Performance analysis of Indian private sector banks: Insights from CAMELS and statistical technique

Sunil Sharma[1], S Prasanna[1]*, Amir Ahmad Dar[2]
[1]Department of Management Studies, B S Abdur Rahman Crescent Institute of Science and Technology, Chennai, India; prasanna.mba@crescent.education (S.S.).
[2]Department of Statistics, Lovely Professional University, Punjab, India.

Abstract: The performance of banks is crucial for a country's economic development as they serve as important financial intermediaries. This study aims to evaluate the performance of private sector banks in India using the CAMELS model. The CAMELS model evaluates bank performance based on six parameters: Capital Adequacy, Asset Quality, Management Quality, Earnings, Liquidity, and Sensitivity to Market Risk. Regression analysis and ANOVA are employed to examine the influence of these CAMELS parameters on banks' return on assets (ROA). Additionally, a weighted average rating technique is used to rank each bank according to the CAMELS parameters. The study utilizes data from 20 banks in the private sector over 24 years from 2000 to 2024 to evaluate these ratios. The study provides insights into the financial health of India's private sector banks, highlighting the significance of CAMELS parameters in determining bank performance. The results indicate which factors most strongly influence ROA and how banks rank based on their overall financial stability. The research underscores the importance of continuous monitoring of CAMELS parameters to ensure the sustainable performance of banks. The findings serve as a valuable tool for stakeholders, including investors, policymakers, and regulators, by enabling informed decision-making regarding bank performance and stability.

Keywords: ANOVA, Bank performance, CAMELS parameters, Economic development, Regression, ROA.

1. Introduction

Banks hold a prominent position within the financial system due to their crucial role in promoting economic growth. They fulfil important functions such as maturity transformation and providing essential support for payments and deposits [1]. However, various factors have exposed banks to a range of risks, including increased market volatility, heightened competition, diversification, global integration of financial markets, along with cross-border activities, and expansion into various other financial parts. Furthermore, the advent of complex products, processes, and digitalization has introduced new risks and challenges for banks.

To address these risks and challenges, close bank supervision is essential, driven primarily by the need to safeguard depositors' interests and ensure overall financial stability. The occurrence of recurring bank failures, mergers, and the recent impact of the Covid-19 pandemic has resulted in a rise in non-performing assets (NPAs) globally over the past decade. Consequently, bank supervisors worldwide have made determined efforts to mitigate the effects of bank failures and contagion through the implementation of "safety nets" such as deposit insurance and liquidity support or capital injections provided by central banks and governments.

The financial performance of banks and other financial institutions is commonly assessed through a combination of methods, including financial ratio analysis, benchmarking, and comparing performance against budgetary targets [2]. These methodologies, as stated by Avkiran [3] are utilized to measure

and evaluate the performance of these institutions. In simpler accounting terms, the performance of banks is determined by their ability to generate sustainable profitability [4].

To evaluate their performance and identify strengths and weaknesses, banks rely on various financial ratios. The traditional approach of utilizing financial ratios to assess the performance of banks has been widely practised, with practitioners employing CAMELS ratings to gauge the financial health and performance of their institutions. The CAMELS rating system serves as a tool for bank management to evaluate their institution's performance [4, 5].

During the 1990s, a specialised group led by Shri S. Padmanabhan carried out comprehensive assessments of Reserve Bank of India's (RBI's) supervisory processes. The group specifically focused on evaluating the systems and procedures pertaining to statutory inspections. Their objective was to identify areas for improvement and propose measures to enhance the efficacy and efficiency of the RBI's method to supervising banks [6].

1.1. Supervision of Banks
By maintaining banks' stability and security, an efficient supervisory system is crucial in reducing the likelihood of bank collapses. There are mainly two types of supervision methods available, and these are shown in Figure 1:
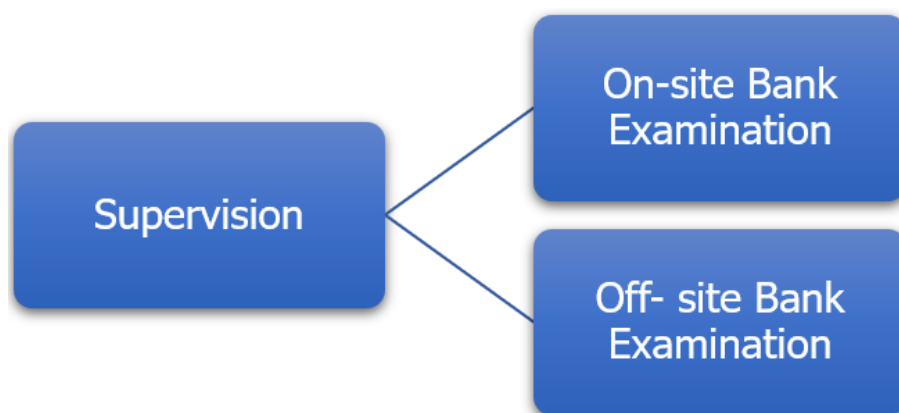

Figure 1.
Supervision method.

The RBI conducts on-site bank examinations as a fundamental part of its supervisory process. These examinations involve regular visits to banks, interviews with management, and assessments of financial statements, along with accounting records, internal controls, and also banking regulation compliance. Based on the findings, bank supervisors assign composite ratings to the banks using the CAMEL rating system. Off-site surveillance relies on call reports filed by banks, providing information on their condition and income between on-site examinations. Supervisors use supervisory screens and econometric models, which analyse financial ratios and statistical tests to assess the bank's overall condition during off-site monitoring. These tools allow for ongoing monitoring and comparison of a bank's performance with industry peers.

The acronym CAMELS represents the following factors in the context of bank assessment:
- C - Capital adequacy
- A - Asset quality
- M - Management Competency
- E - Earning
- L - Liquidity
- S – Sensitivity

Globally, the CAMELS rating system is utilised to evaluate financial firms by regulatory agencies [7]. These factors include Capital adequacy along with Asset quality, and also Management soundness, along with Earnings and profitability, and also Liquidity, and Sensitivity. Over time, the framework was further enhanced with the inclusion of the sixth component, Sensitivity to market risk; 1997 [8, 9].

In the context of Indian banks, the supervisors explored various methodologies for bank supervision. In 1995, they identified the CAMELS model as a suitable approach for Indian banking supervision. The adoption of this model was driven by several factors:

- Alignment with global banking standards and norms.
- Facilitating the adoption of best practices followed by global counterparts in the future.
- Eliminating resistance and facilitating the establishment and ease of doing business for foreign banks and private banks alike. etc.

In this study, the CAMELS rating system is a widely used framework for assessing the performance and stability of banks, focusing on six critical parameters: Capital Adequacy, Asset Quality, Management Quality, Earnings, Liquidity, and Sensitivity to Market Risk. Each bank is rated on a scale of 1 (best) to 5 (worst) for these factors, reflecting their financial health and operational efficiency. This study utilizes the CAMELS framework to evaluate the performance of selected banks and employs statistical techniques such as regression analysis and ANOVA to determine which parameters most significantly impact overall performance, providing actionable insights for improving banking operations and stability.

2. Literature Review

The CAMELS model was utilized in this study to assess and analyze banks' financial performance. According to Sarker [10] CAMELS ratings offer insights into a bank's overall stability and assist in identifying or forecasting various risk factors that could lead to potential issues or even bank failure. Athanasoglou, et al. [11]; Dang [12]; Ilhomovich [13]; Ong and Heng [14]; Nazir [15] and Sarker [10] provide further elaboration on several components of the CAMELS framework.

The Figure 2 shows the factors of the CAMELS, that effects the ROA. It is a key financial metric that can be integrated into CAMELS (Capital adequacy, Asset quality, Management quality, Earnings, Liquidity, and Sensitivity to market risk) studies, particularly in the analysis of financial institutions' efficiency and valuation.
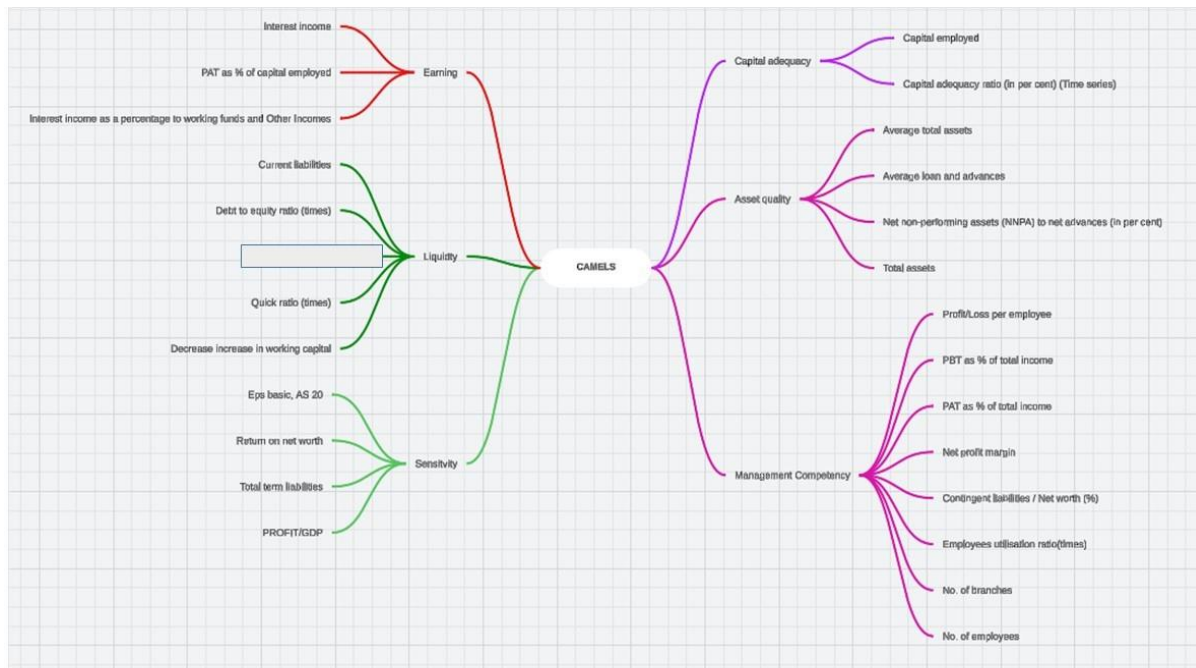
Figure 2.
CAMELS Factors.

Capital Adequacy (C): Banks with higher ranks have a healthier capital adequacy position, indicating a stronger ability to withstand financial risks.

Asset Quality (A): Lower ranks indicate better asset quality, with lower debt in relation to owner's funds. Higher ranks signify better financial charge coverage and a higher proportion of advances or loans to available funds.

Management Quality (M): Higher ranks suggest higher interest income, net interest income, and better coverage of interest expenses. Banks with higher ranks also generate higher profits per employee and per branch, as well as higher business revenue per employee and per branch.

Earnings Capability (E): Banks with higher ranks have a higher net interest margin, a higher ratio of interest income to total assets, and a lower ratio of interest expenses to total assets. These factors indicate better profitability and earnings capacity.

Liquidity Position (L): Higher ranks reflect a stronger liquidity position, with a higher cash deposit ratio, better current ratio, and higher quick ratio. These indicate a bank's ability to meet short-term obligations and manage liquidity effectively.

Sensitivity to Market Risk (S): Higher ranks represent higher earnings per share, a higher price-to-book value ratio (indicating a higher market valuation), and a lower ratio of earnings per share to market price-earnings yield (indicating better valuation).

This section presents the empirical data that are pertinent to the CAMEL rating, which is used to measure a bank's financial performance.

Dang [12] found that a uniform financial Institutions Rating System is called the CAMEL rating, which was the Federal Financial Institution Examination Council officially adopted on November 13, 1979. Subsequently, in October 1987, it was also adopted by NCUA. The CAMEL rating has proven to be a highly effective internal supervisory tool for assessing the financial soundness of a firm. Its purpose is to identify institutions that may require special attention or raise concerns within the regulatory framework.

Examiners, along with regulators have found CAMEL rating to be a vital tool, as determined by Barr, et al. [16]. Financial statements, financing sources, macroeconomic statistics, along with budget, and also cash flow are only some variables that go into this grade, which plays a significant part in determining a bank's overall health.

Hirtle and Lopez [17] stressed the need of maintaining the privacy of a bank's CAMEL rating. The bank's upper management and the appropriate supervisory personnel are the only people with access to this data. Even on a delayed basis, the rating is not shared with the general public. Its confidentiality is maintained to enable the bank's senior management to devise appropriate business strategies and for the benefit of supervisory staff in carrying out their duties effectively.

In contrast to Babar and Zeb [18] and Sarwar and Asif [19] who found that capital adequacy received the highest rating in Pakistan, Rozzani and Rahman [4] observed that management quality achieved the highest overall rating. Furthermore, Christopoulos, et al. [20] reported a consistent decline in capital ratios over time, indicating a worsening financial condition. As illustrated by the Lehman Brothers case, this trend suggested an increase in false and questionable claims, as well as limited access to the capital market.

According to Christopoulos, et al. [20] the asset quality ratio improved over time, indicating a diminished capacity to recognize, evaluate, track, and manage credit risks. This was evidenced by the rise in negative and questionable assertions made by Lehman Brothers. The bank's lending practices, which involved extending credit to high-risk and insolvent clients, resulted in an annual increase in non-performing loans, reflecting the bank's growing volume of poor and doubtful loans.

According to Majithiya and Pattani [21] a high management quality rating indicates that these banks have experienced rapid growth and that their employees are highly skilled, both of which are expected to drive future expansion. Conversely, Christopoulos, et al. [20] observed a steady decline in the management ratio over time, suggesting that a significant number of loans were non-performing due to inadequate borrower evaluation, a responsibility overseen by Lehman Brothers' executives.

According to Hasbi and Haruman [22] ROA declined despite increases in the capital adequacy ratio (CAR), non-performing financing (NPF), operational efficiency (OEOI), and financing-to-deposit ratio (FDR). By providing substantial financing, particularly to large enterprises, the Islamic bank focused on enhancing profit-sharing to attract clients from traditional banks. Additionally, the bank utilized all deposited funds alongside internal equity to maximize profit-sharing or achieve greater spread margins, rather than prioritizing responsible credit and risk management.

Ongore and Kusa [23] found that both ROA and net interest margin (NIM) are significantly positively influenced by capital sufficiency (measured by the ratio of total capital to total assets) and managerial efficiency (measured by the ratio of total operating revenue to total profit) in their study of Kenyan commercial banks. Conversely, ROE is negatively affected by capital adequacy, while ROA, ROE, and NIM are negatively impacted by asset quality, which is assessed by the ratio of non-performing loans to total loans. The ratio of total loans to total client deposits, which gauges liquidity, does not show significant changes. The findings indicate that capital sufficiency has a mixed effect on bank performance, negatively impacting ROE but positively influencing ROA and NIM.

Frederick [24] found that while earnings ability (measured by net interest margin to total assets) had a statistically significant positive impact on ROA, management efficiency (measured by the ratio of operating costs to total income) and asset quality (measured by loan loss provisions to total loans) had a statistically significant negative impact. Frederick's study focused on Ugandan commercial banks. ROA was not statistically affected by capital sufficiency, as determined by the ratio of equity capital to total assets. However, earnings ability had a substantial positive impact when performance was assessed by ROE, while capital adequacy, asset quality, and management efficiency all exhibited significant negative effects. The study underscores that the influence of these factors varies depending on the performance measure, as capital adequacy, for instance, negatively impacts ROE but not ROA.

According to Cekrezi [25] the ROA of Albanian commercial banks was statistically and significantly negatively impacted by both capital adequacy (measured by the ratio of total equity to total assets) and liquidity (measured by the ratio of total loans to total assets).

Getahun [26] examined the financial performance of Ethiopian commercial banks and discovered that (1) management efficiency (measured by non-interest expense relative to net interest income plus non-interest income) and asset quality (measured by loan provision to total loans) had a statistically significant negative impact on ROA, while earnings ability (measured by net interest income to total interest income) and liquidity (measured by total loans to total deposits) had a significant positive impact. Capital adequacy (measured by gross capital to total assets) had no discernible effect on ROA. (2) When looking at ROE, asset quality had no significant impact, earnings ability and liquidity had substantial positive benefits, while capital sufficiency and management efficiency had considerable negative effects. This study illustrates that the CAMEL model aids in evaluating banks' financial performance, yet it yields varying results for ROA and ROE. For instance, asset quality significantly influences ROA but not ROE, whereas capital adequacy significantly affects ROE but not ROA.

Specifically, Veni [27] examined banks' capital adequacy standards and the methods they utilise to increase their capital ratios. Also, the author emphasised that rating agencies utilise the CAMEL model to evaluate the bank's CDs, FDIC insurance, and bonds. Within this model, particular emphasis is placed on the capital ratios of banks when assigning ratings.

Baral [28] identified that the financial health of joint ventures was found to be more effective than that of commercial banks. The CAMEL model demonstrated that managing the potential impact on their balance sheets was not challenging for joint venture banks.

Wirnkar and Tanko [29] conducted an analysis of the CAMEL model's adequacy in assessing the overall performance of Nigerian banks from 1997 to 2005. The findings revealed that each component of CAMEL alone was insufficient to capture the complete performance of a bank.

Based on his research, Al-Tamimi [30] concluded that liquidity and concentration were important indicators of conventional banks' performance in the UAE between 1996 and 2008, while cost along with the number of branches were important indicators of Islamic banks' performance during the same time period.

According to the reviewed literature, the CAMEL model serves as a practical tool for analyzing components to metrics such as ROA, ROE, and NIM has yielded inconsistent results. Furthermore, various measures were selected to represent aspects like liquidity, leading different researchers to utilize distinct ratios for calculating CAMEL components. For instance, some researchers employed total loans to total assets, total loans to total deposits, or total loans to total customer deposits. This methodological variation indicates that the application of CAMEL components to ROA, ROE, and NIM may influence the ratings that commercial banks receive. and evaluating the financial performance of commercial banks. However, applying CAMEL

3. Research Methodology

3.1. Data Collection and Sampling

The researcher regularly analyses data spanning from 2000 to 2024. The researcher includes 20 private banks in India as its sample, selected based on their classification and the availability of comprehensive data from 2000 to 2024. The total observations were determined by multiplying the number of banks (20) with 31 variables and the number of years (24). The data collection process involved accessing the annual reports and auditor reports of each bank for the specified period. From these reports, financial statements, key performance indicators, and other relevant information were collected, which were crucial for calculating the predetermined ratios used in analysing bank performance.

Data sourced CMIE -Centre for Monitoring Indian Economy

3.2. Proposed Model

The proposed model incorporates the concept of heterogeneous groups within the CAMELS six components to assess the indicators of bank performance in Indian commercial banks using the CAMEL model. Following is the Table 1 for a clear understanding of the variables:

Table 1.
Variables in Model.

Acronym	Figures in Rs. Million/ %	Ratio name
Dependent variable	TOBIN Q (%)	TOBIN Q
	(%)	Return on net worth
	(%)	Return on total assets
	(%)	Return on assets
Capital	Rs. Million	Capital employed
	(%)	Capital adequacy ratio (in per cent) (Time series)
Asset	Rs. Million	Average total assets
	Rs. Million	Average loan and advances
	(%)	Net non-performing assets (NNPA) to net advances (in per cent)
	Rs. Million	Total assets
	Rs. Million	Current assets incl long term portion
Management	Rs. Million	Profit/Loss per employee
	(%)	PBT as % of total income
	(%)	PAT as % of total income
	(%)	Net profit margin
	(%)	Contingent liabilities / Net worth (%)
	Times	Employees utilisation ratio(times)
Earning	Nos.	No. of branches
	Nos.	No. of employees
	Rs. Million	Other income
	(%)	Interest income as a percentage to working funds
	Rs. Million	Interest income
	(%)	PAT as % of capital employed
Liquidty	Rs. Million	Current liabilities
	Times	Debt to equity ratio (times)
	Times	Quick ratio (times)
	Times	Quick ratio (times)
	Rs. Million	Decrease increase in working capital
Sensitvity	Indian Rupee	Eps basic, AS 20
	(%)	Return on net worth
	Rs. Million	Total term liabilities
	PROFIT/GDP	PROFIT/GDP

The CAMELS rating system evaluates a bank's performance based on six key parameters: Capital Adequacy, Asset Quality, Management Quality, Earnings, Liquidity, and Sensitivity to Market Risk. Each bank is assigned a rating from 1 (best) to 5 (worst) for these factors, indicating their financial health and operational stability. The methodology involves analyzing financial statements, risk profiles, and compliance with regulatory norms to identify well-performing and underperforming banks.

The objective of this study is also to develop a regression model to predict ROA using 26 factors from a CAMEL analysis framework as shown in Figure 2 and Table 1. Initially, all 28 factors were included in the regression model, and a regression line was drawn to examine their impact on ROA. However, it was observed that several factors had negligible effects, as indicated by coefficients approximately equal to zero. These insignificant factors were systematically removed to refine the model, and a new regression line was generated.

The refined model showed an improved fit, with an R-squared value of 97%, indicating that the selected factors explained a substantial proportion of the variability in ROA. To further validate the model, the percentage contribution of each factor was calculated to identify the most influential

variables affecting ROE. This analysis highlighted key factors with significant contributions while confirming the minimal impact of others.

Additionally, diagnostic checks were performed to ensure the validity of the regression assumptions. Residual analysis confirmed that the residuals followed a normal distribution, supporting the appropriateness of the model. Overall, this methodology ensured a robust and interpretable regression equation for predicting ROA, based on a streamlined set of impactful factors.

4. Model Analysis and Discussion

The model evaluates the capital adequacy ratio to determine if the bank possesses sufficient capital to absorb potential losses. Additionally, it assesses asset quality by examining credit quality and diversification. Management capabilities are analysed to assess the ability to identify profitable opportunities while effectively managing risk. Earnings are considered to gauge the return on capital and the quality of earnings. Liquidity is evaluated to determine the ability to meet current liabilities. Lastly, sensitivity is taken into account, which measures exposure to changes in interest rates, foreign exchange rates, market risk, security prices, commodity prices, and other factors.

4.1. Model Analysis

To generate the CAMELS rating, each of the six components is individually rated on a scale of 1 to 5, 1 being the best and 5 being the worst. A weighted rating is then calculated by assigning weights to each component. In Table 3, the CAMEL rating is assigned, with a score of 1 indicating a very healthy bank, 2 denoting a healthy bank, 3 representing an average bank, 4 indicating an unhealthy bank, and 5 signifying a weak bank.

Table 2.
CAMELS Ranking Law.

Acronym	Figures in Rs. Million/ %	Ratio name	RANK 1	RANK 2	RANK 3	RANK 4	RANK 5	Remarks
Dependent variable	TOBIN Q (%)	TOBIN Q	>1	>.50	>0.10	>.50	<.49	Higher is better
	(%)	Return on net worth	>15	>10	>5	>=1	<1	Higher is better
	(%)	Return on total assets	>3.5	>1	>0.50	>.10	<.09	Higher is better
	(%)	Return on assets	>4	>2	>0.85	>.10	<.09	Higher is better
Capital	Rs. Million	Capital employed	>5000000	>2500000	>1000000	>500000	<499999	Higher is better
	(%)	Capital adequacy ratio (in per cent) (Time series)	>15	>13	>10.16	> 8.3	<8.2	Higher is better
Asset	Rs. Million	Average total assets	>7500000	>2000000	>1000000	>500000	<499999	Higher is better
	Rs. Million	Average loan and advances	>5000000	>1000000	>500000	>100000	<99999	Higher is better
	(%)	Net non-performing assets (NNPA) to net advances (in per cent)	<.99	<1.5	<2.5	>2.6	>3	lesser is better
	Rs. Million	Total assets	>15000000	>5000000	>1000000	<1000000	<499999	Higher is better
	Rs. Million	Current assets incl long term portion	>1000000	>500000	>250000	<249999	<100000	Higher is better
Management	Rs. Million	Profit/Loss per employee	>2	>1	>.5	>.25	<.25	Higher is better
	(%)	PBT as % of total income	>30	>15	>11	>1	<.99	Higher is better
	(%)	PAT as % of total income	>20	>15	>8	>1	<.99	Higher is better
	(%)	Net profit margin	>20	>15	>7	>1	<.99	Higher is better
	(%)	Contingent liabilities / Net worth (%)	<100	>100	>500	>1000	>2000	lesser is betteer
	Times	Employees utilisation ratio(times)	>20	>15	>10	>5	<4.99	Higher is better
Earning	Nos.	No. of branches	>5000	>2500	>1500	>500	<499	Higher is better
	Nos.	No. of employees	>125000	>75000	>15000	>5000	<4999	Higher is better
	Rs. Million	Other income	>25000	>10000	>1000	>500	<499	Higher is better
	(%)	Interest income as a percentage to working funds	>100	>50	>10	>5	<4.99	Higher is better
	Rs. Million	Interest income	>1000000	>100000	>25000	>10000	<9999	Higher is better
	(%)	PAT as % of capital employed	>15	>10	>5	>1	<.99	Higher is better
Liquidty	Rs. Million	Current liabilities	>700000	>300000	>100000	>50000	<49999	Higher is better
	Times	Debt to equity ratio (times)	>5	>2	>1	>.50	<.49	Higher is better
	Times	Quick ratio (times)	>15	>10	>5	>1	<.99	Higher is better
	Times	Quick ratio (times)	>15	>10	>5	>2	<1.99	Higher is better
	Rs. Million	Decrease increase in working capital	>700000	>200000	>15000	>10000	<9999	Higher is better
Sensitvity	Indian Rupee	Eps basic, AS 20	>5000	>1000	>200	>10	<9.99	Higher is better

(%)	Return on net worth	>20	>10	>5	>1	<.99	Higher is better
Rs. Million	Total term liabilities	>100000	>100000	>50000	>10000	<9999	Higher is better
PROFIT/GDP	PROFIT/GDP	>600	>300	>100	>50	<49.99	Higher is better

Table 3.
Ranking.

Bank Name	Axis Bank Ltd.	Bandhan Bank Ltd.	C S B Bank Ltd.	City Union Bank Ltd.	D C B Bank Ltd.	Dhanlaxmi Bank Ltd.	Federal Bank Ltd.	H D F C Bank Ltd.	I C I C I Bank Ltd.	I D F C First Bank Ltd.
RANKING	2.6	2.4	3.4	2.6	3.5	3.7	3.9	2.4	2.5	3.4
Bank Name	Indusind Bank Ltd.	Jammu & Kashmir Bank Ltd.	Karnataka Bank Ltd.	Karur Vysya Bank Ltd.	Kotak Mahindra Bank Ltd.	Nainital Bank Ltd.	R B L Bank Ltd.	South Indian Bank Ltd.	Tamilnad Mercantile Bank Ltd.	Yes Bank Ltd.
RANKING	3.7	3.6	3.8	3.9	2.5	3.2	3.8	3.8	2.6	3.7

Table 2 provides rankings law as per the CAMEL rating system, which assesses the financial health and performance of banks across various factors. Here are the Calculations and interpretations:

According to the CAMELS rating system, a ranking of 1 indicates the highest level of performance and is considered the best, while a ranking of 5 signifies the lowest level of performance and is considered the worst. In our calculation Indian Banking System is well placed in the range of 2.5 to 4. RBI regulatory Bodies is doing very good job therefore all Regulatory ratio are well placed. IBS have need to improve their CAMELS Ratio and we can move from 2.5 Ranking to 1.5 onwards. Analysis shown that HDFC Bank Ltd., Bandhan Bank Ltd., ICICI Bank Ltd., Axis Bank Ltd., City Union Bank Ltd. Is having rating of 2.4 ,2.5 ,2.6 respectively which is the best ranking in Indian banking system. Bank is doing good performance lets they will continue to do the same and work on improving the CAMELS Ranking.

Karur Vysya Bank Ltd., Karnataka Bank Ltd., South Indian Bank Ltd., RBL Bank Ltd., Yes Bank Ltd., IndusInd Bank Ltd., and Dhanlaxmi Bank Ltd. have CAMELS ratings of 3.9, 3.8, 3.8, 3.8, 3.7 and 3.7, respective as shown in Table 3. As the highest ranking in the banking system corresponds to the lowest score, it is recommended that these banks take corrective actions to improve their CAMELS ratings and strengthen their overall performance. Overall, the rankings provide insights into the financial strength and performance of banks across different dimensions, enabling comparisons and monitoring of changes over time.

4.2. Regression Equation

The regression analysis examines the influence of various financial variables on the rate of return, revealing key insights [31]. Significant predictors include PAT as % of total income, interest income as a percentage, employees' utilization ratio, and quick ratio, all with P-values below 0.05, indicating a strong impact. Conversely, variables like net non-performing assets, profit/loss per employee, and PROFIT/GDP are non-significant, showing limited influence. Negative coefficients for factors such as net profit margin, quick ratio, *and* debt-to-equity ratio suggest an inverse relationship with the rate of return. However, high Variance Inflation Factors (VIF) for PAT as % of total income *(57.08)*, net profit margin *(44.78)*, and PBT as % of total income (27.16) highlight multicollinearity issues, which could compromise the reliability of estimates as shown in Table 4. This analysis underscores critical financial metrics affecting returns while suggesting the need for addressing multicollinearity for more robust conclusions.

$$
\begin{aligned}
\textbf{Return on assets} = \ & -0.7118 + 0.00295\ \textit{Capital adequacy ratio (in per} \\
& + 0.00302\ \textit{Net non} - \textit{performing assets (NNPA} \\
& - 0.00250\ \textit{Profit/Loss per employee} \\
& \quad + 0.00812\ \textit{PBT as \% of total income} \\
& + 0.10231\ \textit{PAT as \% of total income} \\
& \quad - 0.01510\ \textit{Net profit margin} \\
& - 0.00541\ \textit{Employees utilisation ratio(tim} \\
& + 0.09290\ \textit{Interest income as a percentage} \\
& - 0.00792\ \textit{PAT as \% of capital employed} \\
& - 0.01766\ \textit{Debt to equity ratio (times)} \\
& \quad - 0.01101\ \textit{Quick ratio (times)} \\
& + 0.00532\ \textit{Return on net worth\_1} \\
& \quad + 0.000051\ \textit{PROFIT/GDP}
\end{aligned}
$$

Table 4.

Coefficients.

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	–0.7118	0.0649	–10.96	0.000	
Capital adequacy ratio (in per	0.00295	0.00199	1.48	0.139	1.64
Net non-performing assets (NNPA	0.00302	0.00356	0.85	0.398	1.54
Profit/Loss per employee	–0.00250	0.00291	–0.86	0.391	1.08
PBT as % of total income	0.00812	0.00386	2.10	0.036	27.16
PAT as % of total income	0.10231	0.00762	13.43	0.000	57.08
Net profit margin	–0.01510	0.00646	–2.34	0.020	44.78
Employees utilisation ratio(tim	–0.00541	0.00108	–4.99	0.000	1.10
Interest income as a percentage	0.09290	0.00669	13.89	0.000	1.43
PAT as % of capital employed	–0.00792	0.00265	–2.99	0.003	6.49
Debt to equity ratio (times)	–0.01766	0.00970	–1.82	0.070	2.12
Quick ratio (times)	–0.01101	0.00310	–3.56	0.000	1.42
Return on net worth_1	0.00532	0.00221	2.40	0.017	10.16
PROFIT/GDP	0.000051	0.000070	0.73	0.463	1.91

Table 5.

Model Summary.

S	R-sq	R-sq(adj)	R-sq(pred)
0.123925	97.08%	96.96%	96.15%

The model summary shown in Table 5 indicates a strong fit, with an R-squared value of 97.08%, showing that 97.08% of the variability in the response variable is explained by the predictors. The adjusted R-squared (96.96%) accounts for the number of predictors, suggesting the model remains robust even after adjusting for potential overfitting. The predicted R-squared (96.15%) reflects the model's predictive accuracy on new data, confirming its reliability. A standard error of 0.123925 implies that the average deviation of the observed values from the fitted values is relatively small, further supporting the model's effectiveness in capturing the underlying data patterns.

4.3. Normality

The residual plots indicate that the regression model for "ROA" fits the data well, with no significant violations of assumptions [32]. The Normal Probability Plot shows that residuals are approximately normally distributed, with only minor deviations at the extremes. The Versus Fits Plot displays a random scatter of residuals around zero, supporting linearity and constant variance. The Histogram reveals a roughly symmetric, bell-shaped distribution centered near zero, reinforcing the normality assumption. Finally, the Versus Order Plot shows no systematic patterns, indicating that the residuals are independent. Overall, the model diagnostics confirm its validity with only minor deviations as shown in Figure 3.
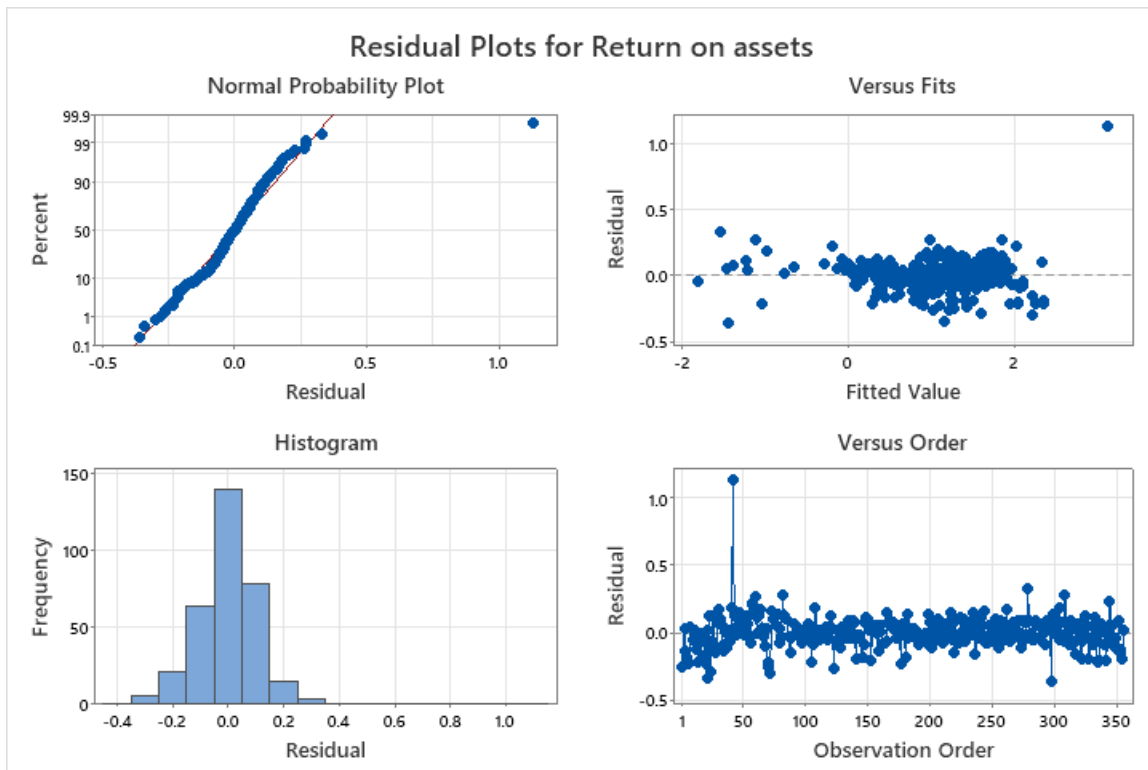
Figure 3.
Normality plots for ROA.

4.4. ANOVA

The ANOVA table provides insights into the variability explained by the regression model and its individual predictors [33]. The model explains a significant proportion of the variance in the response variable, as indicated by the regression F-value of 804.60 (P < 0.001). This confirms the overall significance of the model as shown in Table 6.

Table 6.
Analysis of Variance.

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	13	160.635	12.3565	804.60	0.000
Capital adequacy ratio (in per	1	0.034	0.0338	2.20	0.139
Net non-performing assets (NNPA	1	0.011	0.0110	0.72	0.398
Profit/Loss per employee	1	0.011	0.0113	0.74	0.391
PBT as % of total income	1	0.068	0.0680	4.43	0.036
PAT as % of total income	1	2.771	2.7707	180.41	0.000
Net profit margin	1	0.084	0.0838	5.46	0.020
Employees utilisation ratio(tim	1	0.383	0.3828	24.93	0.000
Interest income as a percentage	1	2.963	2.9626	192.91	0.000
PAT as % of capital employed	1	0.137	0.1372	8.94	0.003
Debt to equity ratio (times)	1	0.051	0.0509	3.31	0.070
Quick ratio (times)	1	0.194	0.1943	12.65	0.000
Return on net worth_1	1	0.089	0.0888	5.78	0.017
PROFIT/GDP	1	0.008	0.0083	0.54	0.463
Error	315	4.838	0.0154		
Total	328	165.473			

Among the individual predictors, several stand out as significant contributors to the response variable. PAT as % of total income (F = 180.41, P < 0.001) and interest income as a percentage (F = 192.91, P < 0.001) have the highest contributions, indicating their substantial influence. Other significant predictors include employees' utilization ratio (F = 24.93, P < 0.001), quick ratio (F = 12.65, P < 0.001), PAT as % of capital employed (F = 8.94, P = 0.003), and return on net worth (F = 5.78, P = 0.017) as shown in Table 6.

In contrast, variables like capital adequacy ratio (P = 0.139), net non-performing assets (P = 0.398), profit/loss per employee (P = 0.391), and PROFIT/GDP (P = 0.463) are non-significant, suggesting they do not significantly affect the response variable within this model as shown in Table 6.

The error sum of squares (4.838) and mean square error (0.0154) highlight the relatively small unexplained variability, emphasizing the model's effectiveness in fitting the data. This analysis confirms the importance of specific financial metrics in predicting the response variable as shown in Table 6.

The percentage contribution of each factors is measured by the (Adj SS)/(Total SS) *100 [34].

Table 7.
Percentage contribution.

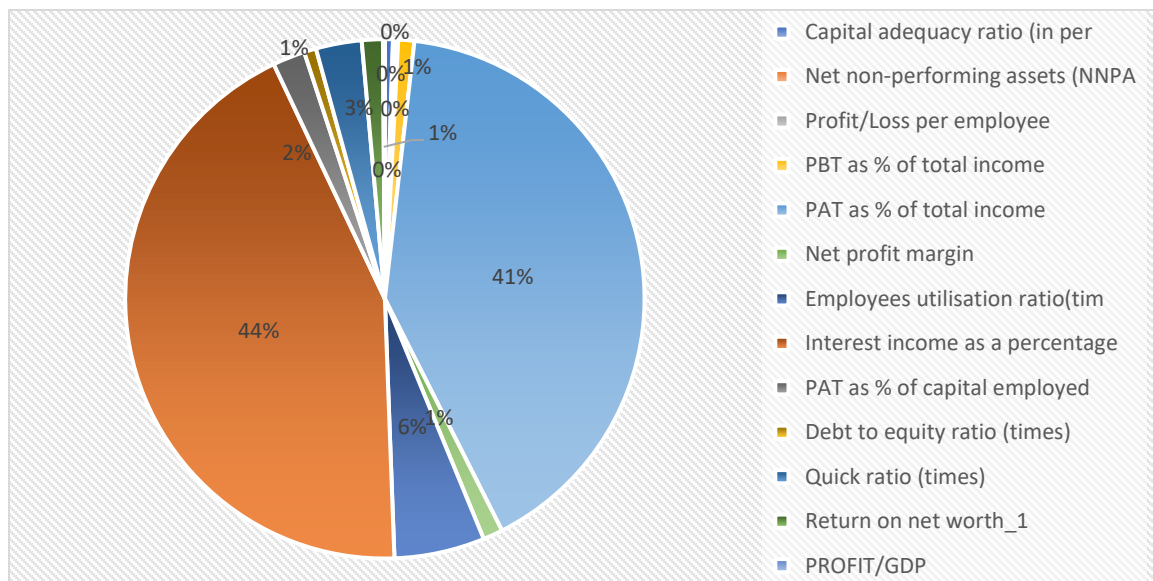| Factor	Percentage contribution
Capital adequacy ratio (in per	0.499706
Net non-performing assets (NNPA	0.16167
Profit/Loss per employee	0.16167
PBT as % of total income	0.999412
PAT as % of total income	40.72604
Net profit margin	1.234568
Employees utilisation ratio(tim	5.629042
Interest income as a percentage	43.54791
PAT as % of capital employed	2.013521
Debt to equity ratio (times)	0.749559
Quick ratio (times)	2.851264
Return on net worth_1	1.308054
PROFIT/GDP	0.117578

Figure 4.
Percentage Contribution.

The percentage contributions of various factors indicate their relative importance in explaining the variability in the response variable. The most influential factors are interest income as a percentage *(43.55%)* and PAT as % of total income (40.73%), highlighting their dominant roles in determining the rate of return. These two factors alone account for over 84% of the contribution, emphasizing their critical impact.

Other significant contributors include employees' utilization ratio *(5.63%)*, quick ratio *(2.85%)*, and PAT as % of capital employed (2.01%), suggesting their moderate influence on the response variable. In contrast, factors such as capital adequacy ratio *(0.50%)*, net non-performing assets *(0.16%)*, profit/loss per employee *(0.16%)*, and PROFIT/GDP (0.12%) contribute minimally, indicating limited impact.

Factors like PBT as % of total income (1.00%), net profit margin (1.23%), and return on net worth (1.31%) show a modest effect, while debt-to-equity ratio (0.75%) also plays a minor role. Overall, the analysis highlights the disproportionate contribution of specific financial metrics, with interest income and PAT as % of total income being the most significant, while others contribute marginally.

5. Conclusion and Recommendations

In recent years, central banks have made significant improvements to their supervision techniques and quality in response to changes in the banking sector. It is crucial to effectively supervise and manage risks as they can both present opportunities and pose threats to the profitability of banks. The findings of this study indicate that private banks in India have demonstrated superior performance and are well-positioned in comparison to other banks. However, further research is recommended to develop a model that can accurately predict bank performance based on ratio analysis.. We are also recommended for further study including textual index in this Models and make more advance version of prediction of bank failure.

CAMELS Ratio Constructing a model using past data and applying linear regression analysis can provide early warning signals for potential issues. Additionally, it is essential to examine the correlation among various ratios to gain new insights into the current context. While previous studies exist, conducting further analysis can offer valuable insights and contribute to a deeper understanding of the subject matter.

The CAMELS analysis reveals that India's banking system is performing moderately well, with ratings ranging from 2.5 to 4, indicating room for improvement. Banks like HDFC Bank Ltd., Bandhan Bank Ltd., ICICI Bank Ltd., Axis Bank Ltd., and City Union Bank Ltd. have achieved the best ratings of 2.4 to 2.6, reflecting strong financial stability. However, banks such as Karur Vysya Bank Ltd., Karnataka Bank Ltd., and Yes Bank Ltd., with ratings above 3.7, need to take corrective measures to enhance their performance. Overall, the study highlights key strengths and areas for improvement, offering valuable insights for regulatory bodies and stakeholders.

The analysis reveals that interest income as a percentage (43.55%) and PAT as a percentage of total income (40.73%) are the most influential factors, collectively accounting for over 84% of the contribution in determining the rate of return. This underscores their critical role in bank performance. Moderate contributors include employees' utilization ratio (5.63%) and quick ratio (2.85%), while factors like capital adequacy ratio (0.50%) and net non-performing assets (0.16%) have minimal impact. The findings highlight the disproportionate influence of specific financial metrics, emphasizing the need for banks to focus on key areas to optimize performance and stakeholder value.

To enhance performance, banks should focus on key revenue drivers like increasing interest income and PAT as a percentage of total income, which significantly impact overall performance. Strengthening employees' utilization, improving quick ratios for better liquidity management, and maintaining robust capital adequacy are critical. Efforts should also target reducing non-performing assets through effective credit risk management and improving profitability metrics like net profit margin and return on net worth. Regular performance monitoring using the CAMELS framework, leveraging technology for operational efficiency, adhering to regulatory guidelines, and maintaining transparent stakeholder

communication are essential. These measures collectively optimize performance and ensure long-term stability.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

References

[1]   D. M. Sadilloyevna, "Role of commercial banks in the development of the modern economic system," *Ethiopian International Journal of Multidisciplinary Research*, vol. 11, no. 11, pp. 241-248, 2024.

[2]   K. A. Chrysafis, G. C. Papadopoulou, and I. N. Theotokas, "Measuring financial performance through operating business efficiency in the global cruise industry: A fuzzy benchmarking study on the "big three"," *Tourism Management*, vol. 100, p. 104830, 2024. https://doi.org/10.1016/j.tourman.2023.104830

[3]   N. K. Avkiran, "Developing an instrument to measure customer service quality in branchbanking," *International Journal of Banks Marketing*, vol. 12, no. 6, pp. 10-18, 1994.

[4]   N. Rozzani and R. A. Rahman, "Camels and performance evaluation of banks in Malaysia: conventional versus Islamic," *Journal of Islamic Finance and Business Research*, vol. 2, no. 1, pp. 36-45, 2013.

[5]   K. K. GK, "An analysis of financial performance of public sector banks in India using CAMELS rating system (2014–2023)," *KIM Journal of Business Research*, vol. 10, pp. 13-22, 2024.

[6]   Reserve Bank of India, "Report of the committee on bank supervision (Padmanabhan Committee). Reserve Bank of India," Retrieved: https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/75586.pdf, 1997.

[7]   R. K. Datta, "CAMELS rating system analysis of bangladesh bank in accordance with BRAC bank limited," Internship Report, BRAC Business School, BRAC University, 2012.

[8]   M. Dash and A. Das, "A CAMELS analysis of the Indian banking industry," *Available at SSRN 1666900*, 2009. https://doi.org/10.2139/ssrn.1666900

[9]   N. Gunsel, "Financial ratios and the probabilistic prediction of bank failure in North Cyprus," *Editorial Advisory Board e*, vol. 18, no. 2, pp. 191-200, 2005.

[10]   A. Sarker, "CAMELS rating system in the context of Islamic banking: A proposed 'S'for Shariah framework," *Journal of Islamic Economics and Finance*, vol. 1, no. 1, pp. 78-84, 2005.

[11]   P. P. Athanasoglou, S. N. Brissimis, and M. D. Delis, "Bank-specific, industry-specific and macroeconomic determinants of bank profitability," *Journal of International Financial Markets, Institutions and Money*, vol. 18, no. 2, pp. 121-136, 2008. https://doi.org/10.2139/ssrn.4162071

[12]   U. Dang, *The CAMEL rating system in banking supervision: A case study*. Finland: Arcada University of Applied Sciences, International Business, 2011.

[13]   S. E. Ilhomovich, "Factors affecting the performance of foreign banks in Malaysia," Master Thesis, College of Business (Finance and Banking), Malaysia, 2009.

[14]   S. T. Ong and T. B. Heng, "Factors affecting the profitability of Malaysian commercial banks," *African Journal of Business Management*, vol. 7, no. 8, pp. 649-660, 2013.

[15]   T. Nazir, "financial performance of commercial banks in India: Application of CAMEL model," *Pakistan Journal of Commerce & Social Sciences*, vol. 4, no. 1, pp. 40-55, 2010.

[16]   R. S. Barr, K. A. Killgo, T. F. Siems, and S. Zimmel, "Evaluating the productive efficiency and performance of US commercial banks," *Managerial Finance*, vol. 28, no. 8, pp. 3-25, 2002. https://doi.org/10.1108/03074350210767988

[17]   B. Hirtle and J. A. Lopez, "Supervisory information and the frequency of bank examinations," *Economic Policy Review*, vol. 5, no. 1, pp. 1–20, 1999.

[18]   H. Z. Babar and G. Zeb, "CAMELS rating system for banking industry in Pakistan: Does CAMELS system provide similar rating as PACRA system in assessing the performance of banks in Pakistan?," Master Thesis, Umea School of Business, Umea Universitet, Pakistan, 2011.

[19]   A. Sarwar and S. Asif, "Safety and soundness of financial sector of Pakistan: CAMEL rating application," *Interdisciplinary Journal of Contemporary Research in Business*, vol. 3, no. 2, pp. 624-630, 2011.

[20]   A. G. Christopoulos, J. Mylonakis, and P. Diktapanidis, "Could Lehman Brothers' collapse be anticipated? An examination using CAMELS rating system," *International Business Research*, vol. 4, no. 2, pp. 1-11, 2011. https://doi.org/10.5539/ibr.v4n2p11

[21] R. Majithiya and A. Pattani, "Rating the performance of the bank through CAMELS model," Post Diploma Thesis, Tolani Institute of Management Studies, India, 2010.

[22] H. Hasbi and T. Haruman, "Banking; According to islamic syaria concepts and its performance in indonesia," *International Review of Business Research Papers*, vol. 7, no. 1, pp. 60-76, 2010.

[23] V. O. Ongore and G. B. Kusa, "Determinants of financial performance of commercial banks in Kenya," *International Journal of Economics and Financial Issues*, vol. 3, no. 1, pp. 237-252, 2013.

[24] N. K. Frederick, "Factors affecting performance of commercial banks in Uganda: A case for domestic commercial banks," in *Proceedings of 25th International Business Research Conference, 13-14 January 2014, Taj Hotel, Cape Town, South Africa*, 2014.

[25] A. Cekrezi, "Factors affecting performance of commercial banks in Albania," in *The European Proceedings of Social and Behavioral Sciences (EpSBS), BE-ci 2015 May, Department of Finance and Accounting, University "A.Xhuvani", Elbasan, Albania*, 2015.

[26] M. Getahun, "Analyzing financial performance of commercial banks in Ethiopia: CAMEL approach," Master Thesis, Addis Ababa University, Addis Ababa, Ethiopia, 2015.

[27] P. Veni, "Capital adequacy requirement of commercial banks: A study in Indian Context," *GITAM Journal of Management*, vol. 2, no. 2, pp. 99-107, 2004.

[28] K. J. Baral, "Health check-up of commercial banks in the framework of CAMEL: A case study of joint venture banks in Nepal," *Journal of Nepalese Business Studies*, vol. 2, no. 1, pp. 41-55, 2005. https://doi.org/10.3126/jnbs.v2i1.55

[29] A. D. Wirnkar and M. Tanko, "CAMELS and banks performance evaluation: The way forward," *SRN Electronic Journal*, vol. 24, 2008. https://doi.org/10.2139/ssrn.1150968

[30] H. H. A. Al-Tamimi, "Factors influencing performance of the UAE Islamic and conventional national banks," *Global Journal of Business Research*, vol. 4, no. 2, pp. 1-9, 2010.

[31] S. Mohammed, A. A. Dar, M. S. Khan, I. Azad, G. Jayaraman, and O. Albalawi, "Goodwill valuation enhancement through capitalization method and statistical impact analysis," *Journal of Risk and Financial Management*, vol. 17, no. 6, p. 226, 2024. https://doi.org/10.3390/jrfm17060226

[32] A. A. Dar, M. Malhotra, N. Alam, A. R. Farooqi, and M. S. Khan, "Unveiling influential factors in the capital asset pricing model: A novel approach utilizing Taguchi method," *Journal of Asian Scientific Research*, vol. 14, no. 2, pp. 266-276, 2024.

[33] A. A. Dar, M. S. Khan, I. Azad, G. Jayaraman, and A. R. Farooqi, "Exploring the impact of input variables on option value: A study using experimental design and analysis techniques," *Discover Applied Sciences*, vol. 6, no. 1, pp. 1-28, 2024. https://doi.org/10.1007/s42452-024-05676-w

[34] M. W. Hisam, A. A. Dar, M. O. Elrasheed, M. S. Khan, R. Gera, and I. Azad, "The versatility of the Taguchi method: Optimizing experiments across diverse disciplines," *Journal of Statistical Theory and Applications*, vol. 23, no. 4, pp. 365-389, 2024. https://doi.org/10.1007/s44199-024-00093-9