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Performance Assessment of State Bank of India During Post Merger for Sustainability – An Application of CAMEL & LSTM Models

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Abstract

Themain aim of the paper isto appraise the performance of the State Bank of India (SBI) during the post-merger. Many research studies have contributed to the performance of the State Bank of India during the pre-merger period. After the mergerof SBI,the specific studies regarding performance evaluation by application of particular tools as well as Artificial Intelligence (AI) are scanty. This kind of study is required by large public sector banks in the country like the State Bank of India, hence, this specific study has been undertaken. A CAMEL Model and Artificial Intelligence (AI), LSTM have been used to evaluate the performance of SBI during post-merger. The performance evaluation process has been assessed by adopting indicators like Capital Adequacy, Asset Quality, Management Efficiency, Earnings Capacity, and Liquidity of SBI post-merger period.

After reviewing the past studies some questions havearisen in the authors' minds. Is it merging SBI associate banks and Bharathiya Mahila Bank with SBIthe correct decision? Didthe post-merger of SBI give good results? By taking these queries the researchers have assessed the study based on the secondary data only with some of thetenets by offering AI.During the post-merger period a five-year data has been undertaken i.e., from 2017-18 to 2021-22 forstudy purposes. The secondary data was gathered from books, standard international journals, annual reports from SBI, and authenticated websites. To analyse the data so as to get concrete inferences to be drawn from the studysome statistical tools have been used wherever is required.

Keywords: State Bank of India, Merger, CAMEL Model, Capital Adequacy, Return on Equity and Liquidity, LSTM etc.,

JEL Classification: G2, G21, L25

1. INTRODUCTION

For developing a country the contribution from financial institutions are pre-requisite. The financial stability and performance of the banking system are essentialforthe achievement of stable and sustainable growth of the country (ganesh et.al. 2021). The development and growth of the banking sector in the countryis unique to the nation. The role of the banking sector in developing countries should not be neglected(Aspal& Dhawan 2016).Besides that banking sector is one of the fastest growing sectors in the country (Bansal, et. al 2013).The banking system is becoming more complex due to some causes and there is a need to evaluate the performance of banks from time to time in the country (Bansal, R., etal.,2013). An effective banking system ensures the supply of surplus savings to the

productive sectors smoothly and efficiently (Kumar, M. S., et.al. 2021). In the country,the Reserve Bank of India recommended two rating models such as CAMEL and CACS (Capital Adequacy, Asset Quality, Compliance, and Systems and Control) to assess the performance of the bank and rating the country's commercial bank (T.pavan kumar., et. al., 2021) [37][38].

Among all the public sector commercial banks, State Bank of India (SBI) has been recognized since its inception. Even though it is a most reputed bank, it has suffered from various problems. The associates of State Bank of India and Bharathiya Mahila Bank were fully merged with State Bank of India on 1 April 2017, making it the largest bank among all the public sector banks [34][35].

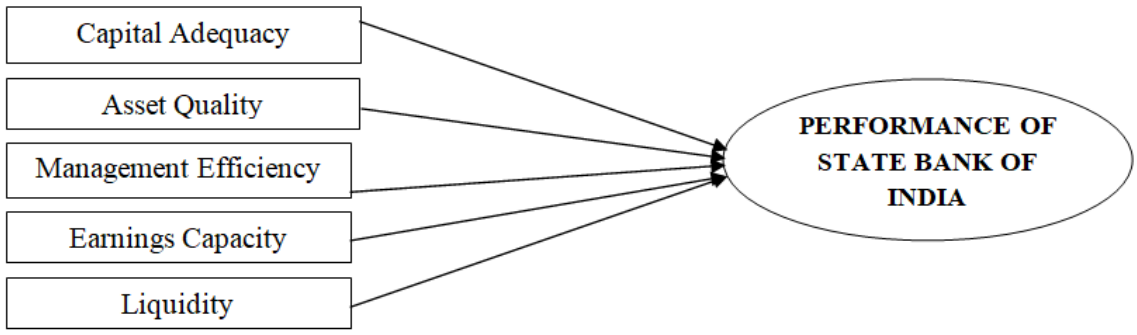
2.0.State Bank of India – A Brief:

State Bank of India (SBI) is the largest multinational bank providing its offices to the public of the country, in the most efficient manner (Murthy,D.S., 2020). It is monitoring the banking activities from its headquarters which is located at Mumbai. Thishas been providing its valuable services to the public withmorethan 22,000 branch networks. The bank is the fifth largest employer with nearly 2,50,000 employees in India.By capturing 5 trillion market capitalization and ranked seventh place.Each employee contributed Rs.2,28,350 in United States Dollars 10,000$ during the year 2020-21 [36].

3.0.Conceptual Research Design:

To evaluate the study on the performance evaluation of the State Bank of India, a CAMEL model has been applied and the process has been depicted in fig.3.1 by the authors. This model has been developed in the year 1970 and revised in the year 1996. The components of the CAMEL model are: Capital Adequacy, Asset Quality, Management Efficiency, Earning Capacity, and Liquidity (Bansal, R., etal. 2013) [39][40].

Fig. – 3.1: Conceptual Research Design



Source: Based on the CAMEL Model the authors have depicted

4.0.CAMEL Model – A Brief

To evaluate the performance of the bank CAMEL model has been used to assess the performance of the study (kumar etal.,2025). This can be discussed as under:

1. **Capital Adequacy:** It safeguards the bank against insolvency which expresses the relationship between bank capital and its risk-weighted assets. Under Capital Adequacy three ratioswill be calculated such asi. Capital Adequacy Ratio, 2. Debt Equity Ratio, iii. Proprietary Ratio.
2. **Asset Quality:**It examines the portfolio risk and further shows the productivity of long-term assets.
3. **Management Efficiency:**To evaluate the board of director's functions and their decision-making ability. Further, it also evaluates the performance of Human Resource Management (Saif-Alyousfi, A. Y., et al., 2017).
4. **Earning Capacity:** It assesses the interest rate policy, it can evaluate the study by i. Return on Equity, ii. Return on Assets, iii. Cost to Income Ratio and iv. Net interest income Margin. (Sarker, 2005).
5. **Liquidity:** It judges the liquidity of the bank with select ratios. Further, it scrutinizes bank liabilities like Interest rate, payment terms, tenor etc., (Sarker, 2005).

4.1. CAMEL Model Rating – An Assessment

Based on the CAMEL model rating range has been generated which is incorporated in Table 4.1.

Table – 4.1: CAMEL Model Rating

Sl.No.	Rating Range	Rating Analysis	Interpretation
1	1.0–1.4	Strong or Outstanding	The bank is good and sound operations without involving inrisk management practices
2	1.6-2.4	Satisfactory or superior	The bank reflects safe and sound operations shows through satisfactory performance and risk management practices.
3.	2.6-3.4	Fair or average	Here the bank performance is marginal, unsatisfactory practices.But limited concern for failure.
4.	3.6-4.4	Marginal with some risk of failure	The bank is below average, poor performance.
5.	4.6-5.0	Unsatisfactory (or doubtful) with a high degree of failure	The bank reflects unsatisfactory performance, there is a chance of failure.

Source: AAA (1996) and Sarker (2006) quoted in Mudathir Ahmed etal., P.No.7.

4.1.1. LONG SHORT-TERM MEMORY MODEL (LSTM):

In most cases, neural networks process data inputs and make decisions invisibl({Prasad et.al.,2024)y. To store the system's learned information from its training sessions, weights serve as a kind of static memory. To address this issue, the LSTM was created to provide RNNs with their own memory representation. Adaptations of NNs, these models thrive with sequential input and use the network's "cell" as its memory unit. The purpose of this proposed research is to test LSTM's efficacy in a decentralised setting for evaluating performance. Figure 4.1.1.1 shows the LSTM in operation.

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Figure 4.1.1.1: Long Shor-Term Model Process

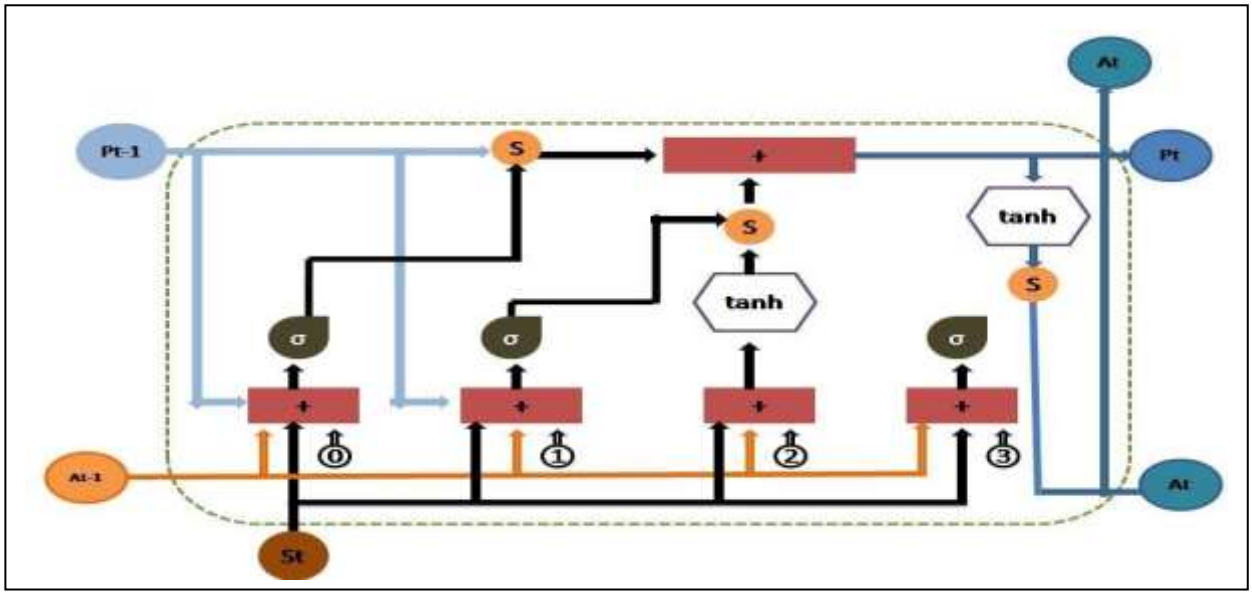

Figure- 4.1.Working of LSTM

The LSTM network makes use of the inputs 'St,' 'At-1,' and 'Pt-1,' as illustrated in Figure 1 up there. The letter "St" represents the input pattern for the current time step. 'At-1' is the previous LSTM unit's hidden state or output. Furthermore, the data from the previous unit is stored in the 'Pt-1' memory component or cell state. Outputs ('At') and storage ('Pt') are the two components that make up the current area. Consideration of the current input, the previous output, and the data stored in memory is applied to all decisions. In response to the quick tempo, a more recent memory is retrieved. A common oversight in multiplication is symbolized by the letter "S," which stands for forget. The forget parameter discards 90% of the data stored in the past when set to 0. When the number is 1, 2, or 3, the unit allows the use of some old memory. The plus operator is utilized by piecewise summation when adding together both old and new data. The amount of access to your long-term memory is determined by the 'S' symbol. Pt-1 is converted to Pt after two processes. The sigmoid and common activation functions, with recall valves as their output, are shown in Figure 2. In its capacity to process both new and old data, the second switch is called a "new memory element." Based on its current input, bias vector, and previous output and input, the amount of memory transmitted to the next unit is controlled by these factors [41][42]

5.0.LITERATURE REVIEW

Some past studies have been reviewed which were done by the academicians andresearchersto evaluate the study. The following most prominent reviews absolutely to judge the performance of State Bank of Indiaare presented hereunder:

Sasikala, S., etal., (2022) in their paper titled, "Post Merger Performance of the State Bank of India: An Analysis" opined that merging is an important development in the banking field and its impact is also durable. Finally, it is concluded that the performance of the SBI is satisfactory during the study period.Magoma, A.,(etal., 2022), in their study entitled "Financial Performance of Listed Commercial Banks in Tanzania: A CAMEL Model approach", discussed and found that commercial banks listed at the DSE in Tanzania are mostly affected by management efficiency and capital adequacy.Saif-Alyousfi, A. Y., et al.,(2017),discussed in their paper "Profitability of Saudi commercial banks: A comparative evaluation between domestic and foreign banks using CAMEL parameters. The study concentrated on the assessment of Financial Risk Management of select banks.Murthy, D.S., (2020) evaluated the study on "Operational Efficacy of State bank of India During Pre-merger – An Analysis by using CAMEL model. The study reveals that the Capital Adequacy Ratio, Debt Equity Ratio and net interest income

margin ratios are comparatively less.Chaudhuri (2018) conducted a comparative study on the "performance of SBI and ICICI for a period of five years from 2011-12 to 2015-16 using the CMEL model". The reults conclude that both the banks are complying with the required standards and are profitable. However, the performance of ICICI is better than SBI on the parameter of earnings and management efficiency.Mouneswari, etal., (2016), in their research paper titled "Performance Analysis of Indian Banking Sector using CAMEL Approach", said that to evaluate the performance of banks CAMEL model is to be applied.Titto Varghese, (2016) conducted a research study on "Evaluating Performance of a Service Co-operative Bank: An Application of Camel Model", said that the CAMEL rating system was introduced to assess the performance of the banks. By analysing the 10 years data, it is found that The Urban Service Co-operative Bank,was making a healthy improvement in its capital acadequacy ratio over the previous years.Tofael Hossain Majumder etal., (2016),in their paper "A Camel Model Analysis of Selected Banks in Bangladesh", find that Bangladesh Banking sector has to improve their financial performance and formulate policies.Aspal, P. K., et al., & Dhawan, S. (2016), explained the process of CAMEL model analysis and rating procedure in their paper "Camel rating model for evaluating financial performance of banking sector: A theoretical perspective". Misra, Sushendra Kumar and Aspal, Parvesh,(2012) discussed in their research paper "A CAMEL Model Analysis of State Bank Group". SBI needs to improve its position with regarding to asset quality and capital adequacy [43].

6.0. RESEARCH DESIGN AND METHODOLOGY

Anexclusive set of methodology has been adopted to analyse the secondary data as gathered from the annual reports of the bank.

6.1. Statement of the Problem

The banking sector's performance is the most significant for future prospects and the mirror of the economic conditions of the country (Misra et al., 2013). Recently some of the banks have merged and five years later State Bank of India merged of its associates. It is playing a significant role in the country's economy, moreover, it is one of the largest public sector banks in the country. Is it the good decision of merging of State Bank of India associates and Bharathiya Mahila Bank with SBI.Whether during post-mergerof the State Bank of India giving good results?On these issues, the study has been carried out on the performance of State Bank of India.

6.2. Research Gap and Need for the Study

After reviewing the various past studies the majority of the studies focussed on select commercial banks. Some studies have concentrated on comparative analysis with SBI and other commercial banks. The role of the State Bank of India in the Indian economy for sustainability could not be neglected. However, specific studies on the State Bank of India (SBI) in the micro level by using any specific tool and the latest technology like Artificial Intelligence are scanty. By keeping in view,this study has been undertaken by the authors.

6.3. Research Objectives

The ultimate aim of the paper is to review the performance of the State Bank of India during post-merger by using the CAMEL model approach. Some objectives were obviously selected for the study purpose.

i. To evaluate the Capital Adequacy of SBI.
ii. To determine the Asset Quality of SBI.
iii. To investigate the Management Efficiency of SBI.
iv. To review the Earning Capacity of SBI.

v. To appraise the Liquidity Status of SBI.
vi. To assess the performance of SBI by applying LSTM.

6.4. Data Collection

The entire research has been carried out based on secondary data only which was gathered from various books, annual reports of the State Bank of India, Reserve Bank of India, International quality journals, magazines and websites etc.,

6.5. Period of the Study:

A five-year data has been gathered from annual reports of the State Bank of India from 2017-18 to 2021-22 during the post-merger period only.

6.6. Tools and Techniques

A CAMEL model and Artificial Intelligence have been applied toappraise the performance of the State Bank of India during the study period. Some statistical tools have been applied wherever they are appropriate.

6.7. Scope and Limitations of the Study

The study discussed the performance of SBI during the five yearspost-merger only. A CAMEL and LSTM both have been used to assess the data to evaluate the performance of the State Bank of India.

6.8. Further Research

So as to know the benefit or risk of merging SBI, it is quickly offered to evaluate the performance of State Bank of India during pre and post-merger.

7.0. PERFORMANCE OF STATE BANK OF INDIA (SBI) – AN ANALYSIS

To review the performanceof the State Bank of India, a CAMEL& LSTM modelhave been applied to get the systematic meaningful inferences which have been discussed under:

7.1 Capital Adequacy:

Under this, it has been analysed three ratios such as 1. Capital Adequacy Ratio, 2. Debt Equity Ratio and 3. Proprietary Ratio.

The central authority of the banks has opined that the higher capital adequacy ratio is safe to prevent the banks from bankruptcy (Aspal& Dhawan, 2016 P.No.12),As per Basel III norms stipulated capital to risk-weighted assets is 8 per cent. However, as per the RBI norms, all commercial banks must maintain a capital adequacy ratio of9 per cent. In the country, the public sector banks are emphasised to maintain the standard capital adequacy ratio is 12 per cent. The ratio is calculated by taking two variables: capital and Risk-weighted assets.

Table – 7.1.1: Capital Adequacy Ratioduring the Year from 2017-18 to 2021-22

(Rs. in Crores)

Year	Tier 1 Capital	Tier 2 Capital	Tier 1 & Tier 2 Capital	Risk-weighted Assets	Capital Adequacy
2017-18	184146	49910	234056	3042728	13.00
2018-19	194655	46418	241073	3133949	13.00

2019-20	217477	49119	266596	3500405	13.13
2020-21	244421	57559	301980	4149205	13.74
2021-22	269708	65121	334829	4637382	13.85
A.M	222081	53625	275707	3692734	13.34
CAGR in %	7.93	5.46	7.42	8.79	1.27
S.D	35284.04	7643.31	42435.28	684190.00	0.42
CV			29005247735.62		

Source: Annual Reports of State Bank of India.

It is apparent from the table 7.1.1 that, during theyear 2017-18 the ratio calculated was 13 per cent and reached to 13.85 per cent for the year ended 2021-22. During the entire study period this has beenshown upward trend. The average of the ratio is 13.34 per cent. The CompoundAnnual Growth Rate also recorded 1.27 per cent. The State Bank of India is out of danger from the bankruptcy.

7.1.2. Debt Equity Ratio

It expresses the relation between Debt and Equity Capital of the bank. Table7.1.2 manifeststhe Debt and Equity.

Table – 7.1.2: Debt Equity Ratio during the period from 2017-18 to 2021-22

(Rupees in Crores)

Year	Debt	Equity	Debt-Equity Ratio
2017-18	306	892.46	0.34
2018-19	331	892.46	0.37
2019-20	355	892.46	0.40
2020-21	409	892.46	0.46
2021-22	447	892.46	0.50
A.M	367	892.46	0.41
CAGR %	7.87	0	7.87
SD	57.64	0	0.06
CV	0.0000000		

Source: Annual Reports of State Bank of India.

As portrayed in table7.1.2, the debt-equity ratio of State Bank of India from 2017-18 to 2021-22 ranging from 0.34:1 to 0.50:1. It is grown every year. The highest Debt Equity Ratio has recorded in the year 2021-22. The average of Debt Equity Ratio is 0.41:1 and Compound Annual Growth Rate has recorded 7.87 per cent.The ideal Debt Equity Ratio is 2 or 2.5 considered as good.

7.1.3. Proprietary Ratio

As measured by the proprietary ratio the amount of funds investors invested for the capital of the bank. The following table depicts the relationship between shareholders' funds and total tangible assets.

Table – 7.1.3: Proprietary Ratio during 2017-18 to 2021-22

(Rs. in Crores)

Year	Shareholders Fund	Tangible Assets	Proprietary Ratio
2017-18	280088.06	2995866.91	0.093
2018-19	253875.19	3152898.87	0.081
2019-20	232007.43	3372244.08	0.069
2020-21	220913.82	3801203.02	0.058
2021-22	219128.56	4215412.06	0.052
A.M	241202.61	3507524.98	0.070
CAGR %	-4.79	7.07	-10.98

SD	25768.79	498298.47	0.02
2017-18	280088.06	2995866.91	0.09
CV	-11182614073.68		

Source: Annual Reports of State Bank of India.

As revealed by table – 7.1.3 that the proprietary ratio during the year 2017-18 was 0.093:1, fluctuating that has been reached to 0.052:1. The average Arithmetic Mean is 0.070, and CompoundAnnual Growth Rate has shown a negative -10.98 per cent.

7.2. A – ASSET QUALITY

The asset quality of the State Bank of India has been assessed by taking the Investments to Assets Ratio, Advances to Assets Ratio,and Allowances to Loan Loss Ratio and provision for loan loss Ratio.

7.2.1. Investments to Assets Ratio:

The investments-to-assets ratio has been evaluated by combining the components of Investments and Assets, which are shown in Table 7.3.1.

Table – 7.3.1: Investments to Assets Ratio during the year from 2017-18 to 2021-22

(Rs. in Crores)

Year	Investments	Assets	Investment Assets Ratio
2017-18	1060987	3454752	30.71
2018-19	967022	3680914	26.27
2019-20	1046954	3951394	26.49
2020-21	1351705	4534430	29.81
2021-22	1481445	4987597	29.70
AM	1181622	4121817	28.60
CAGR %	6.9	7.62	-0.67
SD	222240.57	630126.90	2.06
CV	131949727114.20		

Source: Annual Reports of State Bank of India.

Table 7.3.1 was displayed the Investments to Assets Ratiothat 30.71 per cent during the year 2017-18 by fluctuating that has been reached to 29.70 per cent. The average between investments and assets is 28.60. The Compound Annual Growth Rate recorded -0.67 per cent.

7.2.2.: Advances to Assets Ratio

This ratio has been calculated by taking two components Advances and Assets. A lower ratio of advances to assets is preferred to a higher ratio to reduce the highest risk of credit (will.k.2019)

Table – 7.2.2.: Advances to Assets Ratio during the year from 2017-18 to 2021-22

(Rs. in Crores)

Year	Advances	Assets	Advances to Assets Ratio
2017-18	1934880	3454752	56.01
2018-19	2185877	3680914	59.38
2019-20	2325290	3951394	58.85
2020-21	2449498	4534430	54.02
2021-22	2733967	4987597	54.81
A.M	2325902	4121817	56.61
CAGR%	7.16	7.62	-0.43
SD	297614.93	630126.90	2.40

CV	181742665982.05	

Source: Annual Reports of State Bank of India.

Advances to Assets Ratio has been evaluated and displayed in table - 7.2.2. During the year 2017-18 the ratio has shown 56.00 per cent after up and downs seen that has reached to 54.81 per cent for the year 2021-22.The CAGR calculated was -0.43 per cent.

7.2.3. Allowances to Loan Loss Ratio

This ratio has been evaluated by taking two variables as: Allowances and Loans

Table – 7.2.3: Allowances to Loan LossRatio during the year from 2017-18 to 2021-22

(Rs. in Crores)

Year	Allowances	Loans	Allowance To Loan Loss Ratio
2017-18	46472	1571078	0.030
2018-19	59943	1934880	0.031
2019-20	69687	2185876	0.032
2020-21	15042	2500598	0.006
2021-22	17436	2794076	0.006
A.M	41716	2197301	0.021
CAGR %	-17.8	12.2	-6.89
SD	24689.27	476780.88	0.014
CV	-7665218502.00		

Source: Annual Reports of State Bank of India

As per the table – 7.2.3that the allowances to loan loss ratio drastically declined from 0.030 to 0.006 and the CAGR are also evidenced it is negativeat-6.89. the average of the study period is 0.021.The average value of the ratio is 0.021 and the compound annual growth rate is -6.89.

7.2.4. Provision for Loan Loss Ratio

This ratio has been calculated by taking provisions and contingencies and loans.

Table – 7.2.3: Provision for Loan Loss during the year 2017-18 to 2021-22

(Rs. in Cores)

Year	Provisions and Contingencies	Loans	Provisions for Loan Loss Ratio
2017-18	40363.79	1571078	0.026
2018-19	66058.41	1934880	0.034
2019-20	54573.21	2185876	0.025
2020-21	54618.41	2500598	0.022
2021-22	40059.15	2794076	0.014
AM	51134.55	2197301.60	0.024
CAGR (%)	-0.15	12.2	-11.65
SD	11015.393	476780.880	0.007
CV	-690899616.35		

Source: Annual Reports of State Bank of India

Provision for loan loss ratio as appearing in table – 7.2.3 enables the provisions created to meet the contingencies relating to the loan collection from debtors. If ratio is more, it indicates that more provisions are created to meet the loan contingencies while a lower ratio indicates that the provisions have utilised. Highest ratio has been recorded in the year 2018-19 0.034 and lower ratio could be

observed 0.014 in the year 2021-22. The average of ratio is 0.024. But compound annual growth rate seen -11.65 per cent.

7.3. M – MANAGEMENT EFFICIENCY

Management is a qualitative issue such as the ability to facethe risk. The management of efficiency has been discussed by taking Earnings Per Employee and Business Per Employee.

7.3.1: Earning Per Employee:

The Earnings Per Employee ratio denotes the contribution of an employee of the State Bank of India. This ratio can be calculated by takingEarnings Before Interest and Tax and Number of employees.

Table – 7.3.1: Earnings Per Employee During the years from 2017-18 to 2021-22

(Rupees in Crores)

Year	Earnings Before Interest and Tax [EBIT]	No. of Employees	Earnings Per Employee
2017-18	199720	264041	0.76
2018-19	208395	257252	0.81
2019-20	221155	249448	0.89
2020-21	224455	245652	0.91
2021-22	230042	244250	0.94
A.M	216753	252128	0.86
CAGR %	2.87	-1.55	4.5
SD	12402.29	8357.02	0.08
CV	-103025944.09		

Source: Annual Reports of State Bank of India.

Table – 7.3.1. flashes on the relationship between Earnings Before Interest and Tax and Number of employees. The highest Earning Per Share stood at 0.942 for the year 2021-22 as against lower EPS in the year 2017-18 0.756 crores. The average of EPS is 0.86 crores. The compound annual growth rate during the study period is 4.5 per cent.

Table – 7.3.1: Business Per Employee during the study period from 2017-18 to 2021-22

(Rupees incrores)

Year	Volume of Business	No. of Employees	Business Per Employee
2017-18	175776621	264041	665.72
2018-19	746523015	257252	2901.91
2019-20	223169169	249448	894.65
2020-21	249571543	245652	1015.96
2021-22	277809650	244250	1137.40
A.M	334569999	252128	1323.13
CAGR %	9.59	-1.55	11.31
SD	233333047.3	8357.02	899.61
CV	378825997887.09		

Source: Annual Reports of State Bank of India.

A cursory look at the table – 7.3.1 that the Business Per Employee shown increasing trend. During the study period that has increased from 665.71 crores to 1137.40crores and CAGR stood at 11.31 per cent.

7.3.0 E – EARNINGS CAPACITY

The earning capacity of State Bank of India assessed through Return on Equity, Return on Assets, Cost Income ratio and net Interest Income Ratio.

7.3.1: The Return on Equity: All the business concerns undertake the risk for earning return (Mydathir et.al 2019). The return on equity is calculated in between two variables i.e., Net Profit after tax and Equity. Table. 7.3.1 reveals the Return on Equity of SBI.

Table – 7.3.0: Return on Equity during the Study Period from 2017-18 to 2021-22
(Rupees in Crores)

Year	Net Profit After Tax	Equity	Return On Equity
2017-18	-3007.59	892.46	-3.37
2018-19	348.06	892.46	0.39
2019-20	6202.60	892.46	6.95
2020-21	7907.20	892.46	8.86
2021-22	11004.03	892.46	12.33
A.M	4490.86	892.46	5.03
CAGR %		0	-2.30
SD	5709.91	0	6.40
CV	0.0000000		

Source: Annual Reports of State Bank of India.

A snapshot on Table – 7.3.1reveals that the return on equity has been increased from -3.37 crores to 12.33 crores. The compound annual growth rate has been reached to -2.29 crores.The average during the period is 5.03 CAGR is -2.30.

7.4.2 Return on Assets (ROA):

This ratio indicates how effectively utilized the assets in profit making, higher income generating capacity of the assets and better efficiency of management in the future (Aspal&Dhawan, 2016 P.12).

Table – 7.4.2: Return on Assets during the study period from 2017-18 to 2021-22

Year	Net Interest Income	Total Assets	Return On Assets
2017-18	-621855.36	3454752	-0.18
2018-19	73618.28	3680914	0.02
2019-20	1422501.84	3951394	0.36
2020-21	2040493.5	4534430	0.45
2021-22	3142186.11	4987597	0.63
A.M	1211388.87	4121817.4	0.25
CAGR %		7.62	-1.7
SD	1509575.06	630126.905	0.329438917
CV	925576501546.6980000		

Source: Annual Reports of State Bank of India

As evaluated from table – 7.4.2 that, the return on assets recorded during the year was 0.18 crores and reached 0.63 crores.The compound annual growth rate is-1.7.

7.4.3: Cost Income Ratio:

This denotes the net results of Operating Expenses and Net Interest and Non-interest Income.

Table – 7.4.3: Cost Income Ratio during the study period from 2017-18 to 2021-22
(Rs. in Crores)

Year	Operating Expenses	Net Interest &Non-Interest Income	Cost of Income Ratio (in %)
2017-18	59943	30079.40	50.18
2018-19	69688	38816.22	55.70
2019-20	75174	39436.28	52.46
2020-21	82652	44301.47	53.60
2021-22	85979	45835.40	53.31
A.M	74687	39693.75	53.05
CAGR %	7.48	8.79	1.22
SD	10411.09	6168.94	2.00
CV	63016873.09		

Source: Annual Reports of State Bank of India

In discussion based on table 7.4.3. that the cost and Income Ratio during the year 2017-18 was 50.18 per cent by fluctuating reached to 53.31 per cent and the compound annual growth rate was 1.22 per cent. The Average Cost of Income Ratio is 53.05 per cent.

7.4.4: Net Interest Income Ratio

It shows the ability of the bank to get the net income after meeting all the expenses.

Table – 7.4.3: Net Interest Income Ratio during the study period from 2017-18 to 2021-22

(Rs. in Crores)

Year	Interest Income	Interest Expended	Net Interest Income	Average Earning Asset	Net Interest Income Margin
2017-18	172664.75	97810.75	74854	34654.63	2.16
2018-19	191860.34	103511.34	88349	36812.08	2.40
2019-20	211029.53	112944.53	98085	39550.40	2.48
2020-21	214986.58	104276.58	110710	45372.95	2.44
2021-22	223644.68	102936.68	120708	49879.34	2.42
A.M	202837.17	104295.97	98541.20	412.53.88	2.38
CAGR %	5.31	-2.83	10.03%	12.56%	2.30
SD	20485.00	5461.67	18059.76	6275.88	0.13
CV	110922384.90				

Source: Annual Reports of State Bank of India.

A cursory look at Table – 7.4.4 that Interest income has increased on an average 202837.17 crores. Similarly, the average interest expenses averaged to102936.67 crores and the average net interest income was 98541.2 crores. The compound annual growth rate is 2.30 per cent. The average Net Interest Income Margin is 2.38 crores.

7.5.0: L – LIQUIDITY

Liquidity means the ability of the bank to meet its current obligations. The liquidity position of State Bank of India evaluated by through current ratio, absolute liquid ratio, customer deposits to total assets ratio, and advances to deposits ratio. The following tables can be judged the liquidity position of SBI (Aspal& Dhawan.2016).

7.5.1. Current Ratio:

It is calculated by taking two variables such as Current Assets and Current Liabilities.

Table – 7.5.1.Current Ratio of State Bank of India during the period from 2017-18 to 2021-22

(Rs. in Crores)

Year	Current Assets	Current Liabilities	Current Ratio
2017-18	341476	167138	2.04
2018-19	364172	145597	2.50
2019-20	391295	163110	2.40
2020-21	449601	181980	2.47
2021-22	494989	229932	2.15
A.M	408307	177551	2.31
CAGR %	7.71	6.59	1.05
SD	63092.51	32021.15	0.20
CV	1768813166.59		

Source: Annual Reports of State Bank of India.

The current ratio of State Bank of India has been portrayed in table – 7.5.1. In the year 2017-18, the current ratio was 2.04:1 by fluctuating that has been reached to 2.15:1 for the year ended 2021-22. The average current ratio is recorded 2.31:1 and the calculated compound annual growth rate is 1.15.

7.5.2: Absolute Liquid Ratio

It is the relationship between Cash & Cash Equivalents and Current Liabilities.

Table – 7.5.2: Absolute Liquid Ratio of State Bank of India from 2017-18 to 2021-22

Year	Cash & Cash Equivalents	Current Liabilities	Absolute Liquid Ratio
2017-18	150397.18	167138	0.90
2018-19	176932.42	145597	1.22
2019-20	166735.78	163110	1.02
2020-21	213201.54	181980	1.17
2021-22	257859.21	229932	1.12
A.M	193025.23	177551	1.09
CAGR %	11.39	6.59	4.47
SD	42947.04	32021.15	0.123
CV	1205797767		

Source: Annual Reports of State Bank of India.

It is clear from table 7.5.2 that the absolute liquid ratio of the State Bank of India has been increased from 0.90:1 to 1.12:1. The average ALR is 1.09 and the calculated CAGR is 4.47 per cent.

7.5.3: Customer Deposits to Total Assets Ratio

The ratio has calculated by using the variables Customer Deposits and Total Assets.

Table – 7.5.4: Customer Deposits to Total Assets Ratio

(Rs. in Crores)

Year	Customer Deposits	Total Assets	Customer Deposits Ratio(in %)
2017-18	2701910	3454752	0.78

2018-19	2703306	3680914	0.73
2019-20	73422	3951394	0.19
2020-21	1042132	4534430	0.23
2021-22	4072919	4987597	0.82
A.M	2250897	4121817	0.55
CAGR %	8.55	7.62	0.88
SD	1368327	630126.90	0.31
CV	209217771329.03		

Source: Annual Reports of State Bank of India.

The liquidity position of SBI evaluated by taking the components of customer deposits to total assets explained in table –7.5.4. The average of the ratio is 0.55 and CAGR recorded at 0.88 per cent.

7.5.5: Advances to Deposits Ratio

This ratio exhibits the relationship between Advances and Customer Deposits.

Table – 7.5.5: Advances to Deposits Ratio during the study period

(Rs. in Crores)

Year	Advances	Customer Deposits	Advances to Customer Deposits Ratio
2017-18	1934880	2706344	0.72
2018-19	2185877	2911386	0.75
2019-20	2325290	3241621	0.71
2020-21	2449498	3681277	0.67
2021-22	2733967	4051534	0.68
A.M	2325902	3318432	0.71
CAGR %	7.16	8.40	-1.14
SD	297614.93	551210.74	0.04
CV	160095739166.80		

Source: Annual Reports of State Bank of India.

Table – 7.5.5 interprets the relationship between advances and customer deposits. This ratio has decreased from 0.72 in the year 2017-18 to 0.675 for the year ending 2021-22. The ratio average is 0.71 and the compound annual growth rate is -1.14 per cent.

8.0. DATA ANALYSIS AND INTERPRETATION:

Data analysis and interpretation can be done by formulating some hypothesis.

8.1. Hypothesis: The following hypotheses have been formulated to test withsome statistical tools:

8.1.1. Hypotheses:

The following hypotheses were formulated and employed for testing purposes.

H_1: There is a significant relation between Capital Adequacy and Earning Capacity of SBI during post-merger.

H_2: There is a significant relation between Asset Quality and Earning Capacity of SBI during post-merger

H_3: There is a significant relation between Management Efficiency and Earning Capacity of SBI during post-merger.

H_4: There is a significant relation between Liquidity and Earning Capacity of SBI during post merger.

8.1.2: Pearson Correlation 2-tailed test has been chosen to get fruitful results for the hypotheses set. These analysis results have been portrayed in Table 8.1.1.

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Table 8.1.1: Hypothetical Testing Analysis of State Bank of India during post-merger

Sl. No.	Indicator	EARNINGS CAPACITY							
		ROE (%)		ROA (%)		CIR Ratio (%)		NIIM	
		Pearson Correlation	Sig(2-tailed)	Pearson Correlation2	Sig(2-tailed)3	Pearson Correlation4	Sig(2-tailed)5	Pearson Correlation6	Sig(2-tailed)7
1.	Capital Adequacy Ratio	0.870	0.055	0.865	0.059	0.165	0.790	0.433	0.466
2.	Debt Equity Ratio	0.957	0.011	0.954	0.012	0.290	0.636	0.610	0.274
3.	Proprietary Ratio	-0.990	0.001	-0.989	0.001	-0.356	0.557	-0.755	0.141
4.	Investments Assets Ratio	0.032	0.959	0.021	0.974	-0.609	0.276	-0.580	0.305
5.	Advances to Assets Ratio	-0.433	0.466	-0.422	0.479	0.305	0.618	0.152	0.808
6.	Allowances and Loans Ratio	-0.763	0.133	-0.756	0.139	-0.164	0.792	-0.314	0.607
7.	Provisions for Loan Loss Ratio	-0.768	0.130	-0.762	0.134	0.285	0.642	-0.181	0.771
8.	Earnings Per Employee	0.997	0.000	0.998	0.000	0.310	0.611	0.800	0.104
9.	Business Per Employee	-0.224	0.717	-0.219	0.723	0.849	0.069	0.236	0.702
10.	Current Ratio	0.191	0.758	0.198	0.750	0.776	0.123	0.727	0.164
11.	Absolute Liquid Ratio	0.424	0.477	0.426	0.475	0.964	0.008	0.672	0.214
12.	Customer Deposits Ratio	-0.339	0.576	-0.343	0.572	-0.031	0.961	-0.578	0.307
13.	Advances to Customer Deposits Ratio	-0.781	0.119	-0.775	0.124	0.185	0.766	-0.308	0.614

Interpretation:

Table 8.1.1. portrays the results of the analysis of the hypotheses formulated. It is observed that there is a positive relationship**(0.957)** ROE (%)**,(0.954)** ROA (%)between the Debt Equity Ratio and it is statistically significant at a 5 per cent level of significance since the 2-tailed significance value is less than 0.05. The table reveals that there is no significant relation between Earning Power Ratios such as ROE, ROA, and Cost to Income Ratio and NIIM with that of Capital adequacy ratios such as CAR, Debt Equity Ratio, and Proprietary Ratio since the 2 tailed significant values are greater than 0.05 except in the case of ROE (%) and ROA (%)verses DebtEquityRatio.Hence, it can be concluded that H_1should be rejected i.e., there is no significant relation between Capital adequacy and Earning capacity of SBI pre-merger.

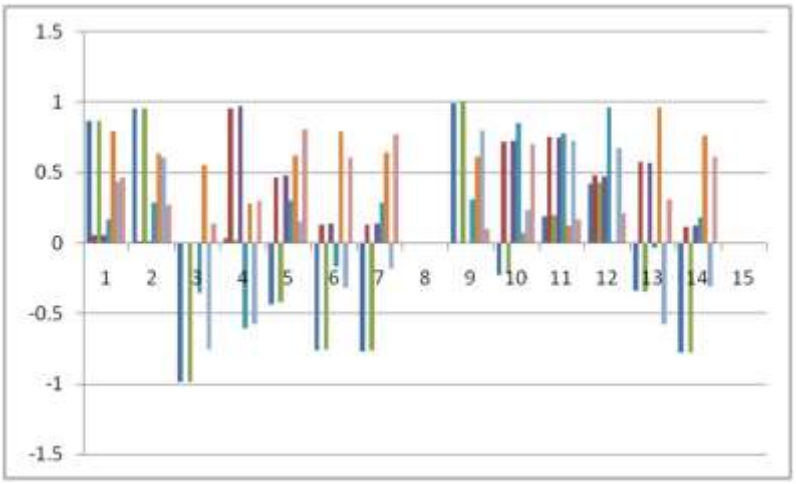
Further, there is a positive relation between Earning capacity ratios such as CIR **(0.305)** NIIM **(0.152)** to those allowances for Advances to Assets Ratio and it is also statistically significant at 10 per cent level of significance, since, the 2 tailed significant value is 0.08 in both the cases. It is also identified that there is no significant relation between Earning power ratios such as ROE, ROA, Cost to Income Ratio and NIIM with that of Asset Quality Ratios such as IAR, Advances to Assets Ratio, Provision for Loan Loss Ratio and Advances to Deposit Ratio since the 2 tailed significant values are greater than 10 per cent level of significance. Hence, it can be concluded that, H_2 should be rejected i.e., there is no significant relation between Asset Quality and Earning Capacity of SBI before merger except for Advances to Assets Ratio.

It is obvious that there is a negative relationship between BPE and ROE **(-0.224)** and ROA **(-0.219)**. Positive relationship between these two CIR**(0.849)** and BPE of SBI. The relation is also statistically significant at a 5 per cent level of significance since the 2-tailed test values are lesser than 0.05.The table also reveals that there is a significant relation between EPE and Earning Capacity Ratios such as ROE, ROA, Cost to Income Ratio, and NIIM of SBI since the 2 tailed significant values are greater than 5 and 10 per cent level of significance. Hence, it can be concluded that H_3 is rejected in the case of Earning capacity to BPE and accept in the case of earning capacity to EPE.
The table 8.1.1 reveals that there is a positive correlation between the Current Ratio to ROE **(0.191)**, positive relation between Absolute Liquid Ratio to Cost to Income Ratio **(0.964)** and these are statistically significant at 10 per cent and 5 percent levels of significance respectively. The table also reveals no significant relation to other liquidity ratios the Earning Capacity of SBI as the two-tailed significant values of the correlation test are greater than 0.05. Hence, it can be concluded that H_4 is partially supported i.e., there is a significant relation between Liquidity Position and Earning Capacity of SBI during the post-merger period.

9.0 LONG SHORT-TERM MEMORY (LSTM)

Long Short-Term Memory (LSTM) has been used to assess the performance of the State Bank of India. The LSTM technique is especially used in the analysis part in Table 8.1.1.

Figure: 8.1.1: LSTM Results of the Hypothetical Testing Analysis



10.0 FINDINGS

The following are the findings identified from the study:

1. **Capital Adequacy:**
   i. The average of SBI Capital Adequacy Ratio is 13.34 per cent which is more than idle ratio of 12 per cent. The bank is out of danger from bankruptcy.
   ii. The average debt equity ratio is 0.41 or 41 per cent which is lower.
   iii. The average Proprietary Ratio calculated during the study is 0.07 crores.
2. **Asset Quality:**
   i. Investments to Assets ratio is 28.60 crores.
   ii. It is found that Advances to Assets Ratio on an average is 56.61 crores.
   iii. Allowances to loan loss ratio is 0.021. It is identified that CAGR is -6.89 percent.
   iv. Provision for Loan Loss Ratio on an average is 0.024 and its CAGR is -11.65 per cent.

3. **Management Efficiency:**
   i. The Return on Equity accounted 5.03 crores whereas CAGR growth rate -2.30 per cent.
   ii. Business per employee on an average is 1323.13 crores and CAGR calculated is 11.31 per cent.

4. **Earning Capacity:**

   i. The return on equity accounted to 5.03 crores whereas CAGR is -2.30 per cent
   ii. Return on Assets averaged to 0.25 crores, CAGR is -1.7 per cent.
   iii. The average cost income ratio is 53.05 cores. But its CGR is only 1.22 per cent.
   iv. Net Interest Income Ratio arithmetic mean is 2.38 crores during the study period.

5. **Liquidity:**
   i. The Current Ratio during the study period is 2.31:1 and its growth rate is 1.05 per cent.
   ii. Absolute Liquid Ratio average is 1.09 and its CAGR is 4.47 per cent.
   iii. Customer deposits to total assets ratio arithmetic mean is 0.55 crores.
   iv. The advances to deposits ratio average is 0.71 crores, the growth rate is -1.14 per cent.

10.0. SUGGESTIONS

The following are the suggestions represented by the authors:

- ✓ The Capital Adequacy Ratio is 13.34 during the year as against its idle ratio 12 per cent as per RBI. Though, it is out of danger the bank has to improve always the Capital Adequacy Ratio on an average.
- ✓ From a pure a risk perspective, Debt Ratios of 0.4 or lower are considered better, while a debt ratio of 0.60 or higher makes it more difficult to borrow money. While a low debt ratio suggests greater creditworthiness, there is also risk associated with a company carrying too little debt.
- ✓ Return on equity after post-merger started to improve. Anyhow, it has to be improved and return on assets also.
- ✓ Earning per employee is low i.e. 0.86 crores on an average. This has to improve either by decreasing the operating cost or improving the profitability by using some strategies.
- ✓ Return on Equity at the starting year was negative, slowly this has been recovered. Anyhow, the Earning Capacity of the bank has to improve.
- ✓ The current ratio of SBI during the post-merger period is upto the mark, but it is cautious to the banker to improve this ratio.
- ✓ The absolute liquid ratio is just up to the mark, it is alarming the bank to improve the highly liquid assets.

11.0. Conclusion

Merger of State Bank of India gave many challenges to the employees. Previously, that had been mounted losses, but the merger has to give the solution to all the problems. Moreover, this study has given good awareness on the bank's performance during the post-merger period to the bank employees and it is always a challenging task to them.

REFERENCES:

1. Annual Reports, State Bank of India, Mumbai, 2017-18 to 2021-22.
2. Roman, A., &Şargu, A. C. (2013). Analysing the financial soundness of the commercial banks in Romania: an approach based on the camels framework. *Procedia economics and finance*, *6*, 703-712, https://doi.org/10.1016/S2212-5671(13)00192-5.

3. Aspal, P.K., & Dhawan, S. 2016,Camels rating model for evaluating financial performance of banking sector: A theoretical perspective. *International Journal of System Modeling and Simulation*, *1*(3), 10-15.
4. Bansal, R., & Mohanty, A. (2013). A Study on financial performance of commercial banks in India: Application of Camel model. *Al-Barkaat Journal of Finance & Management*, *5*(2), 60-79.
5. Banerjee, P., & Nayak, R. (2024). Recommendations on Financial Models for Stock Price Prediction. *SN Computer Science*, *5*(1), 178.
6. Chaudhuri, (2018), "Performance of SBI and ICICI for a period of five years from 2011-12 to 2015-16 using the CMEL model", vol.8, Issue-1,pp:151-156.
7. Chen, Y., Wu, J., & Wu, Z. (2022). China's commercial bank stock price prediction using a novel K-means-LSTM hybrid approach, *Expert Systems with Applications*, *202*, 117370.
8. Dhokane, R. M., & Agarwal, S. (2024). A Predictive Model of the Stock Market Using the LSTM Algorithm with a Combination of Exponential Moving Average (EMA) and Relative Strength Index (RSI) Indicators. Journal of The Institution of Engineers (India): Series B, 1-13.
9. Jayasree, M., &Shette, R. (2021). Readability of annual reports and operating performance of Indian banking companies. IIM Kozhikode Society & Management Review, 10(1), 20-30.
10. Jauhar, S. K., Raj, P. V. R. P., Kamble, S., Pratap, S., Gupta, S., & Belhadi, A. (2024). A deep learning-based approach for performance assessment and prediction: A case study of pulp and paper industries. Annals of Operations Research, 1-27.
11. Kasturi, R. (2018). Performance analysis of Oman's banking sector using select financial indicators. Journal of Commerce & Accounting Research, 7(4), 31-39.
12. Davanam, Ganesh, T. Pavan Kumar, and M. Sunil Kumar. "Novel Defense Framework for Cross-layer Attacks in Cognitive Radio Networks." International Conference on Intelligent and Smart Computing in Data Analytics: ISCDA 2020. Springer Singapore, 2021.
13. Kasturi, R. (2019), Credit allocation by Indian commercial banks. Journal of Commerce and Accounting Research, 8(1), 1-7.
14. Magoma, A., Mbwambo, H., Sallwa, A., &Mwasha, N. (2022). Financial Performance of Listed Commercial Banks in Tanzania: A CAMEL Model Approach. African Journal of Applied Research, 8(1), 228-239.
15. Majumder, M., Hossain, T., & Rahman, M. M. (2017). A camel model analysis of selected banks in Bangladesh. Mohammed Mizanur, A CAMEL Model Analysis of Selected Banks in Bangladesh (November 9, 2017).
16. Kumar, T. P., & Kumar, M. S. (2021). Optimised Levenshtein centroid cross-layer defence for multi-hop cognitive radio networks. IET Communications, 15(2), 245-256.
17. T. Pavan Kumar, and M. Sunil Kumar. "Efficient energy management for reducing cross layer attacks in cognitive radio networks." Journal of Green Engineering 11 (2021): 1412-1426.
18. Saif-Alyousfi, A. Y., Saha, A., & Md-Rus, R. (2017). Profitability of Saudi commercial banks: A comparative evaluation between domestic and foreign banks using CAMEL parameters. International Journal of Economics and Financial Issues, 7(2), 477-484..
19. Murthy, D. S. (2020), "Operational Efficacy of State Bank of India During Pre-Merger–An Analysis by Using Camel Model, Vol.7, Issue 10, pp:5375-5387.
20. Murthy, D.S., Narasaiah, P.V., & Mohan, B. (2013). Performance of Consumer Forums: An Empirical Study of Kadapa District Consumer Forum. Prabandhan: Indian Journal of Management, 6(2), 40-47.
21. Murthy, D. S., Narasaiah, P. V., & Chavan, R., (2019), Demonetization Effect on Agriculture Sector-Problems and Prospects. International Journal of Recent Technology and Engineering, 8(3), 288-296.
22. Rathnam, N.V. et al., (2015), "Performance Appraisal of SBI – An Analytical Review", Vol. 9 Issue 3, p12-18.
23. Reddy, K.S., (2012), "Relative performance of commercial banks in India using CAMEL approach", International Journal of Multidisciplinary Research, 2(3), 38-58.
24. Sasikala, S., & Sudha, B. (2022). Post-Merger Performance of the State Bank of India: An Analysis. Journal of Education: Rabindra Bharati University ISSN, 0972-7175

25. Kumar, M.K., Kudari, R., Sushama, C., Neelima, P., Ganesh, D.," Efficient Algorithms for Vehicle Plate Detection in Dynamic Environments", Communications on Applied Nonlinear Analysis ISSN: 1074-133X Vol 32 No. 1s (2025),PP: 273-289.
26. Prasad, K.R.,Karanam, S.R., Ganesh, D., Talasila, V., Purushotham, P. "AI in public-private partnership for IT infrastructure development", Journal of High Technology Management Research,2024, 35(1), 100496
27. Kasturi, S.B., Burada, S., Sowmyashree, M.S., Kumar, M.S., Ganesh, D., "An Improved Mathematical Model by Applying Machine Learning Algorithms for Identifying Various Medicinal Plants and Raw Materials", Communications on Applied Nonlinear Analysis,2024, 31(6S), pp. 428–439
28. Varghese, T. (2016). Evaluating performance of a service cooperative bank: An application of CAMEL model. Indian Journal of Finance, 10(3), 7-27.
29. Dr. Srinivasa Babu Kasturi, Sreedhar Burada, Dr. Sowmyashree M.S, Sharath.S, Dr. M.Sunil Kumar,Dr. D. Ganesh, "An Improved Mathematical Model by Applying Machine Learning Algorithms for Identifying Various Medicinal Plants and Raw Materials", Communications on Applied Nonlinear Analysis ISSN: 1074-133X ,Vol 31 No. 6s 2024.
30. B. Sangamithra, Asha K.H, M. Sunil Kumar,""An Improved Information Retrieval System using Hybrid RNN LSTM for Multiple Search Engines", Communications on Applied Nonlinear Analysis ISSN: 1074-133X ,Vol 31 No. 5s 2024.
31. Sreedhar Burada,B.E. Manjunathswamy, M. Sunil Kumar, "Early detection of melanoma skin cancer: A hybrid approach using fuzzy C-means clustering and differential evolution-based convolutional neural network",Measurement: Sensors, Volume 33, June 2024, 101168.
32. M. Sunil KumarJ KumarnathSachin S PundMansing Rathod,""A Secure IoT Smart Network Model for the Contributory Broadcast Encryption for the Text Policy Management Scheme", international Journal of Intelligent Systems and Applications in Engineering IJISAE, 2023, 11(3s), 42–48 2023.
33. Hari Prasad Gandikota ,Abirami. S,Sunil Kumar M, "PLoS ONE 18(11): e0292785. https://doi.org/10.1371/journal.pone.0292785.
34. Hari Prasad Gandikota* | S. Abirami M. Sunil Kumar,""Bottleneck Feature-Based U-Net for Automated Detection and Segmentation of Gastrointestinal Tract Tumors from CT Scans",Traitement du Signal, Vol. 40, No. 6, December, 2023, pp. 2789-2797.
35. Burada, S., Manjunathswamy, B.E. & Kumar, M.S. Deep ensemble model for skin cancer classification with improved feature set. Multimed Tools Appl 84, 7599–7626 (2025). https://doi.org/10.1007/s11042-024-19039-5.
36. E.Ramesh Babu, Dr.M.Sunil Kumar,"The Role of Optimization Techniques in Advancing Big Data Analytics : A Survey", Communications on Applied Nonlinear Analysis ISSN: 1074-133X Vol 32 No. 1s 2025.
37. Meriga Kiran Kumar, Rajeev Kudari, C. Sushama, M. Sunil Kumar, P. Neelima, D. Ganesh, "Efficient Algorithms for Vehicle Plate Detection in Dynamic Environments", Communications on Applied Nonlinear Analysis ISSN: 1074-133X Vol. 32 No. 1s 2025 .
38. Rayavarapu Veeranjaneyulu, V. Sumathi, C. Sushama, Savanam Chandra Sekhar, P. Neelima, M. Sunil Kumar, "Predicting Disasters: A Machine Learning Approach", Communications on Applied Nonlinear Analysis ISSN: 1074-133X Vol. 32 No. 1s 2025.
39. https://en.wikipedia.org/wiki/State_Bank_of_India
40. https://www.occ.treas.gov/publications-and resources/ publications/ economics/ working-papers-banking-perf-reg/pub-econ-working-paper-camels-ratings.pdf
41. https://www.researchgate.net/publication/283854804_CAMELS'_ANALYSIS_IN_BANKING_INDUSTRY
42. https://www.moneycontrol.com/financials/statebankindia/balance-sheetVI/SBI.
43. https://bank.sbi/documents/17826/35696/Annual_Report_2023.pdf