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DOES BANK EFFICIENCY ENHANCE BANK PERFORMANCE? EMPIRICAL EVIDENCE FROM INDIAN BANKING

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ABSTRACT

This paper examines the effects of cost, revenue, profit efficiency, and stability inefficiency on bank profitability in India over the period 1997 to 2017. Additionally, this study examines the effect of efficiency on profitability for banks according to their ownership and for periods with (and without) the global financial crisis. The cost, revenue, and profit efficiency scores for 70 banks in India are estimated using stochastic frontier analysis. Our key findings are as follows. First, we find that cost, revenue and profit efficiencies positively influence the profitability conditions of Indian banks. Second, banks that are inefficient adversely influence bank performance, although the global financial crisis did not seem to impact the efficiency-profitability relationship. Finally, we find that bank ownership matters for the association between its efficiency and performance.

Keywords: Efficiency; Profitability; System-GMM; Indian banking.

JEL Classifications: G2; G20; C5.

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I. INTRODUCTION

The main objective of financial deregulation measures in India has primarily been to promote bank competition, enhance stability, improve efficiency, and increase profitability for the Indian banking sector (Ray and Das, 2010; Li *et al.*, 2019; Rakshit and Bardhan, 2021). The deregulation measures that significantly reduced the interest rate margins in agreement with the global standard led to an improvement in bank efficiency (Das and Ghosh, 2006; Kumar, 2013). At the same time, these have prompted concerns about whether gains in efficiency have improved bank profitability. The proponents of deregulation view that considerable changes in banking operations and market structures post-deregulation not only expanded banks' portfolios but also enhanced the efficiency level of banks by driving down the cost of banking products. It is documented that deregulation of banking markets that intensified bank competition further led to a reduction in costs (Rakshit and Bardhan, 2020). However, the direct link between bank efficiency and their profitability has not been examined. Against this backdrop, this study empirically investigates whether increased bank efficiency post-financial liberalization (1997 – 2017) contributed to bank profitability. Our study aligns with several strands of the literature.

First, there is a growing body of empirical literature focused on estimating the technical and cost efficiency of Indian banking (Bardhan, 2013; Tanwar *et al.*, 2020; Kundu and Banerjee, 2021). Ray and Das (2010) are of the view that the principle of profit maximization relies on selecting a blend of input-output in such a manner that the output bundle can initiate higher proceeds utilizing minimal inputs. Moreover, a chosen minimal input combination should produce maximum output at minimum cost. Therefore, the principle of profit maximization considers both cost minimization and revenue maximization at a time (Singh and Thaker, 2020). In line with this argument, this study extends a broad consensus on how revenue and profit efficiencies along with cost efficiency can yield robust information on bank profitability.

Second, there are several studies that examine bank efficiency. The Efficient Structure (ES) hypothesis argues that differences in the scale efficiency of some banks rather than the collusive behaviour improve bank profits (Tan, 2018). Several studies find that bank efficiency is an important determinant of bank profitability (Olson and Zoubi, 2011; Tan, 2018). Various studies show that other factors matter. Some suggest that banks exercising higher inefficiencies, resulting from the highest cost, could generate higher profits than banks that are the most cost-efficient (Berger and Mester, 2003). Lower efficiency in banking operations affects profitability due to higher interest rate spreads (Al-Muharrami and Matthews, 2009). Various efficiency measurements have been explored thoroughly along the lines, and still, the literature mostly reveals inconclusive and varied evidence of efficiency on bank profitability (Chen *et al.*, 2006; Olson and Zoubi, 2011; Le and Ngo, 2020; Kumar *et al.*, 2021). Although a handful of studies investigates the effect of efficiency on bank performance in emerging economics, less is known about the relationship between efficiency and bank profitability in India¹.

¹ For a better understanding on the effects of several efficiency measures on bank performance in emerging economies, see Olson and Zoubi, (2011), Tan *et al.* (2017), Peng *et al.* (2017).

Third, there is a literature that explores the potential effects of risk-taking behaviour on bank performance but pays little attention to the relationship between stability inefficiency (or insolvency risks) and bank performance. For example, Tabak *et al.* (2012) show that stability inefficiency affects bank capitalization in selected Latin American countries. Tan (2018) examines the effect of stability inefficiency on bank performance in the Chinese banking industry and confirms that stability inefficiency affects bank profitability negatively in China. An empirical investigation of the effect of stability inefficiency on profitability for the Indian banking industry holds importance in light of the growing incidence of non-performing loans and deteriorating profits over time. Deregulation measures aimed at improving bank profitability further contributed to insolvency risks as intensified bank competition was partly responsible for financial instability (Rakshit and Bardhan, 2021). This paper examines whether stability inefficiency affects bank performance after the deregulation, in line with the above arguments.

Indian banking gives exceptionally fertile ground to investigate the issue of how different efficiency measures impact bank performance. Unlike other financial intermediaries, different ownerships in Indian banking follow heterogeneous objectives with different regulatory constraints derived from government policies. The input use, cost and revenue structures, nature of banking operations, and management practices vary markedly among state, private, and foreign-owned banks. Furthermore, strict limits imposed on the selection of optimal labour and fixed capital levels caused considerable variations in the level of profitability across banks. This is prominent in public banks as these banks raised equity capital from stock markets through their engagement in various diversified activities.

While previous studies mostly focused on the cost and technical efficiency of Indian banking (Sathye, 2003; Roy, 2014; Singh and Thaker, 2021), this study investigates the effects of cost, revenue, profit efficiency, along with stability inefficiency on bank performance from 1997 to 2017. Furthermore, this study incorporates the effects of macroeconomic and institutional factors on profitability for the Indian commercial banks. Finally, to examine whether the global financial crisis exerts any effect on bank profitability, this study looks at India's bank profitability in the pre- and post-crisis periods. While most studies exhibit the association between the two aspects from advanced and developed countries perspectives, this study explores the role of efficiency in bank performance from an emerging economies perspective.

Applying the most widely accepted Stochastic Frontier Approach (SFA) technique, this study estimates the efficiency measures to meet the paper's goal. We use three different profitability indicators, namely Return On Assets (ROA), Net Interest Margins (NIM) and Return On Equity (ROE). The second stage explores how the different efficiency measures influence bank performance in India. Different empirical specifications for the analysis were estimated by employing the two-step system GMM.

Foreshadowing our main results, we find that an increase in cost, revenue and profit efficiency positively contributes to bank performance. However, stability inefficiency has been found to adversely affect bank performance. The global financial crisis has not affected the efficiency and profitability relationship. Moreover, our analysis across different ownerships shows that public sector banks

are more cost-efficient than private and foreign owned banks. There has been considerable variations in the effect of efficiency measures on bank performance across ownerships.

The rest of the paper is structured as follows. Section II provides the information on data and the empirical framework. Section III extends the empirical findings, and Section IV concludes the paper.

II. DATA AND METHODOLOGY

A. Data

The study employs annual data for 70 Indian commercial banks over the period 1997 to 2017. These 70 commercial banks collectively account for 90 % of the total banking sector assets. To maintain consistency, the study limited the number of banks having at least ten years of observations. RBI's annual publication reports entitled "*Statistical Tables Relating to Bank in India*" was used to obtain information on several bank-specific factors from annual financial statements and balance sheets. Likewise, the study collected information on macroeconomic and institutional factors from Central Statistical Office (CSO) and World Development Indicators (WDI), respectively. Overall, the study covers a balanced panel dataset with 1470 observations from 1997 to 2017. We restrict the period till 2017 since thirteen public sectors banks underwent mergers after 2017. Since most banks merged belong to the public sector and hold around 70 per cent of total assets, an extension of the sample period might render distorted findings on the relationship between efficiency and profitability.

B. Methodology

The estimation of bank profitability has several shortcomings that include the possibility of endogeneity bias, reverse causality between dependent and explanatory variables, and the high persistent effects of bank profitability. To overcome the stated shortcomings, this study employs the two-step system GMM approach. Based on the previous studies authored by Athanasoglou *et al.* (2008), we specify the following empirical specification.

$$\pi_{it} = \alpha_0 + \delta\pi_{i,t-1} + \sum_{j=1}^j \beta_j X_{it}^j + \sum_{l=1}^l \beta_l X_{it}^l + \sum_{m=1}^m \beta_m X_{it}^m + \vartheta_{it} + \mu_{it} \quad (1)$$

where, i represents the individual commercial bank of Indian banking, t denotes the time. The profitability indicator has been denoted by π . The measures of bank profitability are represented by X_{it} . For the sake of simplicity, we group the determinants of bank profitability into three parts, namely bank-specific determinants (X_{it}^j), industry-specific determinants (X_{it}^l), macroeconomic determinants (X_{it}^m). δ shows the adjustment term, which lies between 0 and 1, with a higher estimated value displaying the low adjustment. On the contrary, a lower estimated value exhibits a higher speed of adjustments.

To estimate the above equation, we present the information on how to measure our variable of interest. These variables can be grouped into four major parts: (1)

bank performance indicators, (2) efficiency measures, (3) bank-specific indicators, (4) macroeconomic and institutional indicators.

C. Profitability Indicators

We employ three different indicators to proxy bank performance. Based on the work of Athanasoglou *et al.* (2008), we use ROA as a proxy for measuring bank profitability in India. ROA can be defined as a ratio of net income of a year to total assets for the same year. The second profitability indicator used in this study is the ROE which measures the shareholder's returns on equity. It is defined as a ratio between net income to shareholder's equity. This indicator is widely used in several empirical studies on profitability (Rahman *et al.*, 2015; Ramlan and Adnan, 2016). The final important proxy of profitability measure is that NIM and empirical studies have extensively used NIM to assess bank performance both at single and cross-country set-ups (Nacuer and Omran, 2008; Claessens *et al.*, 2018). This measure of profitability shows a bank's strength and position while making prudent investment decisions, given its relative interest expenditure.

D. Measuring Efficiency

This study employs the SFA (Stochastic Frontier Analysis) over DEA (Data Envelopment Analysis) in estimating efficiency. The former approach is econometrically stronger and accounts for the stochastic element likely to appear in the panel data framework. Following the literature of Kumbhakar and Lovell (2003), we express a translog cost function due to its wide application in efficiency literature. Based on the previous work of Tabak *et al.* (2012), this study specifies the translog cost function as follows.

$$\begin{aligned}
 & \ln(tc_{it} / W_{3,it}) \\
 &= \alpha_0 + \sum_{j=1}^3 \alpha_j \ln(Y_{j,it}) + \sum_{m=1}^2 \beta_m \left(\frac{W_{m,it}}{W_{3,it}} \right) + \frac{1}{2} \sum_{j=1}^3 \sum_{k=1}^3 \varphi_{jk} \ln(Y_{j,it}) \ln(Y_{k,it}) \\
 &+ \frac{1}{2} \sum_{m=1}^2 \sum_{n=1}^2 \mu_{mn} \ln \left(\frac{W_{m,it}}{W_{3,it}} \right) \ln \left(\frac{W_{n,it}}{W_{3,it}} \right) + \sum_{j=1}^3 \sum_{m=1}^2 \tau_{jm} \ln(Y_{j,it}) \ln \left(\frac{W_{m,it}}{W_{3,it}} \right) + \theta_1 T \\
 &+ \frac{1}{2} \theta_2 T^2 + \sum_{j=1}^3 \rho_j T \ln(Y_{j,it}) + \sum_{m=1}^2 \gamma_m T \ln \left(\frac{W_{m,it}}{W_{3,it}} \right) + u_{it} + v_{it} \quad (2)
 \end{aligned}$$

where the total cost of a particular bank has been represented by tc , we consider three output variables as indicated by Y . Keeping a line with the previous literature; we consider loans, deposits and non-interest income as three input variables for the empirical analysis (Chen *et al.*, 2006). Similarly, this study considers three input variables, and the input variables are represented by $W_{m,it}$. T is the time trend, which in turn represents the technological change that could change over the production process. The translog cost function adheres to the assumption of

linear homogeneity. We use one of the input prices to normalize the dependent variable and the rest of input prices to keep the assumption of linear homogeneity intact. An additional equation is created to further divide the error term into two segments.

$$\varepsilon_{it} = v_{it} + u_{it} \tag{3}$$

Where, u_{it} shows the effects of inefficiency. Turning to the estimation of profit and revenue efficiency, this study follows the similar translog cost function followed in the estimation of cost function by changing the regressand with ROA and total revenue, respectively.

It has been argued that Z-index as an indicator of financial stability cannot accurately capture a bank’s potential stability (Tabak *et al.*, 2012). A bank is highly inefficient or more likely to default if the bank reports a low Z-score (“Maximal Z-score” – “Z-score of banks i ”). Employing SFA, we use the measure of banks instability inefficiency (Aigner *et al.*, 1977)². Table 1 presents the details about the variables considered in the empirical analysis of the models.

Table 1.
Description of Variables and Data Sources

This table shows the variables considered for the empirical analysis, their definitions, expected signs and the sources from which we collected the data.

Variable	Definition	Sign	Source
Profitability indicators			
ROA	The ratio of net income to total assets		RBI
ROE	The ratio of interest income to total equity		RBI
NIM	The ratio of net interest income to earning assets		RBI
Bank- Specific Variables			
Cost Efficiency (CE)	Estimated using SFA (see section III for details)	Inconclusive	RBI
Revenue Efficiency (RE)	Derived from SFA (see section III for details)	Inconclusive	RBI
Profit Efficiency (PE)	See section 3 for details	Positive	RBI
Stability inefficiency	Estimated using the SFA (see section III for details)		
Diversification	Ratio between non- interest income to total revenue	Inconclusive	RBI
Capitalization	Ratio between equity and total assets	Inconclusive	RBI
Labour productivity	Total revenue divided by the total number of employees	Positive	RBI
Financial Freedom	The index shows the measure of independence from government controls and interference in the financial sector.	Positive	WDI
Stock Market Development	The ratio of capitalization of listed companies in the stock market to the total GDP of the country	Positive	RBI
Macroeconomic Variable			
GDP growth rate	Annual real GDP growth rate	Inconclusive	WDI
Inflation rate	An annual inflation rate proxied by the Consumer Price Index (CPI)	Inconclusive	WDI

² Following Lepetit *et al.* (2008) and Cihak and Hesse (2010), the study estimates Z-score in the following manner:

$$Z - score_i = \frac{ROA_i + \frac{E_i}{TA_i}}{\sigma ROA}$$

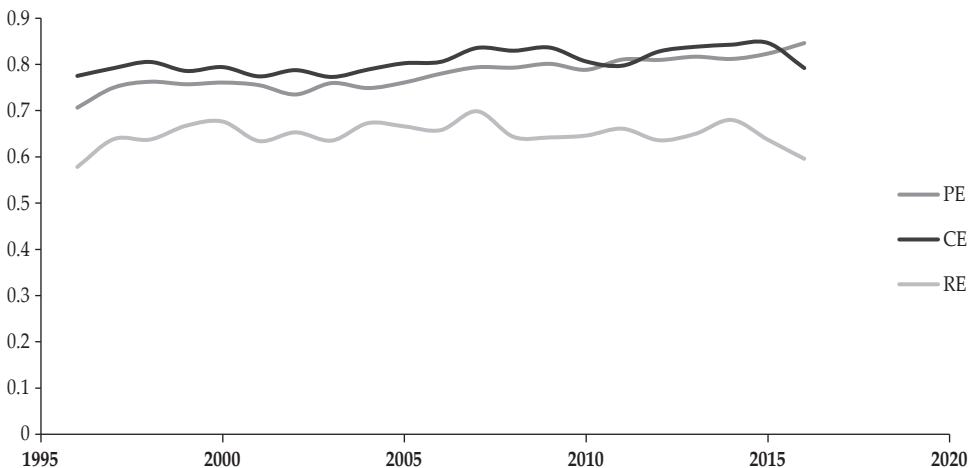
III. EMPIRICAL RESULTS

Figure 1 shows the case of three different estimated efficiency scores (cost, revenue, and profit) for the Indian commercial banking segment over the examined period. Considerable variations in the estimated efficiency scores have been noticed under the study period. It has been shown that the year-wise annual average cost efficiency estimates lie above the profit and revenue efficiencies, indicating the banking system to be more efficient on the cost front than revenue and profit fronts. The average cost efficiency for the entire banking has been 0.82, whereas the mean values of profit and revenue efficiencies are reported 0.71 and 0.80. The relatively higher cost-efficiency scores imply that maximum commercial banks in India operate near the benchmark frontier. Higher cost efficiency estimates suggest that banks can reasonably opt for the mix of inputs optimally, avoiding waste to produce the maximum output. However, the revenue efficiency estimates depict a slightly different picture of their performance. The Indian banks lie a bit far from the efficient revenue frontier, and in some years, the average estimate of revenue efficiency was even lower than 60%.

Regarding the ownership results on efficiencies, it has been noted from the estimated scores that PSBs are cost, revenue and profit efficient than the private and foreign banks. The differences in the efficiency levels across ownership structures are due to several ownership specific factors. For example, by their access to most government businesses, public sector banks can generate higher fee-based income and stay more efficient. The economic reason that can be attributed to the higher revenue efficiency of the foreign banks is the introduction of advanced technology, sound managerial skills, and rapid financial innovation. The findings are consistent with the previous studies conducted domestically and in other developing economies (Olson and Zoubi, 2011).

Figure 1.
Efficiency Scores of Banks

This figure shows the cost, revenue, and profit efficiency scores estimated through SFA for 70 commercial banks in India from 1997 to 2017



It is clear from Figure 2 that foreign and private banks have higher profitability in terms of ROA and ROE than the public sector banks. The reported mean values of ROA for foreign and private sector banks are 0.014 and 0.009, and the public sector banks have a lower mean value of 0.0061. With regards to NIM, we observe that private sector banks have higher NIM than public and foreign sectors banks. Overall, the profitability of banking and different ownership groups varies considerably over the years, whereas foreign banks report higher profitability. It can be noted that the foreign banks with the smallest percentage of share in total assets earn maximum profits in terms of ROA and ROE. The higher profitability of foreign banks can be attributed to foreign banks attracting more equity capital from the markets, unlike public sector banks. Foreign banks are usually well equipped to absorb the risks arising out of the non-performing loans. This observation confirms the findings obtained by Rakhe (2010) for Indian banking. Finally, the higher NIM of the private sector banks implies that this ownership group is based on a business operation that mainly aims at traditional deposit-loan service.

Figure 2.
Profitability Indicators of Banks

Figure A shows the ROA for the overall banking industry and according to the ownerships. Similarly, Figure B and C show the ROE and NIM for the overall banking industry and across ownerships over the period 1997 to 2017.

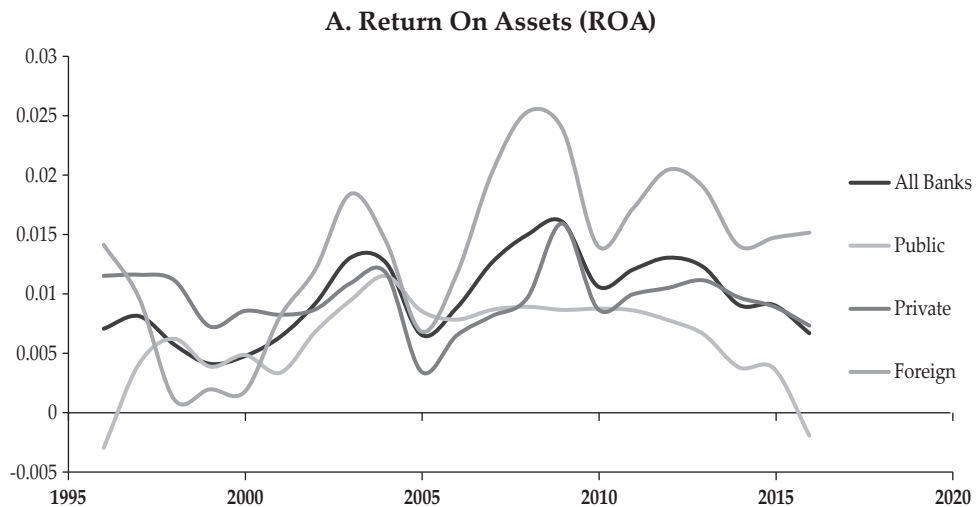
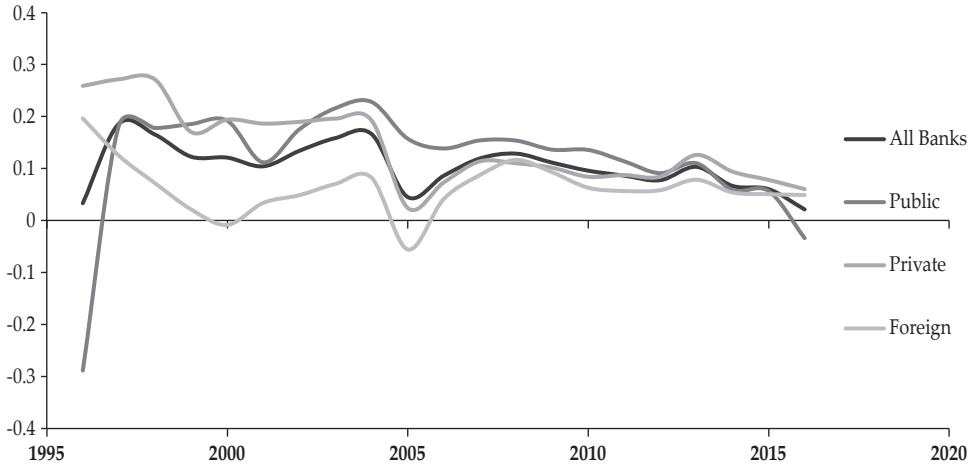


Figure 2.
Profitability Indicators of Banks (Continued)

B. Return On Equity (ROE)



C. Net Interest Margin (NIM)

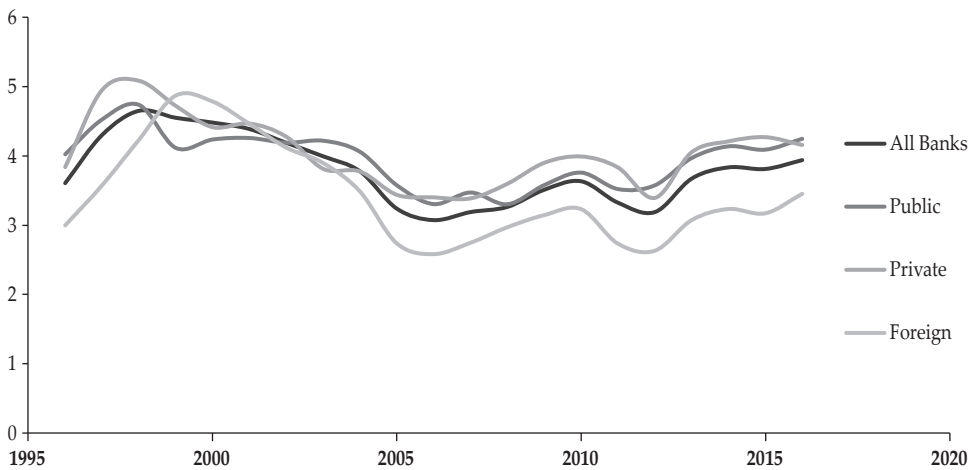


Table 2
Descriptive Statistics of the Variables

This table shows the descriptive statistics of the profitability, efficiency, macroeconomic and institutional variables for the aggregate banking industry and ownership groups. Three profitability indicators are Return On Assets (ROA), Return On Equity (ROE) and Net Interest Margins (NIM). The efficiency indicators concerned are Cost Efficiency (CE), Revenue Efficiency (RE), Profit Efficiency (PE) and Stability Inefficiency (SE). Bank-specific variables are capitalization (CAP), diversification (DIV), size (SIZE), Labour Productivity (LP). Macroeconomic variables are inflation rate (CPI), economic growth (GDP) and Stock Market Capitalization (SMC).

	ROA	ROE	NIM	CE	RE	PE	SE	CAP	DIV	SIZE	LP	CPI	GDP	SMC	
All banks	Obs	1454	1458	1455	1448	1447	1448	1457	1452	1451	1454	1470	1470	1470	
	Mean	0.009	0.1070	3.896	0.8216	0.7177	0.8033	0.6994	12.37	0.1711	9.255	0.6834	0.072	0.070	0.697
	Min	-0.254	-5.556	0.095	0.5458	0.6213	0.5615	0.3720	-14.19	-0.391	3.403	0.0062	3.77	0.038	0.377
	Max	0.137	0.8146	8.927	0.9634	0.7794	0.9147	0.7621	98.31	1.507	14.63	5.747	13.17	0.095	1.514
	SD	0.016	0.2428	1.060	0.1109	0.0593	0.1180	0.1003	12.37	0.687	2.322	0.6875	0.028	0.018	0.274
Public Banks	Obs	530	533	534	532	530	527	537	534	531	534				
	Mean	0.006	0.1189	4.0120	0.8891	0.7254	0.8651	0.5025	4.901	0.1239	11.037	0.3624			
	Min	-0.076	-5.557	0.115	0.8127	0.6851	0.8209	0.4440	-6.131	0.0102	8.464	0.0062			
	Max	0.0173	0.7494	7.984	0.9632	0.7794	0.9147	0.6455	9.496	1.5079	14.63	1.942			
	SD	0.0069	0.3121	0.6493	0.0172	0.0308	0.0258	0.0775	1.521	0.3254	1.188	0.3624			
Private Banks	Obs	392	395	393	390	392	394	395	395	395	395				
	Mean	0.0098	0.1450	4.148	0.8501	0.6801	0.8214	0.4916	7.533	0.1416	9.301	0.4340			
	Min	-0.0340	-0.821	0.096	0.5568	0.6221	0.7083	0.3720	1.663	0.0184	5.349	0.0391			
	Max	0.1373	0.575	6.373	0.9013	0.7294	0.8782	0.6433	90.33	0.3780	13.73	2.001			
	SD	0.0091	0.1253	1.002	0.0297	0.0321	0.0591	0.0941	5.356	0.0597	1.671	0.3285			
Foreign Banks	Obs	532	530	528	526	523	528	525	523	525	525				
	Mean	0.0140	0.0652	3.577	0.7410	0.7098	0.7191	0.5642	24.01	0.2440	7.324	1.218			
	Min	-0.253	-2.361	0.590	0.6646	0.5947	0.5614	0.4793	-14.19	-0.0391	3.403	0.0972			
	Max	0.1044	0.8145	8.927	0.9643	0.7413	0.8738	0.7621	98.31	0.8415	11.94	5.747			
	SD	0.0258	0.2193	1.342	0.0523	0.0853	0.0602	0.1011	18.59	0.1982	2.160	0.8367			

The descriptive statistics presented in Table 2 show that public sector banks have the largest size in terms of total assets. The average value of size, measured by the logarithm of total banking assets for public sector banks, is 11.03, which is higher than the mean values of private (9.30) and foreign banks (7.32). The mean value suggests that foreign banks are more diversified than public and private sector banks as far as diversification is concerned. Since public sector banks have faced greater challenges in terms of non-performing loans, we report a higher mean value of this ownership group. Furthermore, the labour productivity of the public sector banks turned out to be the lowest among all ownership groups of Indian banking markets. The low labour productivity of the PSBs is primarily because the banking operations of this ownership are large and difficult to manage with limited bank employees. Turning to the macroeconomic and industry-specific factors, we notice that India's inflation and GDP growth is more stable than the stock market development over the studied period. The higher standard deviation of the stock market development indicates that the market is volatile in India.

Table 3.
Effects of Efficiency on Bank Profitability

This table shows the effects of efficiency scores (CE, RE, and PE) on profitability indicators (ROA and ROE). Results are estimated using a two-step system GMM. Coefficients are outside, and robust standard errors are inside the parentheses, respectively. Across all the estimated models number of instruments are less than the cross-sections. ***, **, and * denote the level of significance at 1%, 5% and 10%, respectively.

Variables	ROA	ROA	ROA	ROE	ROE	ROE
	(I)	(II)	(III)	(IV)	(V)	(VI)
ROA (-1)	0.390*** (0.0079)	0.410*** (0.0098)	0.396*** (0.0074)			
ROE (-1)				0.414*** (0.0094)	0.404*** (0.0074)	0.415*** (0.0093)
CE	0.467*** (0.0470)			0.442*** (0.1372)		
RE		0.141 (0.0303)			0.376*** (0.1188)	
PE			0.162*** (0.0653)			0.470*** (0.0448)
Div	0.002 (0.0777)	0.247*** (0.0972)	0.853*** (0.0675)	0.002 (0.0777)	0.446*** (0.0790)	0.394*** (0.0149)
Cap	-0.395** (0.0154)	-0.27*** (0.0303)	-0.33*** (0.0286)	-0.395*** (0.0154)	-0.148*** (0.0291)	-0.006 (0.0776)
Size	-0.040*** (0.0067)	-0.004* (0.0071)	-0.093*** (0.0097)	-0.040*** (0.0067)	-0.010** (0.0044)	-0.040*** (0.0063)
LP	0.162*** (0.0122)	0.110*** (0.0171)	0.203*** (0.0172)	0.162*** (0.0122)	0.175*** (0.0221)	0.165*** (0.0122)
GDP Growth	0.234*** (0.0154)	0.277*** (0.0168)	0.363*** (0.0163)	0.335*** (0.0192)	0.231*** (0.0176)	0.332*** (0.0192)
Inflation	-2.197** (0.4687)	-3.55*** (0.5980)	-1.606** (0.6384)	-1.142*** (0.6693)	-1.10*** (0.5926)	-1.13*** (0.6639)
SMC	0.017 (0.0019)	0.062*** (0.0153)	0.014 (0.0012)	0.017 (0.0150)	0.003 (0.0150)	0.018 (0.0150)
FF	0.028*** (0.0122)	0.016** (0.0019)	0.0141*** (0.0012)	0.0280*** (0.0019)	0.023*** (0.0012)	0.027*** (0.0018)

Table 3.
Effects of Efficiency on Bank Profitability (Continued)

Variables	ROA	ROA	ROA	ROE	ROE	ROE
	(I)	(II)	(III)	(IV)	(V)	(VI)
Obs	1470	1470	1470	1470	1470	1470
Cross- Sections	70	70	70	70	70	70
Hansen <i>p</i> -value	0.809	0.614	0.619	0.809	0.858	0.773
No of instruments	68	69	68	69	68	68
AR (1) <i>p</i> -value	0.000	0.000	0.000	0.000	0.000	0.000
AR (2) <i>p</i> -value	0.870	0.581	0.693	0.870	0.983	0.880

Model I, II, and III in Table 3 report the effects of efficiencies on ROA, whereas Model IV, V, and VI show the effects of efficiencies on ROE. The probability values of the Hansen test that confirm the validity of the over-identifying restrictions has been accepted across all the models. The existence of the AR1 across all the regression models has been confirmed by the *p*-values of AR1. In contrast, due to insignificant *P-values* in all models, we reject the existence of AR2. The coefficients of the lagged profitability indicator give an indication of the suitability of the dynamic specifications of the estimated models. These coefficient values also confirm that the current profitability of a bank is largely influenced by the profitability of the previous year.

Considering the effect of cost efficiency on bank profitability, we note that cost efficiency positively and significantly affects bank performance in India as cost efficiency has a positive impact on both the profitability indicators (ROA and ROE) in Model I and IV, respectively. The positive coefficient of cost efficiency signifies that the cost-efficient banks in India, by reducing their interest rates margins, enhance bank profitability. Rakshit and Bardhan (2019) note that intensified bank competition post-deregulation significantly reduced the cost of credit, leading to an increase in the cost efficiency of Indian banks. Increased cost efficiency further contributed to the improvement in bank performance. This finding corroborates Alhassan *et al.* (2016), who noted a positive link between efficiency and profitability in the Ghanaian banking market. Regarding the effect of revenue efficiency on profitability, a positive and significant effect has been reported in Model II, and V. Model II shows that 1% change in revenue efficiency leads to 14.1 % change in bank profitability. By producing the outputs bundle effectively and maximizing bank's revenue, revenue efficiency enhances bank profitability, and our results corroborate the findings of Sufian and Kamarudin (2015). With regards to the relationship between profit efficiency and bank performance, profit efficiency appears to have positively influenced the bank performance, and it can be confirmed by the significant coefficient values of profit efficiency in Model III, and VI. The economic implications suggest that banks that are able to increase their profit efficiency also exercise the ability to increase market shares, which can improve the bank performance in the long run. A similar argument has been advanced by Fang *et al.* (2019), who noticed profit efficiency to be affecting performance positively of Chinese banking.

With regards to how capitalization affects bank profitability, results indicate that there is a negative and significant association between capitalization and bank

performance. This finding has important practical implications as equity is an expensive financial instrument. While making better remuneration to the equity holders, the bank should provide better margins to account for the additional risks and compensate for the risks. As there arises a mismatch between the capital holdings by banks and their regulatory requirements, most of the time, banks cannot exploit the advantage of capital adequacy. Due to a lack of regulatory requirements, banks at times cannot engage in risky investment that yields a high return on their investments. This finding contradicts the results obtained by Ahamed (2017) and Almaqtari *et al.* (2018) for Indian banking, who reported a positive impact of bank capitalization on bank profitability. Concerning bank size, we note that bank size is significantly and negatively associated with bank performance when assessed by both ROA and ROE. The economic explanations of this finding can be attributed to the fact that the large banks' managerial and other operating expenses, especially the large public sector banks, are higher in India than the small banks. Additionally, large-sized banks in India have a larger number of employees, leading to increased labour-related costs and increased labour costs affecting bank profitability adversely. This finding is consistent with Goddard *et al.* (2004). The estimated coefficient of diversification reveals that bank diversification positively impacts bank profitability in India. Well-diversified banks can minimize the costs from the economics of scope, which positively affects the profitability of Indian banking. This finding is in line with Jiang *et al.* (2003) in the context of the Hong Kong banking industry. Concerning the effects of other variables on bank performance, namely financial freedom, stock market capitalization and labour productivity, the results confirm the predicted relationships. Higher labour productivity through efficient bank management fosters bank profitability.

Turning to the macroeconomic variables, we find inflation to be adversely associated with the bank performance indicators, such as ROA and ROE, across all regression models. The negative coefficient of the inflation rate implies that the unanticipated inflation rate that increases the possibility of accumulating loan losses deteriorates the bank performance in Indian banking. Considering the effect of economic growth on bank performance, we find that GDP growth positively affects bank performance. The finding implies a growing demand for bank lending during the cyclical upswings, and higher lending is expected to increase bank profitability.

Table 4 presents the effects of efficiency, banks-specific and macroeconomic variables on bank performance by different ownership groups. Here, we consider two profitability indicators: ROA and ROE and two efficiency indicators: cost and profit efficiency³. With regards to the linkage between cost efficiency and bank performance, results show that cost efficiency positively affects performance of public sector banks in India. However, the same effect is not significant in the case of the private and foreign sector banks in India. The public sector banks benefit from economies of scale and economies of scope as opposed to their private and foreign banks counterparts.

³ Before proceeding with the empirical estimation, we check the issue of multicollinearity among the efficiency indicators, and found the presence of multicollinearity in case of revenue efficiency. Therefore, we exclude this indicator from the empirical analysis in order to get rid of the multicollinearity problem.

Table 4.
Effects of Efficiency on Profitability Across Ownerships

This table shows the effects of efficiency measures on bank performance. Results are estimated using a two-step system GMM. Coefficients are outside and robust standard errors are inside the parentheses, respectively. Across all the estimated models number of instruments are less than the cross-sections. ***, **, and * denote the level of significance at 1%, 5% and 10%, respectively.

	Public Banks		Domestic Private Banks		Foreign Banks	
	ROA	ROE	ROA	ROE	ROA	ROE
ROA (-1)	0.147*** (0.1323)		0.183** (0.5625)		0.212*** (0.0364)	
ROE (-1)		0.139*** (0.1921)		0.194*** (0.7349)		0.243*** (0.3243)
CE	0.493*** (0.1003)	0.645*** (0.8853)	0.134 (0.0746)	0.098 (0.0645)	0.002 (0.0066)	0.032 (0.6974)
PE	0.464** (0.2087)	0.653** (0.1532)	0.019 (0.0325)	0.0335 (0.0758)	0.026** (0.0257)	0.587*** (0.9658)
Div	0.067 (0.4007)	0.285 (0.9231)	0.128** (0.0334)	0.072* (0.0552)	0.013* (0.0417)	0.064** (0.6354)
Cap	0.487 (1.038)	0.548** (0.6432)	0.007 (0.0032)	-0.002 (0.0021)	0.0011 (0.0266)	0.004 (.5333)
Size	-0.422 (1.342)	-0.271 (1.135)	-0.022*** (0.0112)	-0.021 (0.0259)	0.027** (0.0057)	0.321*** (0.2818)
LP	0.185*** (0.1565)	0.174** (0.2305)	0.042*** (0.0038)	0.039** (0.0077)	0.038*** (0.0028)	0.333*** (0.5036)
GDP Growth	1.71** (1.687)	1.89 (1.143)	0.597** (0.0748)	0.674*** (0.1374)	0.175*** (0.1004)	0.174** (0.1204)
Inflation	-0.215** (0.1804)	-0.232*** (0.1754)	0.005 (0.0030)	0.002 (0.0032)	0.0023 (0.0048)	0.0474 (0.6165)
FF	0.004*** (0.0106)	0.013** (0.0134)	0.001 (0.0001)	0.0023 (0.0031)	0.0041 (0.0041)	0.040* (0.0254)
Obs	525	525	390	390	542	542
Cross- Sections	26	26	19	19	25	25
Hansen p-value	0.934	0.874	0.96	1.00	0.914	0.635
AR (1)	0.013	0.008	0.002	0.000	0.0014	0.002
AR (2)	0.654	0.724	0.992	0.643	0.762	0.698

Concerning profit efficiency, we find that a higher level of profit efficiency significantly influenced the profitability of the public and foreign banks. This finding is in line with Singh and Thaker (2020), who found the higher profit efficiency of foreign banks increased overall bank profitability in India. Turning to the bank-specific variables, it has been observed that foreign and private sector banks have higher profitability concerning bank diversification. It implies that the share of non-interest income to total assets is higher for foreign and private sector banks. These banks participate in diverse banking activities and generate profit from non-traditional-based income sources. Concerning labour productivity, findings confirm that higher labour productivity yields higher profitability to the public sector banks. The heterogeneous effects of bank efficiencies on bank performance are largely due to the sub-optimal choice of input-output mix or influenced by the different technology available to different ownership groups.

To investigate whether the financial crisis of 2007-08 impacted the banking performance of India, we divide the sample period into two groups, such as 1996/97 to 2006/07 corresponding to the pre-crisis period and 2007/08 to 2016/17 corresponding to the during and post-crisis period. Table 5 presents the findings on how the financial crisis changed bank performance. With respect to the cost and revenue efficiency, our findings suggest that cost and revenue efficiency influenced the bank performance of India significantly during the pre-crisis period. However, the effects of these two variables were found to be insignificant post the crisis. Regarding the impact of profit efficiency, we find that in both the periods (pre and post), profit efficiency significantly affected bank profitability in India. Turning to the macroeconomic and other bank-specific variables, we fail to draw any significant differences in their effects on profitability during the pre-and post-crisis period.

Table 5.
Effect of Global Financial Crisis on Bank Profitability

This table shows the effect of financial crisis of 2008-09 on bank performance. Results estimated through the two-step system GMM account the pre and post crisis period. Coefficients are outside and robust standard errors are inside the parentheses. ***, **, and * denote the level of significance at 1%, 5% and 10%, respectively.

	Pre-crisis Period (1995-96 to 2006-07)		Post/ during Crisis Period (2007-08 to 2016-17)	
ROA (-1)	0.239*** (0.0533)	0.287*** (0.0445)	0.264*** (0.0395)	0.592*** (0.0865)
CE	0.268*** (0.5939)		-0.136 (0.4198)	
RE		0.615*** (0.5571)		0.542 (1.094)
PE			0.555*** (0.1879)	1.967*** (0.3813)
Div	0.193*** (0.6018)	-0.624 (0.9003)	0.087 (0.8754)	0.534 (0.7086)
Cap	0.918*** (0.2357)	0.875*** (0.2448)	0.619*** (0.2516)	0.161 (0.2775)
Size	0.189** (0.0833)	0.120*** (0.0550)	0.104** (0.0480)	-0.010 (0.0737)
LP	0.026 (0.1033)	0.126 (0.1080)	0.477 (0.0397)	0.170** (0.2434)
GDP Growth	0.668** (0.0036)	0.219* (0.2650)	0.922** (0.2221)	0.515 (0.6956)
Inflation	-0.338*** (0.1523)	-0.086*** (0.1536)	-0.062 (0.1475)	0.408*** (0.1304)
SMC	0.083 (0.0496)	0.052 (0.0371)	0.047 (0.0397)	0.424*** (0.1328)
FF	0.007 (0.0540)	0.011 (0.0357)	0.001 (0.0257)	0.058 (0.0443)
Obs	840	840	840	630
Cross- Sections	70	70	70	70
Hansen p-value	0.466	0.904	0.634	0.404
AR (1)	0.000	0.001	0.001	0.001
AR (2)	0.07	0.421	0.351	0.634

These findings of crisis effect on profitability are consistent with RBI's report published on currency and finance for the year 2010. The report shows that in the face of the global financial crisis in 2008-09 that shook the global financial market could not affect the Indian banking industry much. This is because India's internal macroeconomic fundamentals, prudent banking regulations and supervisions, and the industry's limited exposures to the riskier assets helped Indian banking to remain unaffected by the global financial crisis.

In addition to examining the cost, revenue, and profit efficiency on performance, we assess the impact of stability inefficiency on bank performance. Table 6 presents the findings of stability inefficiency on bank performance in India over the period 1997 to 2017. Stability inefficiency or insolvency risk that captures the risk-taking behaviour adversely affects bank profitability of Indian commercial banks. This interpretation of this finding can be linked to the growing evidence of non-performing loans of Indian banking. Several rounds of reform measures that reduced the interest rates margins also contributed to the stability inefficiency in the banking industry.

To check the consistency of the main findings, we run the robustness test to the previous findings. Table 7 presents the empirical results regarding the impacts of three types of efficiencies and stability inefficiency on bank profitability using NIM as an alternative indicator of bank performance. Coming to the efficiency indicators, Model I reports a positive and significant effect of cost efficiency on performance. Models II and III show the significant effects of profit and revenue efficiency on bank performance, respectively. Regarding the impact of stability inefficiency on bank performance, like previous findings, there exists an adverse effect of stability inefficiency on bank performance in model IV. Regarding the bank-specific, macroeconomic and instructional variables, the findings are closely related to the previous results. The findings of the robustness test suggest the selection of variables and empirical models are well specified for the main findings.

Table 6.
Effect of Stability Inefficiency on Bank Profitability

This table shows how stability inefficiency (insolvency risk) affects bank performance over the years. Results are estimated using a two-step system GMM. Coefficients are outside, and robust standard errors are inside the parentheses, respectively. Across all the models number of instruments are less than the cross-sections. ***, **, and * denote the level of significance at 1%, 5% and 10%, respectively.

	ROE	ROA
ROA (-1)	0.425*** (0.0120)	
ROE (-1)		0.401*** (0.0112)
Stability Inefficiency	-0.851*** (0.2504)	-1.24*** (0.2019)
Div	0.381*** (0.1018)	0.539*** (0.1903)
Cap	-0.305*** (0.0688)	-0.068** (0.0476)
Size	-0.073*** (0.0174)	-0.100*** (0.0140)

Table 6.
Effect of Stability Inefficiency on Bank Profitability (Continued)

	ROE	ROA
LP	0.239*** (0.0267)	0.055** (0.0206)
GDP Growth	0.243** (0.0157)	0.240*** (0.0190)
Inflation	-0.722*** (0.7632)	-2.88*** (0.4317)
SMC	0.039*** (0.0157)	0.022** (0.0094)
FF	0.019*** (0.0021)	0.013*** (0.0010)
Constant	0.858*** (0.2647)	1.139*** (0.3330)
Obs	1468	1459
Cross- Sections	69	69
Hansen <i>p</i> -value	0.550	0.260
AR (1) <i>p</i> -value	0.000	0.001
AR (2) <i>p</i> -value	0.998	0.477

Table 7
Robustness Test

This table presents the results of the robustness test. We use an alternative indicator of bank profitability i.e. NIM. Results are estimated using a two-step system GMM. Coefficients are outside, and robust standard errors are inside the parentheses, respectively. Across all the estimated models number of instruments are less than the cross-sections. ***, **, and * denote the level of significance at 1%, 5% and 10%, respectively

	I	II	III	IV
NIM(-1)	0.125*** (0.0017)	0.131*** (0.0018)	0.126*** (0.0042)	0.116*** (0.0040)
Cost Efficiency	0.681*** (0.0044)			
Profit efficiency		0.729*** (0.0065)		
Revenue Efficiency			1.650*** (0.0880)	
Stability Inefficiency				-0.235*** (0.0637)
Div	-0.885*** (0.0062)	-0.484*** (0.0086)	-0.889*** (0.0225)	-0.893*** (0.0327)
Cap	-0.116*** (0.0028)	-0.171*** (0.0036)	0.018** (0.0097)	-0.057*** (0.0123)
Size	-0.047*** (0.0010)	-0.060*** (0.0016)	-0.015*** (0.0029)	-0.035*** (0.0032)
LP	0.0116*** (0.0021)	0.113*** (0.0030)	0.072*** (0.0071)	0.078*** (0.0072)
GDP Growth	0.180*** (0.0026)	0.171*** (0.0036)	0.147*** (0.0063)	0.145*** (0.0063)

Table 7
Robustness Test (Continued)

	I	II	III	IV
Inflation	-0.994*** (0.0858)	-0.432*** (0.1266)	-0.564*** (0.2453)	-0.556*** (0.3061)
SMC	0.056*** (0.0026)	0.027*** (0.0042)	0.057*** (0.0053)	0.051*** (0.0044)
FF	0.011*** (0.0021)	0.011 (0.0006)	0.0129*** (0.0007)	0.0137*** (0.0007)
Constant	1.287*** (0.0184)	1.079*** (0.0269)	0.526*** (0.0828)	0.002 (0.0891)
Cross- Sections	70	70	70	70
Number of instruments	68	69	69	69
Hansen <i>p</i> -value	0.700	0.772	0.689	0.569
AR (1) <i>p</i> -value	0.001	0.001	0.001	0.001
AR (2) <i>p</i> -value	0.411	0.344	0.299	0.378

IV. CONCLUSION

This paper investigates the effects of several efficiency indicators on bank performance in India from 1997 to 2017. Besides studying the factors that contributed to bank profitability at the aggregate level, this study considers the determinants of profitability across bank ownership structure. To address the global financial crisis on bank performance, we further investigate how the financial crisis in 2008-09 impacted bank performance in the case of the Indian commercial banking sector.

Our findings are as follows. First, changes in the cost, revenue and profit efficiencies are likely to influence the profitability conditions of Indian banking. Second, the cost-efficient banks, by reducing the credit cost, positively contribute to bank profitability in India. Likewise, the revenue and profit efficient banks turned out to be profitable banks. Third, banks that are stability inefficient adversely influence bank performance. However, the global financial crisis did not have any impact on the efficiency-profitability relationship. Finally, we show that bank ownership matters for the efficiency-profitability relationship. Here, we unravel two findings: (1) cost efficiency positively affects performance of public sector banks in India, which benefit from economies of scale and economies of scope as opposed to their private and foreign banks counterparts; and (2) a higher level of profit efficiency significantly influences the profitability of public and foreign banks in India.

The finding of this study provides some important policy recommendations. This study suggests that as the profit maximization principle depends on both cost minimization and revenue-maximizing, an improvement in revenue efficiency in accelerating bank profitability should be given due importance. In the Indian banking sector, the major focus has been directed to the cost and technical efficiency. Additionally, profit efficiency that considers both cost and revenue efficiency should be maintained reasonably to prevent the declining trend of bank profitability that the industry has witnessed over the years. Since the cost efficiency

of the private and foreign banks are relatively low compared to PSBs, the former ownership groups should optimally choose the input-output mix. Furthermore, these banks should make the best use of available banking technology to avoid waste.

This study has the following limitations. First, because of lack of data, the current study could not consider off-balance sheet information in estimating several efficiency scores. Second, another aspect that has an important bearing on the determination of bank profitability is corporate governance. The banking sector in emerging economies has drawn special attention to the role of corporate governance in bank performance. However, collecting time series information on corporate governance for each bank was a major constraint for this study. Therefore, analyzing the interrelationship between these two aspects in one of the fastest-growing banking markets could be considered as an agenda for future research. Third, there is an ongoing debate about the accuracy of the estimation of efficiency scores. Development of improved empirical techniques for estimating efficiency can be an important research topic.

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