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Forecasting Profitability Model of Public and Private Sector Banks of India using CAMELS Variables: A Panel Data Analysis

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Abstract

The study examined the factors influencing the profitability of 50 public and private sector banks in India over a period of 10 years, from the financial year 2013 to 2022. The study used return on assets as the dependent variable to measure profitability, while the determinants of profitability included bank-specific and macroeconomic variables. The bank-specific variables were derived from the CAMELS model, including capital adequacy, net non-performing assets, profit per employee, return on equity, cash to deposits, and the priority advances to total advances ratio. The macroeconomic variables included gross domestic product and inflation. The study used panel data analysis to achieve the objectives of this research study. The descriptive statistics were used to describe the variables, the correlation matrix was used to identify the significant relationships between variables, and the Hausman test was used to find out which model is suitable for panel data analysis between the fixed effect model and the random effect model. The study also used the Wald test to identify significant relationships between the dependent and independent variables. Out of the eight variables examined, seven were found to have a significant relationship with return on assets for both public and private sector banks. The fixed effect model was found to be a more suitable model for explaining the variations in the dependent variable compared to the pooled OLS regression model. The fixed effect model revealed that explanatory variables had a higher predictability power and could explain more than the intercept model. However, it is important to note that this study only focused on 50 banks from the public and private sectors in India, and therefore the results cannot be generalised to the entire banking sector in India. Further research is needed to explore the determinants of profitability for all banks.

Keywords: ROA, ROE, CAMELS, profitability, fixed effect, hausman test

1. Introduction

The banking sector has a crucial role in the financial system of any economy. Banks mobilise savings, create credit, facilitate payment and settlement, manage risk, provide financial intermediation, transmit monetary policy, and promote economic development. The banking industry in India has played a significant role in supporting the country's economic growth in recent years. Both public and private sector banks contribute to the growth of the Indian economy in different ways. Public sector banks have promoted financial inclusion by providing banking services to underserved populations in remote and rural areas. On the other hand, private sector banks have introduced new and innovative banking products and services to increase access to finance and boost economic growth. Both public and private sector banks have invested heavily in technology, including digital banking solutions, to improve their efficiency and reach more customers. However, the financial performance of Indian

banks has been affected by various internal and external factors, including increased non-performing assets, fraud, losses in rural branches, competition from non-banking financial companies, and foreign banks. Therefore, it is essential to evaluate the financial performance of banks to identify their strengths and weaknesses. The Reserve Bank of India uses the CAMELS model to assess bank performance in terms of capital adequacy, asset quality, management efficiency, earnings quality, and liquidity. This ratio-based approach has become one of the most widely used methods for evaluating commercial banks' financial soundness, with return on assets as one of the performance indicators used. In this research study, the CAMELS variables and macroeconomic variables are applied as independent variables. Analysing the financial performance of a company is crucial for stakeholders, as it directly impacts their decision to invest in the company's assets (Penman, 2010). Bank-specific and macroeconomic factors have a significant impact on the profitability of banks (PP Athanasoglou et al., 2008). Profitability is quantified by output, performance, cost, and efficiency (Chatzoglou et al., 2010).

2. Literature Review

(Jain et al., 2019) evaluated macroeconomic and financial data from 45 commercial banks in India to determine the causes of bank profitability using CAMEL variables. They utilised a random effect model to analyse data from 2010 to 2016. They determined that private sector banks outperformed public sector banks, and that macroeconomic variables such as GDP, IIP, and WPI had a substantial impact on bank profitability. (Bourke, 1989) examined the profitability factors of 90 banks in twelve Western nations from 1972 to 1981. The study discovered that bank-specific profitability indicators are sufficient to predict bank profitability. (PP Athanasoglou et al., 2008) utilized GMM techniques to examine the determinants of bank profitability in Greece between 1985-2001 by analyzing macroeconomic, bank, and industry-specific variables. The study revealed that bank-specific and macroeconomic factors had a notable impact on bank profitability. In an analysis of Philippine banks from 1990-2005, (Sufian et al., 2008) identified various factors that influence their profitability. Results indicated that size, credit risk, expenses, and inflation had an adverse effect, while capital and non-interest income had a positive impact. (Kosmidou et al., 2005) conducted a study of UK banks from 1995-2002, examining both bank-specific and macroeconomic factors that affect their profitability. The results revealed that profitability was predominantly influenced by bank-specific factors. A study by (Karimzadeh et al., 2013) on the determinants of profitability in the Indian banking sector. The findings indicated that both internal and external factors played a role in determining the level of profitability. A study on banking productivity in the Greek banking system by (Chatzoglou et al., 2010) highlighted that productivity and profitability are both indicators of effectiveness. To measure profitability, factors such as output, performance, cost, and efficiency are taken into account. In their analysis of 372 commercial banks in Switzerland from 1999-2009, (Dietrich & Wanzenried, 2011) determined that there was a significant positive correlation between bank profitability and GDP growth rate. (Goddard et al., 2001) conducted an examination of the financial performance of European banks, and their findings suggested a noteworthy relationship between liquidity and profitability during the research period. (Sriram, 2018) examined the factors that determine Return on Equity (RoE) for 22

Indian companies from 2013-2018. To accomplish this, the study employed regression analysis, the Hausman test, and the Wald test. The findings indicated that a fixed effect model was the most appropriate method for predicting the companies' profitability. (Gurjar et al., 2019) analysed determinants of off balance sheet items with macroeconomic and bank specific variables for a period from 2008 to 2017 and suggested that NIM and Bank size had positive impact while CAR and NNPA had negative impact on off balance sheet items. (Gupta & Jaiswal, 2020) examined the financial soundness of both public and private sector banks. The findings indicated that, in comparison to public sector banks, private banks had better control over their Non-Performing Assets (NPAs). (Annapurna & Manchala, 2017) assessed the Balanced Scorecard of banks and discovered that the Return on Assets (RoA) of the banks was negatively impacted by their net Non-Performing Assets (NPAs), but positively influenced by their Capital Adequacy Ratio (CAR).

3. Research Methodology

3.1 Sample Selection of the study

The descriptive aspect of the research study aims to predict the profitability model of India's public and private sector banks using CAMELS ratios. The research study included all 50 banks from both the public and private sectors.

3.2 Data Sources and Period of the Study

The period of study is 10 years, starting from the financial year 2013 to 2022. The analysis is based on secondary data, which was obtained from the Reserve Bank of India's website.

3.3 Variables of the study

The study employed the return on equity as a dependent variable and eight additional variables, listed below with their codes, as independent variables:

Sr. No.	Variables	Code
1	Capital adequacy ratio	CAR
2	Net non-performing assets ratio	NNPA
3	Profits per employee ratio	PPE
4	Return on equity ratio	ROE
5	Cash to deposits ratio	CD
6	Priority advances to total advances ratio	PATA
7	Gross domestic product	GDP
8	Inflation rate	INFLATION

3.4 Methodology of the study

The study was done with a ratio analysis of selected samples. The variables are described using descriptive statistics, and pooled OLS regression analysis was performed to forecast the profitability model. The regression model is a crucial tool for forecasting profitability because they enable companies to identify the main factors of profitability, forecast future outcomes with reliability, and evaluate the impacts of changes on profitability. The fixed effect model and the random effect model were compared using the Hausman test in the study. The Wald test was further performed in the research study to identify significant relationships between the dependent and independent variables. The Eviews 12 student light programme was used to conduct all the necessary tests.

3.5 Model Specification of the study

The pooled OLS regression model shown below is used to examine the relationship between ROA and its variables:

ROA = Function of (CAR, NNPA, PPE, ROE, CD, PATA, GDP, and INFLATION)

The specific equation is:

$$Y_{ROAit} = \beta_1 + \beta_1 X_{CARit} + \beta_2 X_{NNPAit} + \beta_3 X_{PPEit} + \beta_4 X_{ROEit} + \beta_5 X_{CDit} + \beta_6 X_{PATAit} + \beta_7 X_{GDPit} + \beta_8 X_{INFLATIONit} + \varepsilon$$

Where,

β = Coefficient

i = Cross sectional observation

t =Time Period

ε = Error term

The Hausman test is used to evaluate fixed effect models and random effect models and determine which model is best for the research. The hausman test model and formula are as follows:

$$Y_{ROA} = bX + \varepsilon$$

Where,

Y_{ROA} = Dependent variable ROA

b = Vector of coefficient

X= Vector of regression

The Hausman test result indicates that the fixed effect model is superior than the random effect model hence the fixed effect model was developed using the following equation :

$$Y_{ROAit} = \alpha_{1i} + \beta_1 X_{CARit} + \beta_2 X_{NNPAit} + \beta_3 X_{PPEit} + \beta_4 X_{ROEit} + \beta_5 X_{CDit} + \beta_6 X_{PATAit} + \beta_7 X_{GDPit} + \beta_8 X_{INFLATIONit} + \varepsilon_{it}$$

3.6 Hypothesis of the study

The hypothesis of determinants of ROA used for wald test is given below:

→ H_0^1: There is no significant difference of CAR on ROA.
→ H_0^2: There is no significant difference of NNPA on ROA.
→ H_0^3: There is no significant difference of PPE on ROA.
→ H_0^4: There is no significant difference of ROE on ROA.
→ H_0^5: There is no significant difference of CD on ROA.
→ H_0^6: There is no significant difference of PATA on ROA.
→ H_0^7: There is no significant difference of GDP on ROA.
→ H_0^8: There is no significant difference of INFLATION on ROA.

4. Results and Discussion

Table 1: Descriptive Statistics

Variables	Mean	Median	Std.Dev.	Skewness	Kurtosis	Observations
ROA	0.3666	0.5500	1.2263	-1.1515	6.7609	439
CAR	14.9594	12.7800	17.3135	11.3673	144.9096	439
NNPA	3.4059	2.4000	3.1465	1.6484	5.9757	439
PPE	2.5506	5.0000	12.6211	-0.9578	21.2519	439
ROE	2.6770	7.3202	17.5397	-2.1039	8.9318	439
CD	5.5748	5.1236	2.1940	5.1863	42.9551	439
PATA	36.1144	35.1482	11.302	1.9940	11.3127	439
GDP	2367.3040	2294.8000	392.9991	-0.0179	1.4702	439
INFLATION	5.8286	4.9000	2.1622	0.9322	2.5361	439

Descriptive statistics for all variables are provided in Table 1. The mean value of ROA is 0.3666%, meaning that 50 banks, both public and private, generated around 0.4% profits on assets. The average CAR is 14.95%, which is more than 9%, expressing that all 50 banks maintain CAR as per RBI norms. The average NNPA is 3.40%, implying non-performing loans were not much higher during the research period. The mean of PPE is 2.55 lakh, indicating that the employees of banks are doing well in terms of earning profits. The average value of ROE is only 2.67%, indicating that bank returns on equity are comparatively lower. The skewness values of PPE, GDP, and inflation are between -1 and +1, implying the data is moderately skewed, whereas ROA, CAR, NNPA, ROE, CD, and PATA have skewness values of more than +1 and less than -1, implying the data is highly skewed. The GDP and inflation variables have kurtosis values less than 3, indicating that the data has lower lighter tails, whereas other variables have kurtosis values greater than 3, indicating that the data has higher lighter tails than a normal distribution.

Table 2: Regression Results

Dependent Variable: ROA — Cross-sections: 50

Method: Panel Least Squares — Total Panel Obs: 433

Variable	Coefficient	Std. Error	t-Stat	Prob.
C	-0.2196	0.2212	-0.9931	0.3212
CAR	0.0054	0.0021	2.5841	0.0101
NNPA	-0.0406	0.0087	-4.6827	0.0000
PPE	0.0135	0.0024	5.6844	0.0000
ROE	0.0536	0.0020	27.3505	0.0000
CD	0.0464	0.0082	5.6550	0.0000
PATA	0.0112	0.0017	6.4951	0.0000
GDP	0.0000	0.0000	-0.2254	0.8217
INFLATION	-0.0274	0.0121	-2.2693	0.0237

R-squared	0.9101	Mean dependent var	0.3525
Adjusted R-squared	0.9084	S.D. dependent var	1.2286
S.E. of regression	0.3717	Akaike info criterion	0.8793
Sum squared resid	58.5930	Schwarz criterion	0.9639
Log likelihood	-181.3741	Hannan-Quinn criter.	0.9127
F-statistic	536.9314	Durbin-Watson stat	0.8729
Prob(F-statistic)	0.0000		

Table 2 shows the pooled OLS regression results for the dependent variable ROA using 50 cross-sections, 433 panel data, and the panel least squares technique. The dependent variable is ROA, and the independent variables are CAR, NNPA, PPE, ROE, CD, PATA, GDP, and inflation. As a result, the R squared of the dependent variable is 91.01%, which means that the difference in the dependent variables is explained by all of the other variables. The prob. values of CAR (0.0101), NNPA (0.0000), PPE (0.0000), ROE (0.0000), CD (0.0000), PATA (0.0000), and Inflation (0.0237) are statistically significant at the 5% significant level, whereas the prob. value of GDP (0.8217) is not significant at the 5% significant level. The result of F statistics is 0.0000, indicating that the model is significant in all aspects, and the pooled OLS regression analysis was done using the following equation:

$$ROA = -0.2196 + 0.0054\,(CAR) - 0.0406\,(NNPA) + 0.0135\,(PPE) + 0.0536\,(ROE) + 0.0464\,(CD) + 0.0112(PATA) + 0.0000(GDP) - 0.0274(INFLATION)$$

Table 3: Hausman Test Result

Correlated Random Effects - Hausman Test — **Equation: Untitled**

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	120.8835	8	0

Cross-Section Random Effects Test Comparisons

Variable	Fixed	Random	Var(Diff.)	Prob.
CAR	0.0343	0.0044	0.0001	0.0004
NNPA	0.0037	-0.0133	0.0000	0.0000
PPE	0.0070	0.0097	0.0000	0.0000
ROE	0.0517	0.0539	0.0000	0.0001
CD	0.0190	0.0331	0.0000	0.0000
PATA	-0.0069	0.0076	0.0000	0.0000
GDP	-0.0002	-0.0001	0.0000	0.0550
INFLATION	-0.0280	-0.0213	0.0000	0.0555

H0= Random effect model is approatitate
H1= Fixed effect model is approatitate

chi2(5) = (b-B) ' [(V_b-V_B) ^ (-1)](b-B)
= 120.8835
Probability = 0.0000

Table 3 displays the outcomes of the Hausman test using an untitled equation. The Hausman test is used to determine which test is best for comparing random effect models with fixed effect models in panel data analysis. The (H0) random effect model is suitable, and the (H1) fixed effect model is suitable, according to the Hausman test. The chi-square of eight variables is 120.8835 with a probability of 0.000 and is significant at the 1% level, rejecting the null hypothesis that the random effect model is acceptable and accepting the alternative hypothesis that the fixed effect model is appropriate for this panel data result.

Table 4: Fixed Effect Regression Result

Dependent Variable: ROA Cross-sections: 50
Method: Panel Least Squares Total Panel Obs: 433

Variable	Coefficient	Std. Error	t-Stat	Prob.
C	0.4380	0.1753	2.4978	0.0129
CAR	0.0343	0.0087	3.9405	0.0001
NNPA	0.0038	0.0076	0.4893	0.6249
PPE	0.0070	0.0018	3.7057	0.0002
ROE	0.0518	0.0016	32.3479	0.0000
CD	0.0190	0.0074	2.5645	0.0107
PATA	-0.0069	0.0031	-2.2203	0.0270
GDP	-0.0018	0.0000	-2.8397	0.0048
INFLATION	-0.0280	0.0094	-2.9693	0.0032
R-squared	0.9598	Mean dependent var	0.3525	
Adjusted R-squared	0.9537	S.D. dependent var	1.2286	
S.E. of regression	0.2642	Akaike info criterion	0.3003	
Sum squared resid	26.1873	Schwarz criterion	0.8455	

Log likelihood	-7.0182	Hannan-Quinn criter.	0.5155
F-statistic	157.2672	Durbin-Watson stat	1.5888
Prob(F-statistic)	0.0000		

Table 4 provides the result of the fixed effect model. The R squared of the dependent variable is 95.98%, which means that the difference in the dependent variables is explained by all of the other variables. The co-efficient of CAR ($p < 1\%$), PPE ($p < 1\%$), ROE ($p < 1\%$), CD ($p < 5\%$), PATA ($p < 5\%$), GDP ($p < 1\%$), and Inflation ($p < 1\%$) are statistically significant, whereas the coefficient of NNPA ($p > 5\%$) is not significant. The ROA was positively influenced by CAR, PPE, ROE, and CD and negatively influenced by PATA, GDP, and inflation.

$$\textit{ROA} = 0.4380 + 0.0343\ (CAR) + 0.0038\ (NNPA) + 0.0070\ (PPE) + 0.0518\ (ROE) + 0.0190\ (CD) - 0.0069\ (PATA) - 0.0018\ (GDP) - 0.0280\ (INFLATION)$$

Table 5. Wald Test Result

Test Statistics	Value	df	Probability
F- Stat	520.5363	(9, 424)	0.0000
Chi-square	4684.827	9	0.0000
Null Hypothesis : C(1)=0, C(2)=0, C(3)=0, C(4)=0, C(5)=0, C(6)=0, C(7)=0, C(8)=0, C(9)=0			
Null Hypothesis Summary :			
Normalized Restriction (=0)		**Value**	**Std. Err.**
C(1)		-0.2196	0.2211
C(2)		0.0053	0.002
C(3)		-0.0405	0.0086
C(4)		0.0135	0.0023
C(5)		0.0535	0.0019
C(6)		0.0463	0.0082
C(7)		0.0111	0.0017
C(8)		0.0000	0.0000
C(9)		-0.0274	0.0120

Table 5 shows the result of the Wald test. The Wald test is used to determine if explanatory variables in an analysis are significant or not, as well as to assess the significance of all hypotheses in a single test. The F value of wald test is 520.53 ($p<0.01$) significant at 1 % level and explaining the difference in ROA for panel data model and the co-efficient of the parameters are not equal to zero. The null hypothesis for all the variables is rejected, so there is a relationship between dependent variables and independent variables at a 5% significant level.

Summary of Hypothesis

→ H_0^1: There is no significant difference of CAR on ROA. = Rejected
→ H_0^2: There is no significant difference of NNPA on ROA. = Rejected
→ H_0^3: There is no significant difference of PPE on ROA. = Rejected

→ H_0^4: There is no significant difference of ROE on ROA. = Rejected
→ H_0^5: There is no significant difference of CD on ROA. = Rejected
→ H_0^6: There is no significant difference of PATA on ROA. = Rejected
→ H_0^7: There is no significant difference of GDP on ROA. = Rejected
→ H_0^8: There is no significant difference of INFLATION on ROA. = Rejected

5. Conclusion

The factors that impact a bank's return on assets can differ between institutions and industries. Return on assets is a crucial metric for assessing the financial performance of any organization, so stakeholders are concerned about what influences it. According to the predicted equation derived from a pooled OLS regression, companies can improve their return on assets by efficiently managing all the independent variables that affect it. The fixed effect model was found to be more appropriate than the random effect model, based on the Hausman test and other independent factors that drive return on assets. The results of the profitability model for public and private sector banks in India using CAMELS variables are significant for shareholders and investors who plan to invest in a bank's shares over the long term. The study shows that the return on assets is determined by factors such as CAR, NNPA, PPE, ROE, CD, PATA, GDP, and inflation. The pooled OLS regression equation suggests that companies can increase their return on assets in the future by efficiently managing all the explanatory independent variables. The Wald test also indicates that the fixed effect model is better at explaining the determinants of return on assets than the OLS regression model.

6. Research Implications

The Research on the financial performance of the banking sector can offer valuable insights for both individual and institutional investors. The forecasting profitability model developed in this study is a crucial factor for shareholders and investors planning to invest in public and private sector banks for the long term. Additionally, the predictable model created by this research study can be useful for managers in making informed decisions regarding the return on assets.

7. Scope for Further Research and Limitations of the Study

The current study focused solely on the determinants of return on assets and did not consider the element of time. The time factor was also not included in this study, so future studies can be done with the time factor along with some other explicit influences in the panel data model. The future study also can be done with all public, private, foreign, and SFBs of India with more number of years and this will impact on result of forecasting model. The study is restricted to only 50 public and private sector banks in India. Therefore, the result of this research study cannot be applied to the entire banking sector in India. The study period of this research study is limited to only ten years, starting from 2013 to 2022.

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