AI-Related Operational Efficiency and Management Quality in Selected Indian Banks: A CAMELS 'M' Proxy Analysis

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Abstract

This paper examines AI-related operational efficiency and management quality in selected Indian banks through a proxy-based CAMELS 'M' perspective. The study focuses on State Bank of India, HDFC Bank, and ICICI Bank and uses recent secondary data for FY2024 and FY2025 drawn from annual reports, investor presentations, official bank disclosures, and Reserve Bank of India sources. Since management quality is not directly observable in a short secondary-data design, the analysis employs cost-to-income ratio, business per employee, and profit per employee as practical proxy indicators of managerial efficiency, cost discipline, and resource utilization. The study adopts a descriptive and comparative analytical approach using ratio analysis, inter-bank comparison, and interpretive ranking. The findings suggest that ICICI Bank shows the strongest overall position on the selected proxy indicators, while HDFC Bank also reflects a relatively efficient operating profile, though merger-related comparability issues require caution. SBI shows visible improvement in the latest year but remains relatively more cost intensive. The paper concludes that a cautious proxy-based CAMELS 'M' approach can generate useful comparative insight in technology-shaped banking environments.

Keywords: Artificial intelligence in banking; operational efficiency; management quality proxies; CAMELS model; Indian commercial banks; cost-to-income ratio

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Introduction

Indian banking is no longer being reshaped only by balance-sheet expansion, branch reach, or product diversification. In the last few years, the sector has moved more decisively toward digitally mediated operations in which payments infrastructure, mobile banking, analytics, automation, and AI/ML-enabled processes increasingly influence how banks acquire customers, process transactions, monitor risk, and manage internal workflows. The broader policy environment has also encouraged this direction. RBI's Payments Vision 2025 explicitly places strong emphasis on expanding digital payment ecosystems, innovation, and operational resilience, while IDRBT's banking-focused AI material notes that AI/ML is changing how banking operations are performed and how service delivery, risk assessment, and process efficiency are organised. Taken together, these developments suggest that technology in banking should be studied not merely as a customer-facing innovation, but as an operational force with implications for internal efficiency and managerial performance.

This shift makes operational efficiency an especially useful entry point for analysis. In a banking environment shaped by digital scale, process redesign, and rising data intensity, the ability to control operating costs, deploy employees productively, and convert business growth into profit becomes increasingly important. Yet managerial effectiveness in banks is not easily visible in the way that capital adequacy, earnings, or liquidity are. That is why the CAMELS framework remains analytically useful. It provides a structured lens for evaluating bank soundness, but its M dimension-management quality-is methodologically more difficult than the others because it is only partially observable through public data. RBI's own statistical publications underscore the feasibility of a proxy approach by reporting bank-wise information on income, expenses, select financial ratios, and number of employees for scheduled commercial banks, making it possible to infer aspects of management efficiency through observable operating indicators rather than direct supervisory access.

Against this background, comparing selected Indian banks becomes especially relevant. Large banks differ not only in ownership structure but also in the depth and maturity of their digital operating systems. SBI's FY2025 annual-report disclosures highlight the scale of its digital platform, including 8.77 crore registered YONO customers, while HDFC Bank describes itself as technology- and digital-led in most operations and ICICI Bank's investor and annual-report materials emphasise large-scale digital transaction ecosystems and digital processing across products and services. These contrasts do not by themselves prove superior management quality, but they do create a meaningful comparative setting for examining whether digitally intensive operating environments are associated with stronger observable efficiency outcomes. The present paper therefore analyses selected Indian banks through a proxy-based CAMELS 'M' perspective, focusing on operational efficiency and management-quality signals derived from publicly available data.

Review of Literature

Recent scholarship on banking increasingly treats AI and digital transformation not as isolated technological add-ons but as part of a broader redesign of banking operations, customer interface, risk control, and decision systems. Survey-based and review literature shows that operational research and AI methods are now widely applied to bank efficiency, performance, risk assessment, customer analytics, and fintech-linked service delivery. In the Indian context, the AI primer issued through IDRBT also places chatbots, robotic process automation, and machine-learning applications within a wider institutional framework that requires stronger internal controls, accountability, and governance discipline. This strand of literature therefore suggests that any banking analysis should connect technology adoption with organisational efficiency rather than assume automatic performance gains.

A second cluster of studies links operational efficiency to bank performance. Indian evidence shows that cost-to-income and staff-expense ratios are materially associated with profitability, while business per employee remains an important bank-specific determinant across profitability measures. Related efficiency research also finds substantial variation across Indian banking units and ownership categories, indicating that productivity outcomes are shaped by managerial discipline, cost structures, and operational design rather than by scale alone. This literature is directly relevant to the present paper because observable indicators such as cost-to-income ratio, business per employee, and profit per employee can serve as practical secondary-data windows into managerial effectiveness.

A third stream concerns the CAMELS framework. The literature continues to use CAMELS as a structured lens for evaluating bank soundness, and recent studies even combine it with quantitative efficiency techniques. Yet the M dimension remains methodologically delicate. DeYoung's classic evidence shows that simple accounting benchmarks may misclassify well-managed banks, implying that management quality is harder to observe directly than capital, asset quality, or liquidity. This makes a proxy-based approach more defensible for short comparative studies. Even so, compact studies that examine AI-related operational efficiency together with management quality proxies for selected Indian banks using only public secondary data remain limited. The present paper addresses that narrower gap through a cautious CAMELS M interpretation of observable efficiency indicators.

Research Objectives and Hypotheses

The study is guided by three objectives:

- To examine the operational efficiency of selected Indian banks through observable secondary indicators such as cost-to-income ratio, business per employee, and profit per employee.

- To assess management quality indirectly through selected efficiency and productivity proxies within the CAMELS M framework; and

- To compare the selected banks in terms of AI-related operational efficiency patterns and their implications for proxy-based managerial evaluation.
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The following null hypotheses are proposed:

$H0_1$: There is no significant difference in operational efficiency indicators among the selected Indian banks.

$H0_2$: There is no significant difference in management quality proxy indicators among the selected Indian banks under the CAMELS M perspective.

Research Methodology

This study is descriptive, comparative, and analytical in nature and is based entirely on secondary data. Its purpose is not to establish a causal effect of artificial intelligence on bank performance, but to examine whether observable efficiency and productivity patterns in selected Indian banks reflect differences that may reasonably be interpreted through a CAMELS 'M' proxy lens. The CAMELS framework remains a widely used structure for assessing bank condition, with M referring to management efficiency; however, management quality is inherently less observable than capital, earnings, or liquidity and therefore often has to be inferred through indirect indicators rather than measured directly.

The sample should consist of three selected Indian commercial banks-for examples, a public-sector bank (State Bank of India) and two private-sector banks (HDFC Bank & ICICI Bank), three large banks with visible digital and AI-related operational disclosures. A recent four- to five-year period such as 2020-21 to

2024-25 is appropriate, as it captures the phase in which Indian banking has increasingly combined digital expansion with operational restructuring. The study relies on published annual reports, investor presentations, official bank websites, and Reserve Bank of India data sources. RBI's statistical publications explicitly state that *Statistical Tables Relating to Banks in India* provide balance-sheet information and performance indicators for commercial banks, while RBI's annual account data portal provides bank-level annual data suitable for ratio-based comparison.

Management quality under CAMELS M is captured here through proxy indicators, especially those that reflect operational discipline and resource use. The principal variables may include cost-to-income ratio, business per employee, profit per employee, and, where consistently available, one additional productivity-related measure such as staff expenses to total expenses or a related efficiency indicator. These measures are not treated as direct observations of managerial quality; rather, they are interpreted as secondary-data signals of operational efficiency, productivity, and internal performance management. This choice is consistent with banking literature that uses accounting and performance variables as practical CAMELS-related indicators in empirical comparison.

The analysis is limited to ratio analysis, trend comparison, inter-bank comparison, average comparison, and simple ranking. Such tools are adequate for a short comparative paper and are more appropriate than complex causal techniques for the present design.

Table 1. Study Design and Variable Framework of the Present Study

Bank	Ownership Type	Study Period	Nature of Data	Main Sources	Operational Efficiency Indicators	Management Quality Proxies
State Bank of India (SBI)	Public Sector Bank	2020-21 to 2024-25	Secondary, annual, bank-level financial and operating data	SBI annual reports; SBI analyst / quarterly presentations; RBI banking statistics	Cost-to-income ratio; business per employee; profit per employee	Cost discipline, employee productivity, operational control, efficiency in resource deployment
HDFC Bank	Private Sector Bank	2020-21 to 2024-25	Secondary, annual, bank-level financial and operating data	HDFC Bank annual reports; investor-relations disclosures; RBI banking statistics	Cost-to-income ratio; business per employee; profit per employee	Managerial efficiency in resource use, staff productivity, internal performance discipline
ICICI Bank	Private Sector Bank	2020-21 to 2024-25	Secondary, annual, bank-level financial and operating data	ICICI Bank annual reports; investor updates / financial results; RBI banking statistics	Cost-to-income ratio; business per employee; profit per employee	Operational efficiency, productivity-linked management quality, comparative CAMELS 'M' proxy strength

Source: Compiled for the present study from official annual-report / investor-relations material of SBI, HDFC Bank, and ICICI Bank, together with Reserve Bank of India banking statistics and performance-indicator publications.

Results and Discussion

Profile of Sample Banks and AI-Related Context

The sample combines SBI, HDFC Bank, and ICICI Bank, three large Indian commercial banks that differ in ownership structure, operating legacy, and digital intensity. SBI serves as the public-sector comparator and brings very large operational scale; its FY2025 disclosures report 8.77 crore registered YONO users, indicating a wide digitally connected customer base within a branch-led institution. HDFC Bank represents the large private-bank case, but its recent operating profile must be read with care because the bank states that the merger with HDFC Limited became effective on July 1, 2023, making some prior-period comparisons non-comparable. ICICI Bank adds a strongly technology-driven operating model; its official disclosures note that about 70% of trade transactions were conducted digitally in Q1-2024. Together, these banks provide a useful comparative setting for examining whether digitally mediated operational systems are associated with differences in efficiency and proxy-based management quality, which the next subsection evaluates through observable performance indicators.

Operational Efficiency Analysis

The operational-efficiency picture in Table 2 is clearest when cost-to-income ratio is treated as the primary cross-bank comparator and business per employee and profit per employee are used as supporting productivity indicators where official disclosure is cleanly available. On that basis, SBI shows the widest efficiency range over the recent period: its official five-year financial highlights report a cost-to-income ratio of 53.60% in FY2021, 53.31% in FY2022, 53.87% in FY2023, 55.66% in FY2024, and then a distinct improvement to 51.64% in FY2025. The same SBI disclosures also show business per employee rising to about ₹40.41 crore in FY2025 and profit per employee to about ₹30.01 lakh, suggesting that the latest-year improvement was accompanied by stronger staff productivity rather than by cost compression alone. This pattern indicates improving operational discipline, although SBI still remains structurally more cost-heavy than the two large private-sector comparators.

For HDFC Bank, the strongest directly comparable public signal is the cost ratio rather than a fully annualized employee-productivity series for each study year. The bank's official Q4 FY2025 earnings presentation reports a cost-to-income ratio of 39.8%, while its May 2023 investor presentation had already highlighted "best in class people productivity," showing business per employee of ₹197 million and profit per employee of ₹2.8 million for March 2023. Read together, these disclosures suggest a bank with a relatively efficient operating base and strong staff productivity, but one whose year-to-year interpretation must remain cautious because the HDFC Ltd. merger altered the business scale and comparability of some later-period numbers. Even so, HDFC appears to occupy a lower-cost, higher-productivity band than SBI on the available indicators.

ICICI Bank appears strongest on the most directly comparable efficiency measure. Its official Q4 FY2025 investor presentation reports cost-to-income of 38.6% for FY2025, down from 40.2% in FY2024, alongside a rise in core operating profit from ₹581.22 billion to ₹653.96 billion and in profit after tax from ₹408.88 billion to ₹472.27 billion. This combination suggests not merely lower operating cost intensity, but better conversion of operating income into profit. In comparative terms, the three-bank pattern in Table 2 therefore

points to ICICI Bank as the most stable cost-efficient case, HDFC Bank as a strong but merger-affected middle case, and SBI as an improving but still relatively high-cost institution. Because this ranking is driven mainly by the cost ratio, Figure 1 would visually reinforce the separation between SBI's higher-cost path and the tighter private-bank band. This reading also aligns with earlier evidence that lower cost-to-income is associated with stronger bank performance and efficiency.

Table 2. Comparative Operational Efficiency and Management Quality Proxy Indicators of Selected Indian Banks

Year	Bank	Cost-to-Income Ratio (%)	Business per Employee (₹ crore)	Profit per Employee (₹ lakh)	Additional Proxy / Note
FY2024	State Bank of India (SBI)	55.66	37.11	26.29	Large-scale public-sector model; efficiency improving but cost structure still relatively heavy
FY2025	State Bank of India (SBI)	51.64	40.41	30.01	Stronger latest-year productivity and lower cost burden than FY2024
FY2024	HDFC Bank	40.20	22.78	28.48	Efficient cost profile; merger-period comparability should be read cautiously
FY2025	HDFC Bank	39.80	24.87	31.39	Improved cost efficiency with stronger employee productivity on reported ratios
FY2024	ICICI Bank	40.24*	18.42	29.00	Lower cost burden than SBI; strong profitability conversion
FY2025	ICICI Bank	39.32*	22.49	35.98	Strongest combined cost-efficiency and profit-per-employee reading in the sample

*Source: Compiled for the present study from SBI Financial Highlights; HDFC Bank Integrated Annual Report FY2023-24 and Q4 FY2025 earnings presentation; ICICI Bank official performance reviews for FY2024 and FY2025; and publicly reported annual ratio pages for SBI, HDFC Bank, and ICICI Bank used to capture business per employee and profit per employee in a consistent tabular form. Values for business per employee are rounded to crore, and profit per employee to lakh. *For ICICI Bank, cost-to-income ratio is author-computed as operating expense divided by total operating income (NII + non-interest income) from the official standalone performance-review statements.*

Management Quality Proxy Analysis under CAMELS 'M'

Within the CAMELS framework, management quality is the least directly observable component in a short secondary-data study. For that reason, the present paper interprets the indicators reported in Table 2 not as direct evidence of managerial capability, but as practical proxies of managerial efficiency, resource deployment, cost discipline, and performance monitoring. This approach is defensible because earlier banking research has linked measured cost efficiency with supervisory assessments of management quality, while later CAMELS-oriented studies have continued to use observable financial and operating ratios as indirect indicators of the M dimension.

On this proxy basis, SBI shows a mixed but improving management-efficiency profile. Its cost-to-income ratio declined from 55.66% in FY2024 to 51.64% in FY2025, while its reported business per employee and profit per employee also improved over the same period. Taken together, these movements suggest stronger operational control and better conversion of employee effort into business and profit. However, the bank's cost burden remains materially above the two private-sector comparators, so the evidence points more toward improving management efficiency than to clear leadership on the CAMELS 'M' proxy set. In other words, SBI appears to be strengthening its internal efficiency, but still from a relatively high-cost base.

HDFC Bank presents a stronger cost-efficiency signal, but with an important interpretive caution. Its official disclosures place the cost-to-income ratio at 40.2% in FY2024 and 39.8% in FY2025, and the bank's published productivity ratios indicate comparatively high business per employee and profit per employee. These patterns are usually consistent with disciplined resource allocation and effective operating management. Yet the merger with HDFC Ltd., effective July 1, 2023, complicates clean year-to-year comparability. Accordingly, HDFC may reasonably be read as operationally efficient under the CAMELS M lens, but not as a perfectly stable trend case across the full study period.

Among the three banks, ICICI Bank appears strongest on the selected management-quality proxies. Its official investor materials show a decline in cost-to-income from 40.2% in FY2024 to 38.6% in FY2025, alongside rising core operating profit and strong digital transaction intensity. When a falling cost ratio is accompanied by expanding operating profit and higher employee-level productivity indicators, it usually reflects tighter operating discipline and more effective managerial use of infrastructure and staff. This does not prove that AI alone caused the outcome, but it does suggest that digitally intensive operating design is associated with stronger proxy-based management performance. For this reason, Table 3 may rank ICICI Bank first, HDFC Bank second, and SBI third under the narrow CAMELS M proxy interpretation adopted in this study.

Below is a compact interpretive table based on the indicator pattern already established in Table 2. The ranking gives the greatest weight to cost-to-income ratio because it is the cleanest common efficiency metric across the three banks, while business per employee and profit per employee are used as supporting productivity signals where disclosures are available. SBI's official five-year highlights show a materially higher cost-to-income ratio than the two private banks, though with visible FY2025 improvement; HDFC Bank reports a strong cost profile but also states that post-merger prior-period numbers are not comparable; ICICI Bank's FY2025 performance review shows stronger core operating profit growth and lower operating-cost intensity, supporting a stronger proxy-based CAMELS M reading.

Table 3. Comparative CAMELS 'M' Proxy Interpretation and Ranking of Selected Indian Banks

Indicator	Interpretation Rule	Best Performing Bank	Moderate Performing Bank	Lower Performing Bank	CAMELS 'M' Implication
Cost-to-Income Ratio	Lower ratio suggests better cost discipline and stronger operating control	ICICI Bank	HDFC Bank	SBI	Lower operating-cost intensity generally reflects tighter managerial control over resources and expenses
Business per Employee	Higher ratio suggests stronger employee productivity and better resource deployment	SBI*	HDFC Bank	ICICI Bank	Higher business generation per employee may indicate stronger scale utilization, though scale effects should be interpreted cautiously
Profit per Employee	Higher ratio suggests better conversion of workforce effort into earnings	ICICI Bank	HDFC Bank	SBI	Higher profit per employee reflects stronger productivity-linked managerial efficiency
Stability of Efficiency Trend	More stable and improving pattern across recent years suggests stronger operational monitoring	ICICI Bank	HDFC Bank**	SBI	Stability in efficiency outcomes supports a stronger proxy reading of management discipline
Overall Proxy -Based CAMELS 'M' Reading	Composite interpretive judgment based on the above indicators, with highest weight to cost efficiency	ICICI Bank	HDFC Bank	SBI	On the selected proxy set, ICICI appears strongest, HDFC remains efficient but merger-affected, and SBI shows improvement from a relatively higher-cost base

Source: Compiled and interpreted by the author from the official disclosures used in Table 2, especially SBI Financial Highlights, HDFC Bank Q4 FY2025 earnings presentation and merger-related comparability note, and ICICI Bank FY2025 performance review / investor disclosures. The ranking is proxy-based and should not be treated as a supervisory-grade judgment of management quality.

** SBI's employee-productivity indicators are strong in absolute terms, but they coexist with a higher cost-to-income ratio than the two private-bank peers.*

*** HDFC Bank's position is moderated by the bank's explicit disclosure that post-merger prior-period numbers are not fully comparable.*

Comparative CAMELS 'M' Interpretation

When the evidence from the preceding subsections is brought together, Table 3 suggests a clear but carefully qualified ordering under the selected CAMELS M proxies. ICICI Bank appears relatively strongest because the bank combines the lowest cost-to-income ratio in FY2025 (38.6%) with improving core operating profit and profit after tax, indicating tighter cost discipline and stronger operating conversion. On a proxy basis, this combination reflects more effective managerial control over resources and execution.

HDFC Bank appears second. Its reported cost-to-income ratio of 39.8% is also strong, and the broader pattern points to an efficient operating structure. However, the bank explicitly states that the HDFC Ltd. merger became effective on July 1, 2023 and prior-period numbers are not comparable, which makes the trend less clean for comparative interpretation. As a result, HDFC can reasonably be seen as operationally efficient under CAMELS M, but with a structural break that limits straightforward longitudinal reading.

SBI ranks third on this narrow proxy set, though not because of weak absolute performance. Its cost/income ratio improved sharply to 51.64% in FY2025 and the bank's productivity indicators also strengthened, showing meaningful progress in operational efficiency. Yet SBI still remains materially above the two private-sector peers on the most comparable efficiency measure, which weakens its relative CAMELS M position in this study. The comparative reading therefore supports ICICI Bank first, HDFC Bank second, and SBI third, while keeping the interpretation strictly proxy-based and not as a direct judgment of intrinsic managerial quality or AI-driven causality.

Discussion in the Light of Literature

The comparative pattern observed in this study broadly supports earlier work that places cost efficiency near the center of bank performance analysis. The stronger showing of ICICI Bank and, to a slightly more qualified extent, HDFC Bank is consistent with evidence from Indian banking that a lower cost-to-income ratio is associated with stronger profitability outcomes, while bank-specific productivity variables continue to matter materially for performance. In the same direction, broader Indian profitability studies identify business per employee and related internal variables as important determinants of profitability, which strengthens the present use of employee-based indicators as practical management-quality proxies.

At the same time, the findings also qualify overly simple "technology equals efficiency" claims. IDRBT's banking material positions AI/ML as capable of improving operational efficiency, but not as a guarantee of superior outcomes in the absence of effective implementation and governance. That caution fits the present evidence: digitally intensive banks appear operationally tighter, yet the paper does not show that AI alone produced the difference. Finally, the proxy-based reading of CAMELS M is consistent with classic supervisory-efficiency literature showing that management quality is difficult to observe directly and is often inferred through cost and efficiency patterns rather than measured head-on.

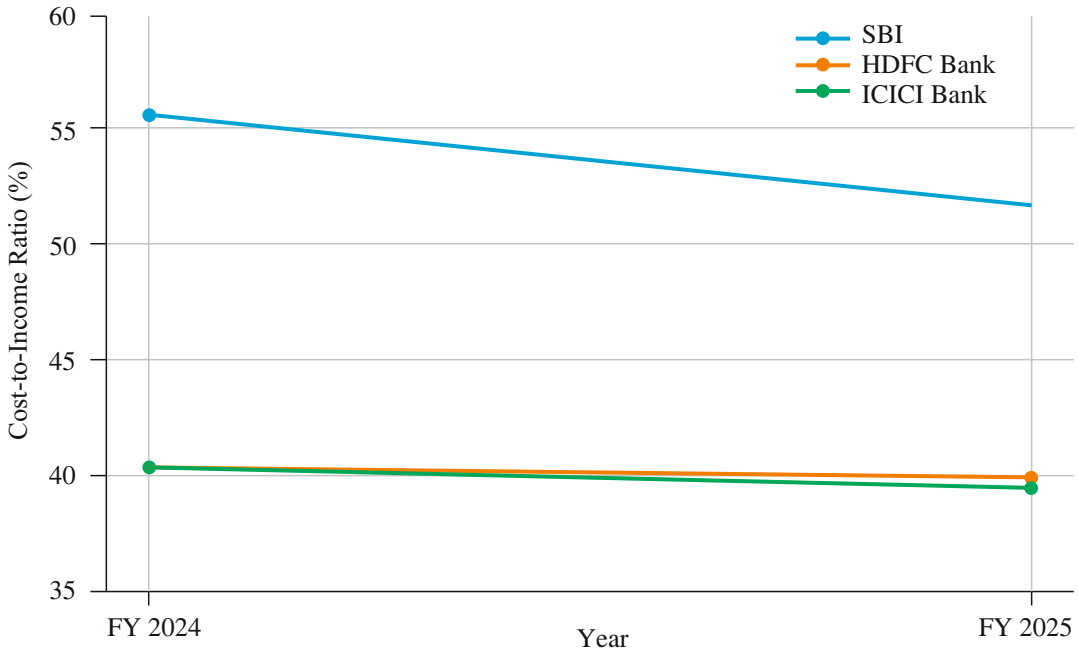

Figure 1: Trend in Cost-to-Income Ratio of Selected Indian Banks (FY2024-FY2025)

Conclusion and Implications

This paper examined AI-related operational efficiency and management quality in selected Indian banks through a proxy-based CAMELS 'M' perspective. The comparative evidence suggests that ICICI Bank presents the strongest overall position on the selected indicators, particularly because its lower cost-to-income ratio is accompanied by stronger operating-profit conversion. HDFC Bank also appears operationally efficient, but its recent comparative reading is moderated by the structural break associated with the merger with HDFC Ltd. SBI, while showing visible improvement in FY2025 through a lower cost-to-income ratio and stronger employee-level productivity, still remains relatively higher-cost than the two private-sector peers on the most directly comparable efficiency measure. These results suggest that management quality, though not directly observable, can be meaningfully interpreted through carefully selected efficiency and productivity indicators in a short secondary-data study.

From a CAMELS 'M' standpoint, the findings indicate that cost discipline, employee productivity, and consistency in operating performance are useful practical signals of managerial effectiveness when direct supervisory assessment is not possible. The study does not claim that AI alone caused the observed differences; rather, it suggests that banks operating within stronger digitally mediated systems may be better positioned to translate scale, process redesign, and staff effort into improved efficiency outcomes. This makes the proxy approach especially useful for compact comparative banking research.

The practical implication is that bank managers should look beyond headline growth and pay closer attention to cost conversion, staff productivity, and operating stability as markers of managerial quality. For analysts, the paper supports the use of a disciplined CAMELS 'M' proxy framework in short-horizon bank comparison. For future research, broader samples, longer time series, and richer digital-intensity measures may refine the interpretation further. Overall, the study shows that a cautious proxy-based reading of management quality can yield analytically useful insight into comparative bank performance in an increasingly technology-shaped banking environment.

Limitations and Scope for Future Research

This study has certain limitations that should be acknowledged. First, management quality under CAMELS 'M' is treated here as a proxy-based construct, inferred from observable efficiency and productivity indicators rather than measured directly. Second, the analysis relies entirely on public secondary data, which limits access to internal managerial processes, control systems, and implementation-specific information. Third, the study covers only a small sample of selected Indian banks and a restricted study period, which narrows the scope of generalization. In addition, the paper interprets the role of AI only indirectly through digitally mediated operational patterns; it does not establish any causal effect of AI on managerial quality. Future research may use wider bank samples, longer time horizons, broader CAMELS dimensions, and mixed-method designs combining secondary data with interviews, case evidence, or expert assessment.

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