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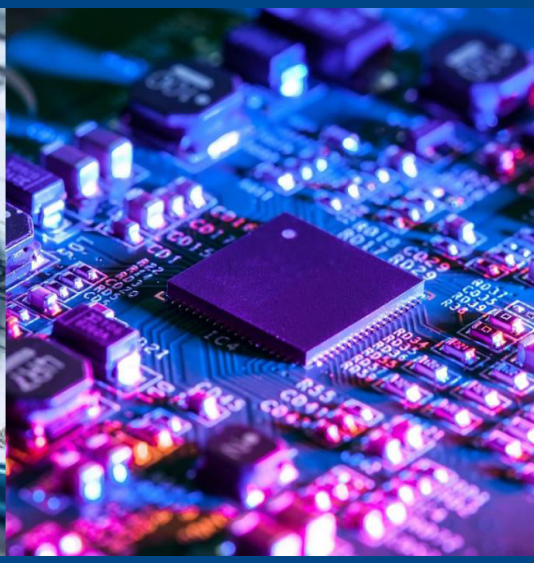

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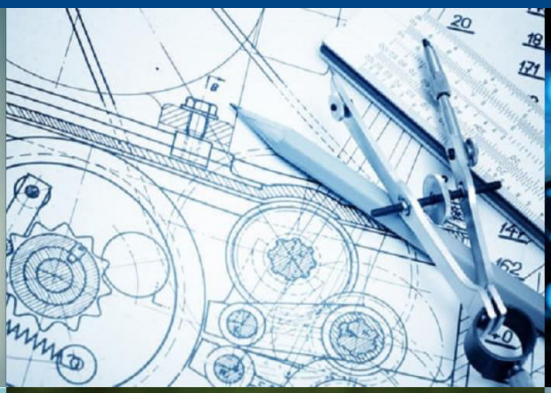

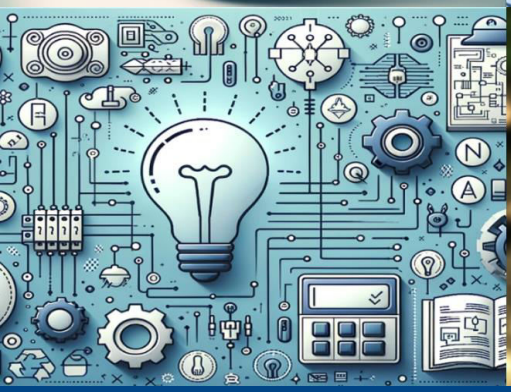

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Evaluating Cost Efficiency of Indian Banks Using Data Analysis Techniques: Evidence from Secondary Financial Data (2011–2021)

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ABSTRACT: This research examines the cost efficiency of the different types/categories (6 types) of Indian banks — 1) Public Sector, 2) New Private Sector, 3) Old Private Sector, 4) Foreign, 5) Small Finance, and 6) Payments Banks — during the years 2011 to 2021, with a panel dataset consisting of 999 observations of bank/year from 137 Scheduled Commercial Banks. Through the use of financial ratios (including the financial ratios collected), one-way ANOVA (with Tukey's HSD post-hoc test) for the costs associated with operating banks, and applying Ordinary Least Squares (OLS) regressions, the costs associated with the cost efficiency (temporal and structural aspects) can be evaluated. The results of the study indicate that there are large differences across ownership categories (including their operating expenditures), with Public Sector Banks having the lowest expense-to-total asset ratio as compared to other ownership categories (e.g., Payments Banks). The greatest contributor to the decrease in profitability for all ownership categories was the provision of non-performing asset provisioning, which would be a major cause of declining profitability. There were also statistically significant negative scale efficiency impacts on the cost of non-functional banks. Through the temporal analysis of the cost efficiency of all Indian banks, it was found that for most of the period from 2011 to 2021, the aggregate cost efficiency was stable; however, the costs of providing non-performing assets were greatly impacted during the 2020-2021 period. The results of this research will advance the current empirical research on banking efficiency in developing economies and provide practical recommendations for nightly banks, regulators, and/or bank management.

KEYWORDS: cost efficiency, Indian banks, operating expenditure, ANOVA, OLS regression, panel data, NPA, bank ownership.

I. INTRODUCTION

The Indian banking industry is suited into the base of the economic structure of the country as it is the main channel of allocation of capital, financial intermediation, and passing of monetary policy. The Indian banking environment is among the structurally most diversified banking environments of major emerging market economies, given that it has a network of public sector banks, private commercial banks, foreign banks, cooperative institutions, small finance banks, and the relatively new payments banks. By the time of the study period which was between 2011 and 2021, the sector had over several hundred trillion rupees of assets and this helped to drive the provision of credit to households, businesses and even government programs.

Banking efficiency is not just a question of operation; it is a question of system. Ineffective banks create direct costs to the borrowers through high lending spreads, limit access to credit to productive sectors and also lead to financial weakness through poor capital buffers. Cost efficiency -the capacity to earn money with the lowest possible level of operational spending - is of specific importance in a competitive, liberalising world where margins are becoming narrower and digital disruption is raising the rate of structural change. Here, the review of the cost structure management of the Indian banks is an opportune and a resultant study.

The main aim of the thesis is to assess the cost effectiveness of Indian banks based on the secondary financial information based on the application of systematic data analysis method. To be more precise, the study aims at: (i) calculating and comparing cost performance ratios within six bank categories between 2011 and 2021; (ii) tracing the change in cost performance across the sector and each of the six institutional types; (iii) evaluating the correlation of cost effectiveness and the following financial variables total income, profitability, total assets, and credit deployment; and (iv) making

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policy-relevant conclusions concerning the determinants of cost efficiency differentials within Indian banking system. The data used in this research is a balanced and unbalanced panel data based on secondary sources consisting of 999 observations on 137 banks over the course of eleven years. Such variables are interest income, other income, total income, interest expenditure, wages and salaries, rent, depreciation, advertising, operating expenditure, provisions, net interest income, profit, investments, total advances, total assets, capital, reserves, total deposits, borrowings and some derived ratios. This broadness of financial data allows conducting a multi-dimensional analysis of cost dynamics beyond ratio analysis.

II. LITERATURE REVIEW

The academic interest in the efficiency of banks dates back to **Farrell** (1957), who developed a groundbreaking model that decomposed aggregate economic efficiency to both its technical and allocative elements. This theoretical framework spawned decades of methodological evolution, leading to parametric and non- parametric frontier models that have since been popularly used to banking institutions the world over. To the extent of foundational research, the research that is more specifically Indian banking and the newer institutional category of research.

One of the most significant additions to the cross-country body of knowledge on bank efficiency was made by **Berger and Humphrey** (1997) who reviewed 130 studies conducted in

21 countries. They analysed that banks in developed economies generally worked at approximately 80 per cent cost efficiency, and left a non- trivial amount of slack. Although they claimed that front-based method was more appropriate to benchmarking than the plain financial ratio, they did not reject the latter, which were useful in the intra-industry comparison. The analytical orientation condition of the current research was informed by the tripartite division of efficiency in terms of cost, profit and technical which consequently came out of their work.

In the Indian banking sector, **Bhattacharyya, Lovell and Sahay** (1997) came up with one of the first DEA-based evaluations, which discovered that the public sector banks were more technically efficient than the foreign or private banks over the first years of liberalisation. They explained this by the scale benefits of the state-owned sector. Nevertheless, Das and Ghosh (2006) re-examined this question on a more up-to-date dataset and discovered that scale efficiency, rather than technical efficiency, made the gains in technical efficiency in Indian banks as the banks underwent the consolidation and recapitalisation policies of the 1990s.

Sensarma (2006) used Indian bank data under SFA and found that there was a significant cost inefficiency and estimated that the average cost efficiency of Indian commercial banks was around 74 per cent over the 1986-2003 period, with the performance of the Indian private banking being better than that of the Indian public ones once the output mix and input prices were held constant. Similar results were reported by **Mohan and Ray** (2004) who recorded that the new private sector banks proved to be more efficient in terms of profits as compared to the

public sector banks, and this was in line with the competitive forces brought about by the liberalisation after 1991.
In the study by **Kumar and Gulati** (2008), DEA was used to determine the technical efficiency of 27 state banks in India and continuously large banks like state bank of India and Bank of Baroda were in the top half of the table indicating that small nationalised banks were incurring constant inefficiencies which could be attributed to overstaffing and underutilisation of their branch network. They advocated consolidations of poorly performing state-owned banks as an efficiency response and this was implemented at least in part over the next ten years.

Turning to the case of the private sector banks, **Chatterjee and Sinha** (2011) indicated that old Indian private sector in terms of structural costs was disadvantaged compared to their new counterparts, which revealed the differences in the technology adoption, human capital quality and the sophistication of the product portfolio. The new types of private banks, as they enjoyed the green field establishment and contemporary core banking facilities, reported low cost to income ratios and the trend was supported by the descriptive statistics in the current data set which indicated the old types of the private banks had mean cost efficiency ratio of 0.22 as compared to 0.23 in the new types of the bank.

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III. RESEARCH DESIGN AND METHODOLOGY

The present study is confined to evaluating the cost efficiency of Indian banks and select foreign banks operating in India through the application of secondary databased analytical techniques The scope is delineated along four key dimensions the institutional coverage temporal span data sources and the analytical framework employed.

Institutional Coverage: The study encompasses a broad cross-section of the Indian banking landscape covering 137 banks classified across six distinct categories public sector banks old private sector banks new private sector banks small finance banks payment banks and foreign banks operating in India This multicategory design enables a comparative analysis of cost efficiency patterns across diverse ownership structures and operational mandates ranging from large nationalised banks with extensive branch networks to smaller niche oriented entities such as small finance banks and payments banks that have entered the sector more recently

Temporal Span: The dataset spans elven financial years from 2011 to 2021 capturing a decade of significant transformation in the Indian banking sector This period encompasses the aftermath of the global financial crisis the implementation of Basel III norms the Reserve Bank of Indias asset quality review the demonetisation event of 2016 the merger of public sector banks and the economic disruptions triggered by the COVID19 pandemic This wide temporal window lends sufficient depth to observe structural shifts and cyclical trends in cost behavior across bank categories over time

The present study is guided by the following research objectives formulated to systematically examine the cost efficiency of Indian banks using secondary financial data over the period 2011 to 2021

- To analyse the structural composition of operating expenditure across different categories of Indian banks including public sector banks old and new private sector banks small finance banks payments banks and foreign banks operating in India in order to identify the dominant cost drivers within each bank category
- To evaluate the cost efficiency of Indian banks by computing key cost related financial ratios and efficiency indicators derived from income expenditure and balance sheet variables thereby enabling an objective comparison of cost performance across bank groups over the study period
- To examine the temporal trends in cost efficiency across the study period from 2011 to 2021 capturing the impact of significant macroeconomic and regulatory developments including asset quality reviews bank mergers demonetisation and the COVID19 pandemic on the cost structures of Indian banks
- To compare cost efficiency across ownership categories distinguishing between public sector private sector small finance payments and foreign banks with a view to identifying whether ownership type and operational mandate significantly influence a bank's ability to manage costs
- To draw policy relevant inferences from the empirical findings that may assist regulators bank management and policymakers in formulating strategies aimed at improving cost efficiency and long-term financial sustainability within the Indian banking sector.

Hypothesis Formulation

Five hypotheses are formulated to test distinct dimensions of cost efficiency:

- H1: There is a significant difference in cost efficiency among the six ownership categories of Indian banks (tested using one-way ANOVA on the operating expenditure to total assets ratio).
- H2: There is a significant change in the cost efficiency of Indian banks over the study period 2011–2021 (tested using one-way ANOVA across financial years).
- H3: The individual components of operating expenditure have a significant impact on the profitability of Indian banks (tested using OLS multiple regression with net profit as dependent variable).
- H4: There is a significant relationship between total asset size and cost efficiency among Indian banks (tested using log-linear OLS regression).
- H5: There is a significant difference in interest expenditure efficiency across ownership categories of Indian banks (tested using one-way ANOVA on the interest expenditure to total assets ratio).

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IV. DATA ANALYSIS AND FINDINGS

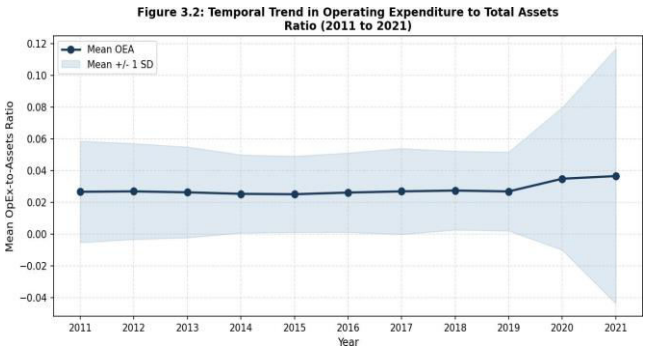
H1: Cost Efficiency across Bank Categories

SL.NO	bank_category	N	CTI_Mean	CTI_SD	OEA_Mean	OEA_SD	IEA_Mean	IEA_SD
0	Foreign Banks	475	0.880919	10.19355	0.033777	0.036952	0.022546	0.01546
1	New Private Sector Banks	105	0.233933	0.052863	0.022468	0.005787	0.048187	0.008925
2	Old Private Sector Banks	121	0.220951	0.053258	0.020622	0.004532	0.057048	0.010071
3	Payments Banks	3	4.05916	4.249367	0.402317	0.307961	0.010901	0.003593
4	Public Sector Banks	259	0.193544	0.061208	0.016151	0.00445	0.052768	0.0095
5	Small Finance Banks	35	0.372069	0.057691	0.052245	0.014691	0.057044	0.00657

The table is presented in excel for better presentation purposes only. The above table reveals a much considerable heterogeneity across multiple bank categories. Here Public sector banks exhibit the lowest mean cost-to-income ratio which in this case is (0.193), which is followed by Old Private Sector Banks which basically suggests that there is relative superiority in terms of cost management among mainstream banking groups. The payment banks record the highest ratio alongside with a large standard deviation as well; which is sort of proved due to front- loaded infrastructure costs during their formative operating years. The Foreign banks also register a high mean cost to income ratio which is powered by some forms of extreme variability within the provided category.

H2: Temporal Trends in Cost Efficiency

Year	N	MEAN OEA	STD DEV
2011	81	0.02668	0.03199
2012	87	0.02693	0.03019
2013	89	0.02634	0.02858
2014	90	0.02537	0.02462
2015	91	0.02514	0.024
2016	93	0.02617	0.02498
2017	94	0.02693	0.02707
2018	93	0.02746	0.02481
2019	93	0.0269	0.02484
2020	97	0.0349	0.04491
2021	90	0.03657	0.08031
ANOVA (OEA by Year): F = 1.0000, p = 0.441397			



The table shown in Excel is shown for better representation. One-way ANOVA across the financial years basically results in F = 1 and the p-value to be 0.441 which confirms that a year-to-year variation is not statistically significant at the 5% level. Due to this the null hypothesis H02 is not rejected. The table and the above graph reveal a very discernible trend. The OEA ratio declined from 2011 to what it is at 2015 which is 0.02514 which suggests a very progressive efficiency improvement during the mid-study period. From the year 2018 onwards, the ratio increased with a sharp upturn in 2020 and 2021 which is consistent with pandemic- induced cost pressures including elevated provisions and digital infrastructure expenditure.

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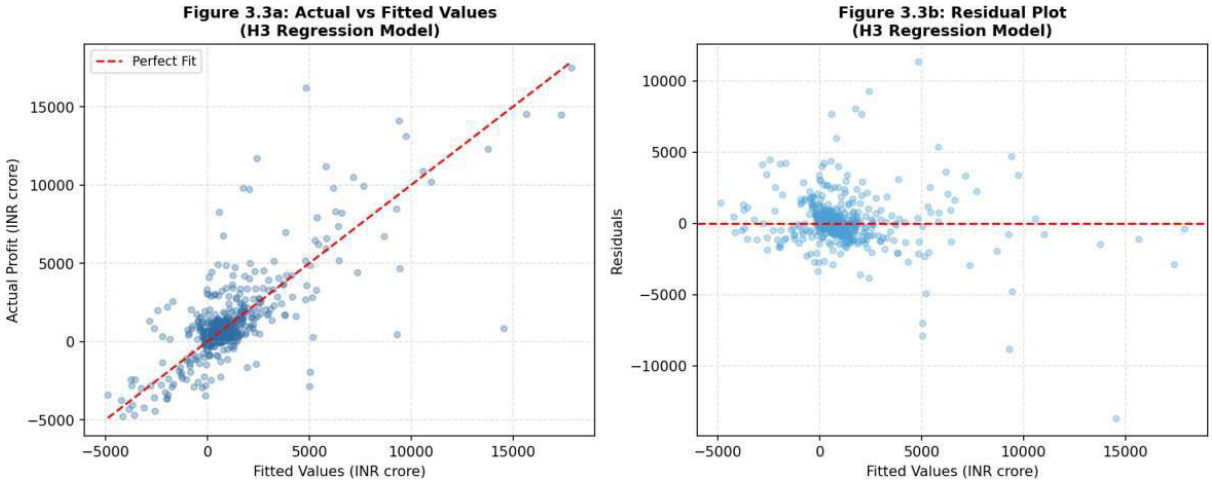
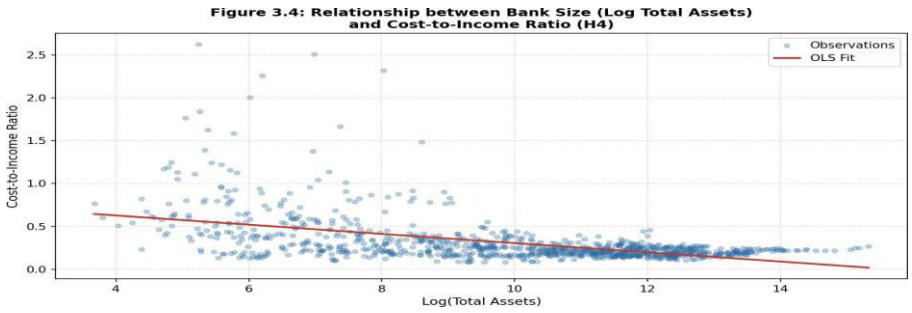
H3: Impact of Operating Expenditure Components On Profitability



The OLS model explains that approximately 77% of variance in the bank profitability is highly significant. Certain provisions especially for non-performing assets exert the strongest effect only because of the coefficient of -0.958 which has a p-value of less than 0.001, which also confirms that the rising requirements are the dominating factor of profitability erosion in Indian banking. The other operating-expenditure also carries a strong positive coefficient of 2.351 which has a p value of less than 0.001, which likely reflects a scale-driven income effects among the larger banks.

Wages are not significant in this case which suggests that once the other components are controlled; labour costs do not independently explain the variation in profitability. Due to this the null hypothesis of H03 is rejected on the basis of four out of five significant predictors and the overall model significance.

H4: Relationship Between Cost Efficiency and Asset Size



The regression of the log of the total assets on the cost-to-income ratio results a statistically significant negative coefficient of -0.054 wherein t = -18.562, p <0.001; which shows an overall model F-stat of 344.5 where p < 0.001. The R-squared of 0.258 is indicating that the log of total assets explains that approximately 26 percent of the variance in cost-to-income ratios. This basically explains that there is a negative relationship which confirms that larger banks tend to sort of exhibit lower cost-to-income ratios; which is consistent with scale-related efficiency advantages.

In this case the null hypothesis H04 is rejected. However, there are other factors in play including the business model employed, ownership structure and the asset quality possessed which thereby plays an important role in determining the cost efficiency across the Indian Banks.

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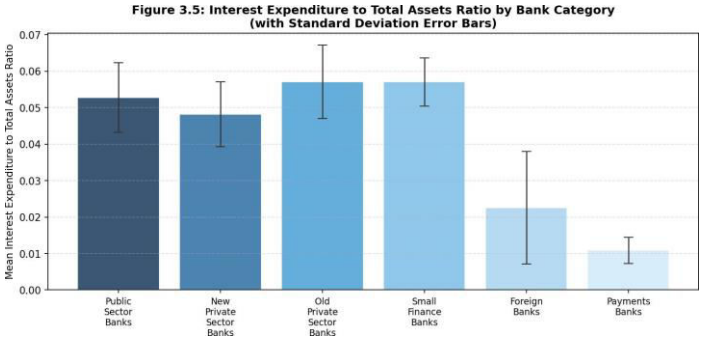
H5: Difference in Interest Expenditure Efficiency across Bank Groups

Bank Category	N	Mean IEA	Std. Dev.	Min	Max
Public Sector Banks	259	0.0528	0.0095	0.0004	0.0708
New Private Sector Banks	105	0.0482	0.0089	0.03	0.0747
Old Private Sector Banks	121	0.057	0.0101	0.0291	0.0781
Small Finance Banks	35	0.057	0.0066	0.0439	0.0693
Foreign Banks	475	0.0225	0.0155	0	0.1912
Payments Banks	3	0.0109	0.0036	0.0083	0.015



The F-statistic of 299.648 and p of less than 0.001 are overwhelming indicators of the rejection of the H05 since one-way ANOVA is overwhelming. The least IEA (0.0225) belongs to foreign banks, which have access to less expensive sources of international and interbank funding. Payments banks are registered with the lowest total ratio (0.0109) and this is in line with credit limits and minimal mobilisation of term deposits. The highest ratios are registered by public sector banks (0.0528), old private sector banks (0.0570) and small finance banks (0.0570),

showing that they rely on retail term deposits at competitive rates. Post-hoc Tukey HSD affirms the fact that foreign banks are not similar to all other categories except payments banks. There are no significant differences between old private sector banks and small finance banks and indicate that there is convergence in funding cost structures between the two types of banks.

V. CONSOLIDATED FINDINGS SUMMARY

H#	Hypothesis (Alternate)	Method	Test Statistic	Decision
H1	Significant difference in cost efficiency across bank categories	One-way ANOVA + Tukey HSD	F=116.67, p<0.001	Reject H0
H2	Significant temporal change in cost efficiency (2011-2021)	One-way ANOVA (year-wise)	F=1.00, p=0.441	Fail to Reject
H3	Operating expenditure components significantly impact profitability	OLS Multiple Regression	F=666.3, p<0.001	Reject H0
H4	Significant relationship between asset size and cost efficiency	Log-linear OLS Regression	F=344.5, p<0.001	Reject H0
H5	Significant difference in interest expenditure efficiency across categories	One-way ANOVA + Tukey HSD	F=299.65, p<0.001	Reject H0

VI. CONCLUSION

This research paper sought to assess Indian banking efficiency as related to banking costs, from 2011 to 2021. The study investigated 137 scheduled commercial banks across 6 regulatory categories to determine the extent of banking cost efficiency throughout this time period, through the use of financial data analyses based on ratio analysis, one-way analysis of variance with Tukey HSD post hoc testing, and ordinary least squares regression models.

The results of this study indicate that there is a large amount of structural heterogeneity in banking cost efficiency within the banking industry, by the category of ownership, where public sector banks share the most financial discipline, while

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payments banks and small finance banks are utilizing fundamentally different, highly intensive cost structures. Based on temporal findings, cost efficiency has been generally consistent across banks, but the lack of cost efficiency during the last portion of the study was attributed to pandemic-related cost increases (mostly related to loan loss provisioning for non-performing assets). The single largest contributor to loss of profitability for banks has been related to increases in loan loss provisioning, greatly overshadowing any negative influence from other expenditure categories. Bank size had a statistically significant, negative effect on the cost-to-income ratio, lending support to the presence of scale-related cost efficiencies in banking.

Interest on deposits varies widely among banks across different types of deposits based on how they fund themselves, as well as the way they mobilize deposits from households and businesses.

This article is meaningful in that it adds new empirical data to the body of knowledge about banking efficiency in developing nations. Additionally, it provides a number of useful suggestions and ideas for bank managers, directors, and policymakers. Moreover, this report shows that gaining cost efficiencies in India's banking sector will involve managing four different factors simultaneously: quality of loans; size of operations; cost of funds; and governance, whereby no one single factor can replace the need for a comprehensive strategy towards managing banking efficiency.

VII. SCOPE FOR FUTURE RESEARCH

The current research opens up many different possibilities for additional empirical examinations in the future. To start off with there is the possibility of adding an analytical measure; specifically, the use of either Data Envelopment Analysis or Stochastic Frontier Analysis would allow for the evaluation of technical efficiency scores on a per bank basis, thus allowing for a further breakdown of cost efficiency into technical and allocative components beyond what is currently done through sending out ratios.

There is also the opportunity to expand the time frame of this study beyond 2021 and include the period after the pandemic has ended in order to see how the costs incurred on the digital transformation in 2020 and 2021 might have resulted in long-term improvements in cost efficiency for banks in the future. The third avenue for empirical research would be the placement of large economic factors like GDP growth rate, inflation, and policy interest rates into a dynamic panel regression, therefore finding the unique factors associated with cost efficiency at the bank level isolated from the overall business cycles occurring in the economy. Finally, an international comparison of the cost efficiencies of bank systems in other, larger, developing countries, such as Brazil, Indonesia, and South Africa, would assist in putting the findings of the Indian banking system into a broader context and address potential generalising of the relationships described in this study between institutions and economies of scale based on analysis of cost efficiency in the banking systems of developing nations.

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