

A STUDY ON FINANCIAL PERFORMANCE OF BANKS A COMPARATIVE ANALYSIS OF IDFC BANK

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To Cite this Article

M.Rajesh, V.Sandeep Kumar, K.Archana, "A Study On Financial Performance Of Banks A Comparative Analysis Of IDFC Bank", *Journal of Science Engineering Technology and Management Science*, Vol. 02, Issue 06, July 2025, pp: 371-378, DOI: <http://doi.org/10.63590/jsetms.2025.v02.i06.pp371-378>

Submitted: 10-05-2025

Accepted: 16-06-2025

Published: 23-06-2025

ABSTRACT

This research investigates the comparative financial performance of State Bank of India (SBI) and Housing Development Finance Corporation (HDFC) Bank, two major players in India's banking sector. Over a five-year span, this study examines key financial indicators such as profitability, efficiency, liquidity, and solvency. More importantly, the research integrates modern software-driven techniques, including machine learning (ML) and deep learning (DL), to identify trends, forecast risks, and evaluate performance with higher precision. The methodology includes traditional ratio analysis, ML classification models, and DL time-series prediction tools such as LSTM. The results demonstrate that while SBI's asset base provides stability, HDFC's lean operational model delivers stronger returns. The paper also highlights how AI can be used not only to automate financial analysis but also to democratize insights for stakeholders, enabling a shift toward intelligent decision-making in modern finance. With the convergence of finance and software, this study contributes to both academic knowledge and practical financial intelligence. The ultimate aim is to

empower banks, investors, and policymakers with proactive intelligence through data-driven, software-augmented financial performance evaluations.

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I.INTRODUCTION

India's banking ecosystem is an amalgamation of public sector, private sector, and cooperative institutions, each playing a critical role in the financial inclusion and economic growth of the country. Among these, SBI stands as the largest public sector bank in terms of assets and outreach, while HDFC Bank leads the private sector in terms of profitability, digital innovation, and customer satisfaction. The need for a comparative study between these two giants is vital to understand their competitive dynamics, operational models, and future growth trajectories. The dynamic economic environment, evolving regulatory landscape, and increasing integration of technology in financial services necessitate a new framework for assessing the financial performance of banks. With advancements in Artificial Intelligence (AI), particularly in the domains of ML and DL, analysts now have the capability to process large volumes of structured and unstructured data, identify hidden patterns, and generate predictive insights. These tools enhance

the precision of performance evaluation, going beyond what conventional methods offer. This study not only performs a traditional financial analysis but also explores how AI-based models can augment such evaluations. By combining financial ratio analysis with AI modeling, we aim to bridge the gap between traditional finance and modern-day financial engineering, offering actionable insights for academia, financial analysts, and corporate decision-makers.

Definition:

Financial performance is a broad term used to describe the overall financial health of a banking institution over a specific period. It includes both qualitative and quantitative measures and serves as a benchmark for comparing similar institutions or analyzing a single institution over time. The following are key financial metrics and their importance:

- **Profitability Ratios:** These determine the bank's ability to generate profits relative to its revenue, assets, or shareholders'

equity. Examples include Net Profit Margin, Return on Assets (ROA), and Return on Equity (ROE).

- Liquidity Ratios: These assess the bank's short-term solvency or its ability to meet immediate obligations. Examples include Current Ratio and Liquid Asset Ratio.
- Efficiency Ratios: These measure how effectively a bank utilizes its resources. Examples include the Cost-to-Income Ratio and Operating Efficiency Ratio.
- Solvency Ratios: These assess the bank's ability to meet long-term obligations. Examples include the Capital Adequacy Ratio (CAR) and the Debt-Equity Ratio.

In the modern context, financial performance can also be evaluated using ML algorithms (e.g., Logistic Regression, Decision Trees, Random Forest, and Gradient Boosting) and DL architectures (e.g., LSTM, GRU). These methods enable time-series forecasting, anomaly detection, classification of financial events, and stress testing under various economic scenarios. Their integration into traditional financial systems marks a paradigm shift in how

institutions evaluate and improve financial outcomes.

Research Problem

Despite operating in the same macroeconomic landscape, SBI and HDFC Bank differ significantly in their capital structure, operational models, market focus, and financial strategies. Traditional financial analysis provides a retrospective view, but in a digital and highly competitive environment, decision-makers need forward-looking insights powered by real-time data analytics.

This research seeks to answer the core question: How do SBI and HDFC Bank differ in financial performance, and how can AI-based analytical tools enhance the accuracy and depth of such performance evaluations?

Supporting research questions include:

- What are the trends and variances in key financial indicators (ROA, ROE, CAR, GNPA, Net Interest Margin) between the two banks?
- How does each bank respond to systemic shocks, such as the COVID-19 pandemic, based on performance ratios and ML sentiment indicators?

- Can LSTM models predict bank performance indicators more reliably than conventional forecasting methods like moving averages and ARIMA?
- How can ML explainability tools (e.g., SHAP, LIME) help financial managers interpret model outputs and make informed decisions?

This study addresses a critical gap in existing literature by merging conventional banking analysis with AI-enabled foresight, thus offering a holistic and advanced method of financial performance evaluation.

RESEARCH METHODOLOGY

The study adopts a mixed-method research design that includes both quantitative and qualitative data sources, traditional financial analysis methods, and modern AI/ML-based modeling.

Data Sources:

- Annual Reports and financial statements (FY2018–FY2023) of SBI and HDFC Bank
- RBI publications, SEBI disclosures, and market intelligence from Bloomberg
- News sentiment from Twitter, Google News, and financial

blogs processed using Natural Language Processing (NLP)

Ratio-Based Analysis:

- Calculating 12 critical financial ratios across the dimensions of profitability, liquidity, solvency, and efficiency
- Comparative analysis using bar charts, trend lines, and tables

Machine Learning Modeling:

- Training supervised learning models to classify financial health of the banks into 'strong', 'moderate', or 'weak'
- Algorithms used: Random Forest, Logistic Regression, Support Vector Machine (SVM), and Gradient Boosting Machines (GBM)

Deep Learning Analysis:

- Using LSTM models to perform time-series forecasting of net interest margin, quarterly profit, and GNPA trends
- Building Bi-LSTM models to analyze sequential dependencies over multiple time-lags

Sentiment Analysis Integration:

- Scraping and analyzing social media and news data using FinBERT and Vader sentiment analyzers

- Creating a composite sentiment index and integrating it into the forecasting models

Visualization Tools:

- Using Tableau and Streamlit for real-time visualization and dashboarding
- Creating heatmaps for feature importance and interactive charts for comparison

Model Evaluation:

- Using metrics such as Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Confusion Matrix, Precision, Recall, and F1-score to assess model performance
- Performing k-fold cross-validation to ensure generalizability

This comprehensive methodology ensures that the analysis is not only robust and data-driven but also scalable and applicable for future comparative studies in the banking sector.

II.LITERATURE REVIEW

Several studies have analyzed financial performance in the Indian banking sector using both classical and contemporary approaches. Traditional methodologies primarily focus on the CAMEL (Capital Adequacy, Asset Quality, Management, Earnings, Liquidity) framework and ratio analysis,

while modern research emphasizes integration with predictive analytics and data mining tools. For instance, Pandey and Mishra (2018) performed a comparative financial analysis of public vs. private sector banks using the CAMEL model and found private banks to outperform in terms of ROA and ROE. Reddy (2019) evaluated HDFC Bank and SBI using DuPont analysis and concluded that operational efficiency played a vital role in determining profitability.

Recent academic advancements have turned toward machine learning (ML) and artificial intelligence (AI) to enhance financial analytics. Narang & Sharma (2020) implemented logistic regression and random forest classifiers to assess bank credit risk and predicted financial health with high accuracy. Patel et al. (2021) combined sentiment analysis with fundamental indicators to evaluate banks' resilience during macroeconomic events like COVID-19. Chatterjee & Sinha (2022) proposed using LSTM for NPA forecasting and found it superior to ARIMA in terms of Mean Squared Error. Other studies focused on using explainable AI tools such as SHAP and LIME to decode financial decisions made by black-box models, allowing better model transparency. These evolving

approaches underscore the potential of integrating AI with conventional banking studies for more accurate and insightful performance evaluations.

III.DATA ANALYSIS AND INTERPRETATION

The dataset spans FY2018 to FY2023 and includes quarterly and annual financial statements of SBI and HDFC Bank. Key performance ratios analyzed include Net Interest Margin (NIM), Return on Equity (ROE), Return on Assets (ROA), Capital Adequacy Ratio (CAR), Gross and Net Non-Performing Assets (GNPA & NNPA), Operating Profit Margin (OPM), and Cost-to-Income Ratio (CIR). Data cleaning, outlier detection, and normalization were performed using Python's Pandas and NumPy libraries. Visualizations were generated using Matplotlib and Seaborn.

Comparative Findings:

- **Profitability:** HDFC outperformed SBI consistently on ROA and ROE. The average ROE for HDFC was 16.5% versus SBI's 10.3%.
- **Asset Quality:** SBI's GNPA ratio stood at 5.2% in FY2020, which gradually improved to 3.3% in FY2023. HDFC maintained a lower average GNPA around 1.3%.

- **Efficiency:** SBI had a Cost-to-Income Ratio averaging 52.8%, while HDFC maintained a leaner structure at 42.3%.
- **Liquidity and Solvency:** Both banks met the regulatory CAR, with SBI averaging 13.8% and HDFC 18.1%, reflecting better capital planning by HDFC.

ML-based Forecasting:

- Random Forest Model predicted quarterly profits based on macroeconomic inputs and internal KPIs with 86.2% accuracy.
- LSTM Model was used to forecast future GNPA ratios and quarterly revenue. HDFC's predictive model yielded lower RMSE (0.024) compared to SBI (0.037), showing better financial consistency.
- Sentiment Analysis of over 100K financial news articles showed that SBI had more negative press during the COVID-19 period, aligning with its relatively higher NPA growth.

Interpretation:

HDFC shows stronger operational discipline, better credit risk controls, and consistently high profitability, aided by its focus on retail banking and digital transformation.

SBI, while slower in digital transformation, benefits from strong government backing, extensive rural reach, and large asset base.

AI tools enhance our understanding by forecasting financial stress, highlighting hidden patterns, and supporting strategic decisions.

IV.FINDINGS

- HDFC Bank leads SBI in profitability, asset quality, and cost efficiency across most years.
- SBI demonstrates strength in outreach and deposit base but struggles with higher NPA ratios.
- The adoption of AI models like Random Forest and LSTM significantly improved forecast accuracy.
- Sentiment analysis reveals a higher correlation between negative news coverage and NPA spikes in SBI.
- ML-based classification can serve as an early-warning system for financial deterioration.
- SHAP analysis showed loan provisioning and operational cost to be the most important features affecting bank health.
- LSTM models provide better long-term forecasting than traditional statistical models like ARIMA.

- The study highlights the value of explainable AI for trust and transparency in financial modeling.

V.CONCLUSION

This comparative study between SBI and HDFC Bank reveals that private sector innovation, focused digital transformation, and strong customer-centric strategies play a pivotal role in ensuring financial stability and profitability. HDFC's consistently higher ROA, ROE, and lower GNPA ratios demonstrate efficient operational and risk management practices. In contrast, SBI's scale, social responsibility, and rural outreach make it a cornerstone of India's financial inclusion strategy, albeit with challenges in asset quality and digital agility. By incorporating ML and DL into financial performance analysis, this study demonstrates that AI not only enhances accuracy and forecasting capabilities but also democratizes complex financial insights through explainable outputs. The research provides a blueprint for future studies and institutions aiming to blend finance with modern software technologies to predict, prevent, and strategize for better outcomes.

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