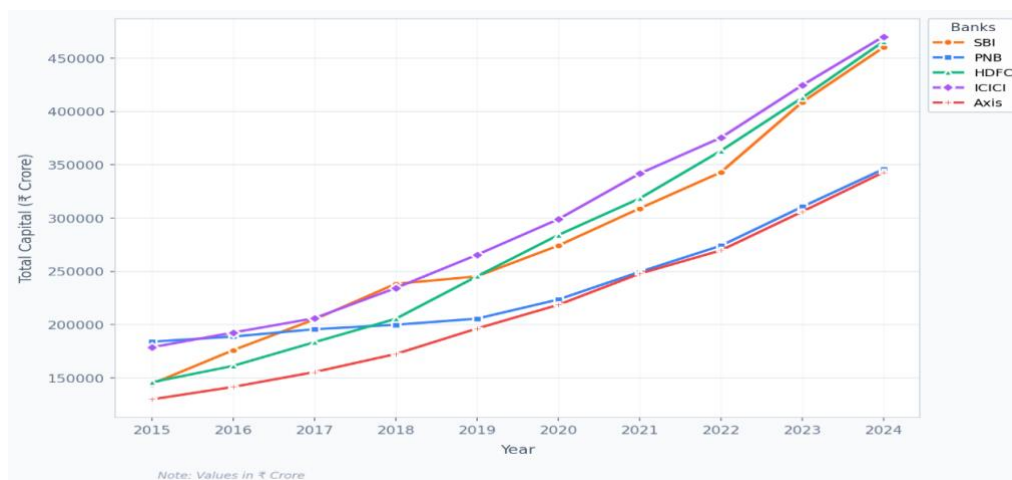


Figure 1. Total Capital of Selected Banks

Source: compiled by the authors based on Annual Reports of selected banks.

The correlation between SBI and PNB is 0.980, showing a strong positive relationship between public sector banks. The correlation among private sector banks, HDFC, ICICI, and Axis, is extremely high, around 0.999, indicating very similar growth patterns. The correlation between public and private banks is also strong, above 0.99, showing that their performance trends move in the same direction. Overall, private banks show slightly stronger correlation among themselves compared to public banks. The analysis indicates that both public and private banks exhibit strong positive relationships in their performance, with private sector banks showing slightly more consistent growth patterns.

The regression analysis results for public versus private sector banks show that the R^2 value of 0.991 indicates that about 99.1% of the variation in SBI performance is explained by private sector banks, namely HDFC, ICICI, and Axis. The Significance F value shows that the regression model is statistically significant. Among the variables, Axis Bank has the strongest positive influence, while HDFC and ICICI show weaker relationships with SBI. Overall, the results suggest a strong relationship between public and private sector bank performance.

The ANOVA results for total capital indicate that the calculated F value of 18.907 is greater than the critical value of 2.6335, and the p-value is less than 0.05. Therefore, the null hypothesis is rejected. This shows that there is a significant difference in performance among the selected banks during the study period. The t-Test for public versus private sector banks shows that although private sector banks have a slightly higher average value compared to public sector banks, the difference is not statistically significant at the 5% level.

Capital Adequacy Ratio. Capital Adequacy Ratio is the main independent variable in this study. It indicates the ability of banks to absorb financial losses and meet regulatory capital requirements.

Table 2. Capital Adequacy Ratio (CAR %)

Year	SBI	PNB	HDFC	ICICI	Axis
2015	12.00	12.43	17.00	17.02	15.80
2016	13.12	11.98	15.53	16.64	15.04
2017	13.11	12.84	15.00	16.63	15.29
2018	12.60	11.65	14.82	18.42	16.57
2019	12.72	12.16	17.11	19.16	17.00
2020	13.06	14.21	18.52	19.12	17.53
2021	13.74	14.32	18.80	19.84	19.12
2022	13.83	14.50	18.90	19.16	17.42
2023	14.68	15.53	19.26	18.72	19.66
2024	14.28	16.15	18.80	18.34	18.50

Source: compiled by the authors based on Annual Reports of selected banks.

The CAR levels of all selected banks remained above the regulatory minimum during the study period. Private sector banks such as HDFC and ICICI maintained consistently higher capital adequacy compared to public sector banks. SBI showed gradual improvement over the years, while PNB experienced fluctuations but improved significantly after 2020. The higher CAR levels indicate better risk absorption capacity and financial stability.



Figure 2. Capital Adequacy Ratio (CAR %)

Source: compiled by the authors based on Annual Reports of selected banks.

The correlation between SBI and PNB is 0.862, showing a strong relationship among public sector banks. HDFC and Axis show a strong correlation of 0.841 among private banks. The relationship between ICICI and public banks is comparatively moderate, around 0.38-0.44. Overall, most banks show positive correlation in maintaining capital adequacy levels.

The regression analysis for Capital Adequacy Ratio shows that the R^2 value of 0.731 indicates that about 73.1% of the variation in SBI's CAR is

explained by private sector banks. The Significance F value of 0.039 shows that the regression model is statistically significant. Among the variables, HDFC shows a relatively stronger positive relationship with SBI, while ICICI shows a weaker relationship. Overall, the results indicate a moderate to strong relationship between public and private sector banks in maintaining capital adequacy levels.

The variance results show that SBI has a mean CAR of 13.31 and variance of 0.64, PNB has a mean CAR of 13.58 and variance of 2.50, HDFC has a mean CAR of 17.37 and variance of 2.34, ICICI has a mean CAR of 18.31 and variance of 1.19, and Axis has a mean CAR of 17.19 and variance of 2.27. The ANOVA results show that the calculated F value of 32.15 is greater than the critical value at the 5% significance level. Therefore, the null hypothesis is rejected. This indicates that there is a significant difference in CAR among the selected banks during the study period.

The t-Test for CAR shows that public sector banks have a mean CAR of 13.46, while private sector banks have a mean CAR of 17.58. The t statistic is -9.84, the p-value is 0.000, and the t critical value is 2.01. Since the p-value is less than 0.05 and the absolute t statistic is greater than the t critical value, the null hypothesis is rejected. The results reveal that private sector banks maintain a higher Capital Adequacy Ratio compared to public sector banks, indicating stronger capital stability and better risk-absorbing capacity.

Return on Assets. Return on Assets indicates the efficiency of banks in utilizing their assets to generate profits.

Table 3. Return on Assets (ROA %)

Year	SBI	PNB	HDFC	ICICI	Axis
2015	0.48	0.24	2.02	0.81	1.50
2016	0.46	-0.97	1.89	0.70	1.20
2017	0.41	-1.42	1.88	0.44	0.67
2018	-0.19	-2.35	1.93	-0.09	-0.27
2019	0.02	-4.71	1.90	0.36	0.28
2020	0.38	-4.29	2.01	0.39	0.41
2021	0.48	0.45	1.97	1.05	0.47
2022	0.67	0.80	2.03	1.67	0.92
2023	0.96	1.10	2.07	2.05	1.20
2024	1.04	1.55	1.98	2.35	1.55

Source: compiled by the authors based on Annual Reports of selected banks.

ROA indicates the efficiency of banks in utilizing their assets to generate profits. HDFC Bank maintained consistently high ROA during the study period, reflecting strong operational efficiency. ICICI Bank showed significant improvement after 2020. Public sector banks, particularly PNB, experienced negative ROA during the middle years due to higher NPA levels. However, both SBI and PNB showed improvement in profitability in recent years.



Figure 3. Return on Assets (ROA %)

Source: compiled by the authors based on Annual Reports of selected banks.

The correlation results show that SBI and ICICI have a very strong positive correlation in ROA performance, with a coefficient of 0.934. SBI and PNB show a correlation of 0.771, indicating similar profitability trends among public banks. Some relationships, such as HDFC and Axis, are relatively weaker. Overall, the results suggest moderate to strong relationships in asset profitability among banks.

The regression analysis for ROA shows that the R^2 value of 0.876 indicates that about 87.6% of the variation in SBI's ROA is explained by private sector banks. The Significance F value of 0.004 indicates that the regression model is statistically significant. HDFC shows a stronger positive relationship with SBI, while ICICI and Axis show moderate influence. Overall, the results suggest a strong relationship between public and private sector banks in terms of asset profitability.

The variance of ROA shows that HDFC Bank has the most stable ROA, with very low variance, while PNB shows the highest fluctuation due to negative ROA in several years. The ANOVA test for ROA shows that the calculated F value of 9.41 is greater than the critical value of 2.58. Therefore, the null hypothesis is rejected. The analysis reveals that private sector banks maintain higher profitability compared to public sector banks. HDFC Bank shows the most stable ROA performance, whereas PNB experienced significant fluctuations and negative returns during several years of the study period.

The t-Test for ROA shows that public sector banks have a mean ROA of 0.22, while private sector banks have a mean ROA of 1.24. The t statistic is -2.88, the p-value is 0.006, and the t critical value is 2.01. Since the p-value is less than 0.05 and the absolute t statistic is greater than the t critical value, the null hypothesis is rejected. The analysis reveals that private sector banks maintain higher profitability compared to public sector banks. Banks

such as HDFC and ICICI consistently report higher ROA, while PNB experienced negative returns during several years, lowering the overall performance of public sector banks.

Return on Equity. Return on Equity represents the return generated on shareholders' equity.

Table 4. Return on Equity (ROE %)

Year	SBI	PNB	HDFC	ICICI	Axis
2015	10.53	3.85	19.37	8.40	15.20
2016	7.74	-16.57	18.26	7.80	12.40
2017	7.25	-30.08	17.95	4.40	7.00
2018	-3.80	-50.99	17.87	-0.70	-2.00
2019	0.48	-48.94	16.50	3.30	3.00
2020	7.74	-46.82	16.40	3.60	3.70
2021	9.94	4.45	16.61	9.90	4.80
2022	13.92	7.34	16.66	13.70	10.60
2023	19.43	9.82	16.96	17.30	13.70
2024	20.32	11.29	16.88	18.50	16.80

Source: compiled by the authors based on Annual Reports of selected banks.

ROE represents the return generated on shareholders' equity. Private sector banks, particularly HDFC Bank, maintained consistently high ROE throughout the study period. SBI showed strong improvement in recent years, reaching the highest ROE in 2024. PNB experienced negative returns during earlier years due to high NPAs and financial stress but gradually recovered after 2021.



Figure 4. Return on Equity (ROE %)

Source: compiled by the authors based on Annual Reports of selected banks.

The correlation results show that SBI and ICICI have a very strong positive relationship in return on equity, with a coefficient of 0.956. SBI and PNB also indicate strong similarity among public sector banks, with a correlation of 0.865. HDFC shows weak or negative correlation with some

banks, indicating different ROE trends. Overall, most banks demonstrate positive correlation in equity profitability except HDFC in some cases.

The regression analysis for ROE shows that the R^2 value of 0.899 indicates that about 89.9% of the variation in SBI's Return on Equity is explained by private sector banks. The Significance F value of 0.002 indicates that the regression model is statistically significant. The coefficients show positive relationships between SBI and private sector banks, suggesting similar profitability trends. Overall, the results indicate a strong relationship between public and private sector banks in terms of equity profitability.

The variance of ROE shows that HDFC Bank has very stable performance, with the lowest variance. PNB shows extremely high fluctuations due to large negative values during several years. The ANOVA results show that the calculated F value of 10.47 is greater than the critical value of 2.58. Therefore, the null hypothesis is rejected. The analysis indicates clear variation in performance among the selected banks. Private sector banks generally maintain more stable and higher values compared to public sector banks. Among all banks, HDFC shows the most consistent performance, whereas PNB records the highest volatility during the study period.

The t-Test for ROE shows that public sector banks have a mean ROE of -2.86, while private sector banks have a mean ROE of 10.09. The t statistic is -3.69, the p-value is 0.0006, and the t critical value is 2.01. Since the p-value is less than 0.05 and the absolute t statistic is greater than the t critical value, the null hypothesis is rejected. The findings suggest that private sector banks demonstrate stronger shareholder returns compared to public sector banks. Banks such as HDFC and ICICI maintain relatively stable and higher ROE, whereas PNB experienced large negative values in several years, which significantly reduced the overall performance of public sector banks.

Net NPA Ratio. The NPA ratio shows the asset quality of banks and is a key control variable in the study.

Table 5. Net NPA Ratio (%)

Year	SBI	PNB	HDFC	ICICI	Axis
2015	2.12	2.88	0.25	1.40	1.34
2016	3.81	6.78	0.28	2.28	1.67
2017	3.71	13.21	0.33	4.89	2.54
2018	5.73	16.59	0.40	4.77	5.25
2019	3.01	10.11	0.39	2.06	2.70
2020	2.23	4.19	0.36	1.59	2.03
2021	1.50	1.97	0.40	1.14	1.05
2022	1.02	1.27	0.32	0.76	0.41
2023	0.67	0.92	0.27	0.48	0.39
2024	0.57	0.34	0.33	0.42	0.36

Source: compiled by the authors based on Annual Reports of selected banks and RBI data.

The NPA ratio shows the asset quality of banks. Public sector banks such as SBI and PNB experienced higher NPA levels during the middle years of the study period. PNB recorded the highest NPA levels in 2017 and 2018. Private sector banks maintained relatively lower NPA levels throughout the period, indicating better credit risk management. The NPA levels of all banks improved significantly after 2020.

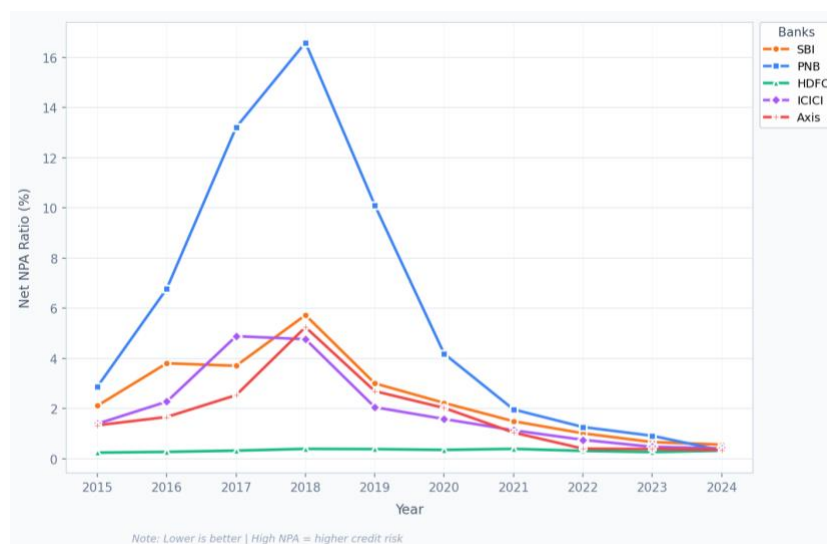


Figure 5. Net NPA Ratio (%)

Source: compiled by the authors based on Annual Reports of selected banks and RBI data.

The correlation between SBI and PNB is 0.938, showing a strong positive relationship between public sector banks in terms of NPA levels. PNB and ICICI also show a very strong correlation of 0.954, indicating similar trends in NPA changes. The correlation between HDFC and other banks is relatively lower, around 0.33-0.53, suggesting different NPA behaviour. Overall, most banks show positive correlation in NPA ratios, indicating that changes in bad loan levels tend to move in a similar direction across the banking sector.

The regression analysis for Net NPA Ratio shows that the R^2 value of 0.914 indicates that about 91.4% of the variation in SBI's Net NPA Ratio is explained by private sector banks. The Significance F value of 0.001 shows that the regression model is statistically significant. ICICI Bank shows a stronger positive relationship with SBI, while HDFC shows a weaker relationship in terms of NPA trends. Overall, the results indicate a strong relationship between public and private sector banks regarding changes in non-performing assets.

The variance results show that HDFC Bank has very stable values, with the lowest variance, while PNB shows the highest variability because of large fluctuations in earlier years. The ANOVA results show that the calculated F value of 7.45 is greater than the critical value of 2.58. Therefore, the null hypothesis is rejected. The results reveal clear variation in the performance indicators of the selected banks. Private sector banks, especially

HDFC Bank, maintain stable values, while PNB experiences greater fluctuations over the study period.

The t-Test for Net NPA Ratio shows that public sector banks have a mean NPA ratio of 4.14, while private sector banks have a mean NPA ratio of 1.36. The t statistic is 2.53, the p-value is 0.015, and the t critical value is 2.01. Since the p-value is less than 0.05 and the absolute t statistic is greater than the t critical value, the null hypothesis is rejected. The results indicate that public sector banks have a higher Net NPA Ratio compared to private sector banks, reflecting relatively weaker asset quality. Private sector banks such as HDFC, ICICI, and Axis maintain lower NPA levels, suggesting better credit risk management.

The analysis reveals several key findings. Private sector banks demonstrate higher profitability and lower NPA levels compared to public sector banks. Capital adequacy plays a positive role in improving bank performance. Higher levels of non-performing assets negatively impact profitability. Asset quality management is a crucial factor for sustainable banking performance.

Discussion. The findings of the study show that Basel III capital adequacy norms have strengthened the capital structure of Indian banks. All selected banks maintained CAR levels above the RBI-mandated minimum throughout the study period. This indicates that the sampled banks complied with regulatory requirements and developed stronger capital buffers. However, the profitability effect of capital adequacy differs between public and private sector banks.

Private sector banks maintained higher CAR levels than public sector banks. HDFC Bank, ICICI Bank, and Axis Bank showed stronger capital adequacy, higher ROA, higher ROE, and lower NPA ratios. This suggests that private banks were more effective in converting capital strength into profitability. Their performance may be explained by stronger governance mechanisms, better credit appraisal systems, lower NPA burdens, and greater operational efficiency.

Public sector banks, especially PNB, experienced significant pressure from high NPA levels during the middle years of the study period. This negatively affected both ROA and ROE. The findings confirm that capital adequacy alone is not sufficient to improve profitability when asset quality is weak. Higher NPAs increase provisioning requirements, reduce earnings, and weaken shareholder returns. Therefore, the profitability impact of Basel III depends not only on the level of capital but also on the quality of assets and the efficiency of risk management.

The correlation and regression results indicate strong relationships among banks in capital adequacy and profitability indicators. The positive relationship between capital adequacy and profitability supports the argument that well-capitalised banks are better positioned to absorb risk and maintain financial stability. However, the findings also show that higher

capital requirements may not produce equal benefits across all banks. Banks with lower NPA levels and stronger operational structures are more capable of translating regulatory capital into profitability.

The t-Test and ANOVA results confirm statistically significant differences in performance among selected banks and between public and private sector banks. Private sector banks demonstrate more stable and higher profitability, while public sector banks show greater volatility. These results confirm that Basel III norms strengthened the regulatory capital framework, but their impact on profitability is asymmetric across ownership categories.

Overall, the study shows that Basel III capital adequacy norms contribute to banking stability, but profitability depends on a broader set of factors. These include NPA control, credit risk management, governance quality, operational efficiency, and the ability to deploy capital productively. In this sense, Basel III is a necessary but not sufficient condition for improving bank profitability.

Conclusions. This study examined the relationship between Capital Adequacy Ratio, Non-Performing Assets, and profitability indicators such as Return on Assets and Return on Equity for selected public and private sector banks during the period 2015-2024. The analysis was conducted using statistical tools such as correlation, regression analysis, t-Test, and ANOVA with the help of MS Excel.

The results show that capital adequacy plays an important role in maintaining the financial stability of banks. Banks with higher capital adequacy were better able to absorb financial risks and maintain consistent profitability. Private sector banks such as HDFC Bank, ICICI Bank, and Axis Bank generally maintained higher CAR and better profitability performance compared to public sector banks.

The analysis also indicates that higher NPA levels negatively affect bank profitability. Public sector banks, particularly during the middle years of the study period, experienced higher NPA ratios, which led to lower ROA and ROE. In contrast, private sector banks maintained relatively lower NPA levels due to stronger credit risk management and operational efficiency.

The comparative analysis using t-Test and ANOVA shows that there are noticeable differences in profitability performance between public and private sector banks. Private banks demonstrated more stable and higher profitability throughout the study period, while public sector banks showed gradual improvement in recent years.

Overall, the study concludes that maintaining adequate capital levels and controlling non-performing assets are essential for improving the profitability and financial stability of banks. Strengthening risk management practices, improving credit monitoring, and maintaining strong capital buffers can help banks achieve sustainable growth in the long run.

Conflict of interest. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest, except where separately disclosed in the manuscript.

Funding. The authors declare that the publication of this article was funded by the author. The research was conducted without separate funding.

Ethics statement. All procedures performed in this study complied with institutional and international ethical standards.

Generative AI statement. The authors declare that no Generative AI was used in the preparation of this manuscript unless otherwise explicitly stated in the manuscript.

Author contributions. All authors contributed equally to the development of the study concept, writing the text, and approving the final version of the manuscript.

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References:

1. Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific, and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money*, 18(2), 121-136.
2. Axis Bank Limited. (2015-2024). *Annual reports 2014-15 to 2023-24*. <https://www.axisbank.com/shareholders-corner/annual-report>
3. Basel Committee on Banking Supervision. (2010). *Basel III: A global regulatory framework for more resilient banks and banking systems*. Bank for International Settlements.
4. Berger, A. N. (1995). The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking*, 27(2), 432-456.
5. Bodla, B. S., & Verma, R. (2006). Determinants of profitability of banks in India: A multivariate analysis. *Journal of Services Research*, 6(2), 75-89.
6. Chaudhary, K., & Sharma, M. (2011). Performance of Indian public sector banks and private sector banks: A comparative study. *International Journal of Innovation, Management and Technology*, 2(3), 249-256.
7. Das, A., & Ghosh, S. (2006). Financial deregulation and efficiency: An empirical analysis of Indian banks during the post-reform period. *Review of Financial Economics*, 15(3), 193-221.
8. Dietrich, A., & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money*, 21(3), 307-327.
9. Goddard, J., Molyneux, P., & Wilson, J. O. S. (2004). The profitability of European banks: A cross-sectional and dynamic panel analysis. *The Manchester School*, 72(3), 363-381.
10. HDFC Bank Limited. (2015-2024). *Annual reports 2014-15 to 2023-24*. <https://www.hdfcbank.com/content/bbp/repositories/723fb80a/files/annual-report>
11. ICICI Bank Limited. (2015-2024). *Annual reports 2014-15 to 2023-24*. <https://www.icicibank.com/aboutus/annual.page>
12. Kaur, M., & Kapoor, S. (2020). Impact of Basel III norms on the profitability of selected Indian banks. *Indian Journal of Finance*, 14(6), 22-36.
13. Mohan, R. (2012). *Indian financial sector: Structure, trends and turns* (RBI Working Paper Series WPS [DEPR]: 03/2012). Reserve Bank of India.
14. Pasiouras, F., & Kosmidou, K. (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance*, 21(2), 222-237.
15. Punjab National Bank. (2015-2024). *Annual reports 2014-15 to 2023-24*. <https://www.pnbindia.in/annual-report.html>

16. Reserve Bank of India. (2015-2024). *Report on trend and progress of banking in India* (Various years). RBI Publications.
17. Reserve Bank of India. (2015-2024). *Database on Indian economy*. <https://dbie.rbi.org.in>
18. Singh, A., & Gupta, R. (2021). Basel III implementation and bank profitability: Evidence from India. *Journal of Financial Regulation and Compliance*, 29(4), 411-428.
19. State Bank of India. (2015-2024). *Annual reports 2014-15 to 2023-24*. <https://sbi.co.in/web/investor-relations/annual-reports>