Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 6
Open Access

Performance Analysis Of Consolidation On The Efficiency And Profitability Of Public Banks In India

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Cite this paper as: Sumitha S, Valarmathi B (2024) Performance Analysis Of Consolidation On The Efficiency And Profitability Of Public Banks In India. Frontiers in Health *Informatics*, *13(6)* 1246-1262

Abstract

Consolidation in the banking sector is a major policy directive used to remedy economic deficiencies while also promoting growth in the sector. In many countries, the consolidation of the banking sector has involved a large number of small banks, creating concerns that the reduction in the number of these institutions could harm the availability of credit to small businesses that have traditionally relied on bank credit. When a bank merges, the larger bank can increase its lending capacity to larger borrowers and restructure its portfolio, concluding credit arrangements with smaller debtors. The economic case for internal consolidation is undisputed. This study examines the manner in which the consolidation affects the performance of India's nationalized public banks. The study uses random sampling to identify the banks for the investigation. Four hypotheses were assessed with the student t-test and a multiple linear regression model. The results demonstrate a significant difference in bank performance following the consolidation process. Furthermore, the findings demonstrated that bank consolidation has a considerable impact on the performance of deposit-taking banks. The primary goal of this research is to investigate the factors of profitability and efficiency, as well as to investigate how consolidation affects the profitability and efficiency of Indian public banks. The Simultaneous Equation Method (SEM) and META Analysis are used to compute the relationship between bank profitability, efficiency, and consolidation. The findings suggest that efforts to provide financial system stability and efficiency should take into account the process of banks consolidation and the increasing globalisation of financial transactions. The ultimate outcome of the study suggests that consolidation has increased the overall efficiency of combined institutions.

Keywords: *consolidation, Simultaneous Equation Method, META Analysis, financial transactions*

Nomenclature

$\overline{X}$	3 year pre-merger mean
$\overline{Y}$	3 year post-merger mean
$S_{\overline{D}}$	standard error of the difference between the means
π_i	profitability indicator (ROA, ROE)
g_i	logit transformation of efficiency indicator (OTE, PTE and SE)
PTE	pure technical efficiency
OTE	overall technical efficiency
SE	Scale Efficiency

1. INTRODUCTION

A country's economic growth depends heavily on its banking industry. It serves as a mediator between savers and borrowers, facilitating capital accumulation. They give loans and advances to small, medium, and large-scale firms in India, promoting economic growth. Since its liberalisation in the early 1990s, the Indian banking system has evolved and diversified globally. However, growing competition from international banks has made efficiency gains and profitability susceptible. The Reserve Bank of India (RBI) and the Government of India are focusing on bank consolidation to achieve economies of scale and increased efficiency [1].

Consolidation might also result in a more stable banking sector. The Indian banking industry is fragmented due to globalisation. To sustain a growing economy, consolidation of strong, profitable, and well-capitalized banks is necessary. Consolidation can improve industrial efficiency and increase bank profits. Consolidation can improve the efficiency of banks, leading to larger economies. Merging banks can significantly impact their management and operating costs, potentially increasing profits by decreasing waste and increasing efficiency. According to a 2013 RBI analysis, merging small and large banks leads to increased economies of scale and higher profits. Mergers with weaker banks may lead to lower profitability for large banks. According to RBI (2013), larger banks are more efficient and profitable than smaller banks [2 – 4].

Bank consolidation occurs when two banks join to form a single organisation. In the banking business, consolidation occurs in two ways: mergers and acquisitions. Mergers unite two banks into a single company, while acquisitions include one bank (the acquirer) taking over another bank (the target) in a friendly or aggressive manner. Mergers in the banking sector lower the number of banks while also creating synergy. Bank Mergers increase economies of scale and expand production capabilities. An acquisition occurs when a larger bank seeks to purchase a target bank due to its failing performance [5 – 9].

Bank consolidation is projected to boost banking sector performance. Mergers can significantly impact a bank's management and operating costs due to structural changes. This may enhance economies of scale and scope among combined banks. Several studies have revealed evidence of this (Sufian et al., 2007; Peristiani, 1997; Khasawneh, 2006; Berger and Humphrey, 1993; Singh, 2009) [10 – 14]. Empirical research suggest that bank consolidation may not boost profitability or efficiency, but may instead decrease it (Kaur and Kaur, 2010; Altunbas et al., 2004; Sanjeev, 2007) [15 – 17]. RBI (2013) suggests that mergers and acquisitions (M&As) can stabilise the banking industry and prevent financial crises.

Consolidating commercial banks in the US has been shown to reduce their financial hardship. Consolidation can improve a bank's profitability and efficiency by increasing its output, loans, and services. Consolidating banks globally aims to attain economies of scale and expand their manufacturing scope. Economy of scope refers to a company's capacity to generate a wider range of products at cheaper costs due to higher volume of business. According to Berger and Humphrey (1993), this category accounts for the majority of merger deals in the United States [10].

In India, weak banks have been restructured through consolidation (RBI, 2013). According to RBI (2013), acquiring a less efficient bank might result in cost savings by lowering operating expenses. Consolidated banks have been shown to improve management effectiveness. Improving efficiency can lower service costs and increase product quality [18].

Rapid changes in India's banking sector have led to a focus on consolidation. According to RBI (2013), merging of smaller and healthier banks has led to increased production efficiency and profitability. Mergers between banks with similar asset sizes strengthen the business. Strengthening the business leads to improved performance. RBI (2013) suggests that consolidating the Indian banking system could help banks secure global markets. The Narasimhan committee's reforms in 1991-I and 1998-II stated that consolidating two strong banks would improve intermediation [19 – 20].

The fundamental purpose of this research is to look into the elements that influence profitability and efficiency, as well as how consolidation impacts the profitability and efficiency of Indian public banks. The Simultaneous Equation Method (SEM) and META Analysis are employed to determine the relationship between bank profitability, efficiency, and consolidation. The findings show that attempts to promote financial system stability and efficiency should consider the consolidation of banks as well as the increasing internationalisation of financial transactions. The analysis concludes that consolidation has boosted the overall efficiency of combined institutions.

2. METHODOLOGY

2.1 Profitability Analysis

Banks' performance and profitability are determined by comparing their balance sheets. The profitability is analysed by comparing pre- and post-merger performance characteristics of commercial banks that consolidated from 1995 to 2022. The hypothesis of the study is,

- H_0: Consolidation has no impact on profitability of consolidated bank
- H_1: Consolidation has improved profitability of the consolidated bank

The performance indicators are analysed by three years before and three years after the merging of each consolidation phase. Common profitability measurements are employed such as Return on Assets (ROA), Return on Equity (ROE), and so on. Three-year pre and post-consolidation profitability measurements are used to assess the impact of consolidation. The use of a three-year term before and after consolidation is common in literature. Consolidation's influence typically takes three years to stabilise, according to research. As a result, it operates within a three-year timeframe.

2.2 Paired sample t-test

The paired sample t-test is used to compare the profitability indicators of banks before and after consolidation during a 3-year period. The study measures banks' profitability using ROA, ROE, operating costs, interest revenue, interest spending, and capital. We calculated the average of three-year pre and post-consolidation metrics for commercial banks that underwent consolidation. The t-test is a typical statistical test used to determine the significance of differences between means of paired samples. The test statistics are [25],

$$t = \frac{observed\ difference\ between\ pre-merger\ and\ post-merger\ means}{standard\ error\ of\ the\ difference\ between\ the\ means}$$

$$t = \frac{\overline{X} - \overline{Y}}{S_{\overline{D}}} \qquad (1)$$

To calculate the probability of discovering a t value with a given size and several degrees of freedom, follow the same steps as for the independent samples t-test.

2.3 Efficiency Analysis

The bank's efficiency is calculated using data envelopment analysis (DEA) against a common efficiency frontier for commercial banks. If a bank's input-output combination is on the frontier, it means the bank is the most efficient. If a bank's input/output combination is below the efficient frontier, it indicates inefficiency. The DEA model measures technical efficiency scores across multiple dimensions, including constant, growing, and declining returns to scale. It describes the actual nature of returns to scale. DEA also analyses the input and output-oriented results of efficiency scores. Efficiency scores are measured in two dimensions, allowing for adjustments to input and output to achieve maximal efficiency. DEA explains the elasticity of substitution between inputs, allowing for full efficiency through input adjustment. We use efficiency scores to assess pre- and post-merger efficiency for banks that underwent consolidation. To compare pre- and post-merger bank efficiency measures, we will apply a basic statistical technique called the median test.

2.4 Simultaneous Equation Method

The Simultaneous Equation Method (SEM) is used to analyse the relationship between bank profitability, efficiency, and consolidation. The SEM approach is ideal for analysing the factors that impact a bank's profitability and efficiency as they are highly connected. The Three-Stage Least Squares estimation (3SLS) is used to estimate the SEM. The 3SLS method addresses the simultaneity bias associated with the ordinary least squares (OLS) method. Both banks' profitability and efficiency are interconnected and impact each other. Efficient banks can increase earnings, whereas inefficient banks can decrease profits. Higher profitability can lead to increased productivity and managerial efficiency. Thus, profitability and efficiency are linked. Similarly, ROA and ROE are used to measure profitability. The mathematical equations for profitability and efficiency are given below [26 – 27],

$$g_i = \ln \frac{Y_i}{1 - Y_i} \quad (2)$$

$$\pi_i = f \quad (3)$$

$$g_i = h \quad (4)$$

3. RESULTS AND DISCUSSIONS

3.1 Impact of bank consolidation on Indian commercial banks (Paired t – Test Analysis)

The study used ratios to quantify profitability and standardise by dividing all variables by total bank assets. Using three-year pre and post-merger mean values of selected bank ratios (e.g., operating cost (OC/TA), return on assets (ROA), interest income (II/TA), interest expenditure (IE/TA), capital (C/TA), and return on equity (ROE), this study examines whether post-merger data indicates an improvement in bank profitability. Table 3.2 shows the average profitability metrics of combined banks three years before and three years after consolidation. Table 3.3 shows the t-test findings to determine whether the average values before and after consolidation differ significantly. Table 3.3 compares the null hypothesis of no significant difference before and after consolidation to the alternative hypothesis of improvement after consolidation.

Table 3.2 Pre and Post-Merger Three-Year Mean Value of Selected Mergers (Ratios)

Name of the Bank	Pre-Merger (Three Year Average)						Post- Merger (Three Year Average)					
	OC/TA	ROA	II/TA	IE/TA	C/TA	ROE	OC/TA	ROA	II/TA	IE/TA	C/TA	ROE
Punjab National Bank	2.4826	0.2556	8.1452	5.34456	0.48552	0.3256	1.856	1.1364	10.876	7.1236	0.84256	1.3232
Canara Bank	2.25876	-0.4456	8.2531	7.15235	0.80281	-0.6561	1.5322	1.23658	7.5263	4.9632	0.5698	2.56987
Union Bank	2.35123	1.24569	6.55425	2.88458	0.45954	2.83415	2.756	1.32204	7.78892	3.91539	0.20187	6.71969
Indian Bank	1.76442	1.04522	9.72353	6.62396	0.622383	1.69729	1.48671	1.26325	6.86013	4.25049	0.34252	2.88562

urce: Author's own calculations.

3.1.1 Punjab National Bank

Table 3.2 shows that on four banking metrics, namely operating cost, returns on assets, interest expenditure, and return on equity, the consolidated bank's post-consolidation performance was superior than its pre-consolidation performance. The other two metrics, interest income and capital, performed worse after consolidation than before. According to Table 3.2, pre-merger operating costs averaged 2. 84, while post-merger costs averaged 1.856. It

suggests that consolidation has decreased the bank's operational costs for its many divisions.

Return on assets is recorded as 0.2556 in the pre-merger era, which is lower than the post-merger ratio of 1.1364. It demonstrates that the return on assets of banks increased following the transactions. On interest income, it is clear that the pre-merger mean value of interest income on loans is larger than the post-merger mean value, which is 10.876, and this is influenced by loan interest income. It demonstrates that consolidation has no effect on bank interest ratios for loans and management.

Interest expense is recorded at a lower ratio in the post-merger period than it was before the merger. This suggests that consolidation has reduced interest spending on deposits to 7.1326, which is higher than the pre-merger average of 5.34456. The post-merger capital ratio is 0.84256, lower than the pre-merger average. More significantly, the merged entity's return on equity has increased to 1.3232 in the post-merger period, exceeding the pre-merger number of 0.3256. The t-test results show that all of the differences between the pre and post-acquisition deals are significant at conventional significance levels. As with the last transaction, this consolidation deal resulted in considerable improvements in OC, ROA, IE, and ROE, as well as significant deterioration in II and C.

Table 3.3 P-values of t-test of comparison between pre and post-merger average profitability indicators of acquirer banks

Deal No	Acquirer	Null Hypothesis (H_0): Pre-Merger Acquirer = Post-Merger Results					
		OC/TA	ROA	II/TA	IE/TA	C/TA	ROE
1	Punjab National Bank	0.00506***	0.023946**	0.003569***	0.000235***	0.058564*	0.005128***
2	Canara Bank	0.2942513	0.337896	0.017452**	0.014123**	0.117786	0.142153
3	Union Bank	0.057452*	0.008963***	0.0245232**	0.1534236	0.0321221**	0.007896***
4	Indian Bank	0.4475243	0.368562	0.2645231	0.412355	0.089633*	0.104215

Source: Author's own calculations. ***, ** and * = 1 percent, 5 percent and 10 percent level of significant.
OC/TA = operating cost is divided by total assets; II/TA= interest income is divided by total assets; IE/TA=interest expenditure is dividedby total assets; C/TA = capital is divided by total assets;

3.1.2 Canara Bank

Table 3.2 reveals that the average pre-merger operating cost was 2.25876, which is higher than the post-merger results of 1.5322. It suggests that consolidation has decreased the bank's operational costs for its many divisions. Return on assets is recorded at 0.4456in the pre-merger era, which is somewhat lower than the post-merger ratio of 1.23658. In terms of interest income, it is clear that the pre-merger mean value of 8.2531 is larger than the post-merger value of 7.5263, suggesting that the merged bank's interest revenue decreased following consolidation. Interest expenditure has improved from 7.15235 in the pre-consolidation era to 4.9632 in the post-consolidation period.

Capital ratio is recorded at 0.5698 in the post-merger phase, which is lower than the pre-merger average value, indicating deterioration. More significantly, the merged entity's return on equity was 2.56987 in the post-merger period, greater than the pre-merger value of 0.6561, indicating an improvement. The statistical t-test results shown in Table 3.2 can be used to determine if the variations in performance indicators before and after the acquisition are significant or not. Table 3.2 shows that, except for ROA and ROE, the other metrics differed significantly at conventional levels of significance. Thus, we may conclude that the purchase had no substantial influence on the acquired bank's ROA and ROE.

3.1.3 Union Bank

Table 3.2 reveals that the average pre-merger operating cost was 2.35123, which is higher than the post-merger results of 2.756. It demonstrates that consolidation lowered the bank's operating costs across its divisions. The return on assets is recorded as 1.24569 in pre-merger times, which is lower than the post-merger ratios of 1.32204. It demonstrates that the return on assets of banks increased following the transactions. On interest income, the pre-merger mean value of interest income on loans is noted to be greater than the post-merger, which registers at 7.78892 and was judged to be significant at the 5% level. It demonstrates that consolidation has a negative influence on the bank's interest ratios for loans and management.

In terms of interest spending, it showed a greater ratio after the merger than it did before. This suggests that consolidation has boosted interest expenditure on deposits, which was seen at 3.91539 in the post-merger period, higher than the pre-merger value of 2.88458. The capital ratio is registered at 0.20187 in the post-merger period, which is lower than the pre-merger mean figure. More notably, the merged entity's return on equity was 6.71969 in the post-merger period, which is higher than the pre-merger value of 2.83415. The statistical t-test results in Table 3.2 shows that whether or not these profitability metrics differ significantly before and after the consolidation deal.

3.1.4 Indian Bank

Table 3.2 shows that the acquirer bank performed better after consolidation in four banking parameters: operating cost, interest expenditure on deposits, capital ratio, and return on assets. According to Table 3.2, pre-merger operating costs averaged 1.76442, which was higher than post-merger results of 1.48671. It suggests that consolidation has decreased the bank's operating costs for its operations. The ROA value was 1.04522 in the pre-merger period, which is greater than the post-merger ratio of 1.26325. It demonstrates that the return on assets of banks decreased following the transactions.

In terms of interest income, the pre-merger mean value of interest income on loans was higher than the post-merger average, which was 6.86013. It demonstrates that consolidation has little effect on bank interest ratios on loans. In terms of interest spending, the ratio is lower in the post-merger period than it was before the merger. This suggests that consolidation has reduced interest spending on deposits, which now stands at 4.25049 in the post-merger period, down from 6.62396 in the pre-merger period. The results were also reflected in the capital on assets ratio, which was 0.34252 post-merger, higher than the pre-merger mean value of 0.622383. The t-test in Table 3.2 shows that the consolidation agreement resulted in significant improvements in OC (at the 5% level), ROA, and capital (at the 10% level), whereas others were judged to be negligible.

3.2 Impact of Mergers and Acquisitions on Efficiency of Banks

Table 3.4 displays the input and output-oriented DEA efficiency scores for selected commercial bank mergers and acquisitions in India. It provides the average of three-year pre-merger efficiency scores for the four consolidation mergers in India. It is clear that in two out of four consolidation deals, the PTE is bigger than the OTE, indicating that acquirers used less input to create the same amount of output. The output-oriented model yielded the same findings as the input-oriented approach. Hence, two out of four banks, Punjab National Bank and Union Bank, demonstrate that the acquirer is more efficient, with superior efficiency ratings in all three efficiency measures (OTE, PTE, and SE). The overall technical inefficiency is the result of PTE and SE.

Table 3.4 displays the output-oriented PTE and SE scores. In terms of output-oriented scores, it is clear from the four consolidation mergers that two banks have achieved complete efficiency with a PTE score of 1. Furthermore, the remaining banks achieved inefficient results in PTE, with efficiency scores ranging from 50 to 90 percent. In terms of scale efficiency concerns, two out of four target banks are more efficient than target banks at the manufacturing scale. The non-parametric median test was used to determine whether the observed differences in acquirer and target bank efficiency ratings were statistically significant. In this scenario, median tests are more suitable.

Table 3.4 Mean of Efficiency Scores of Selected Consolidations of Public Banks in India three-year pre-merger

Input-Oriented					Output-Oriented			
S.No.	**Name of the Bank**	**OTE**	**PTE**	**SE**	**Name of the Bank**	**OTE**	**PTE**	**SE**
1	Punjab National Bank	0.68953	0.9258	0.67852	Punjab National Bank	0.68953	0.92	0.67756
2	Canara Bank	0.54563	0.9258	0.5752	Canara Bank	0.54635	0.92	0.576
3	Union Bank	0.62587	0.81236	0.84412	Union Bank	0.6256	0.81	0.8442
4	Indian Bank	0.44853	0.67757	0.77452	Indian Bank	0.449	0.677	0.7746
Source: SPSS calculation								
OTE = overall technical efficiency (Constant Return to Scale of Technical Efficiency)								
PTE = pure technical efficiency (Variable Returns to Scale of Technical Efficiency)								
SE = Scale Efficiency								

Table 3.5 shows the median test P-values for the difference in acquirer and target bank efficiency scores (OTE, PTE, and SE), calculated using both input-oriented and output-oriented models. The null hypothesis examined here is that there is no difference in efficiency scores between acquirer and target banks, as opposed to the alternative hypothesis that the acquirer bank's efficiency is greater than the target bank's efficiency. The median test of the overall efficiency of bank consolidation reveals that two out of four consolidation deals accepted the null hypothesis with a higher probability value (0.45). The results for the input-oriented model apply to the output-oriented approach as well.

Table 3.5 Median test results of hypothesis of equal efficiency score (pre-consolidation)

Name of the Bank	Input-oriented			Output-oriented		
	OTE	**PTE**	**SE**	**OTE**	**PTE**	**SE**
	P value	P value	P value	P value	P value	P value
Punjab National Bank	0.45	0.05**	0.05**	0.45	0.05**	0.05**
Canara Bank	0.45	0.05**	0.05**	0.45	0.05**	0.05**
Union Bank	0.45	0.05**	0.45	0.45	0.05**	0.45
Indian Bank	0.45	0.45	0.45	0.45	0.45	0.45
Source: Authors own calculations. ***,** and * = 1 percent , 5 percent and 10 percent level of significant respectively						

3.3 Consolidation as Determinant of Profitability and Efficiency of Banks

3.3.1 SEM analysis 1: Endogenous variables E_{OTE} and Π_{ROA}

Table 3.6 summarizes the 3SLS estimation results for overall technical efficiency and profitability. In SEM 1, we

analyze how consolidation affects EOTE and ΠROA. Table 3.6 left panel displays the results of SEM using input-oriented efficiency, while the right panel displays the results of SEM using output-oriented efficiency scores.

3.6 Simultaneous Equation results of E_{OTE} and Π_{ROA}

Input-oriented efficiency scores					**Output-oriented efficiency scores**				
OTE equation (dep var: E_{OTE})	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**OTE equation (dep var: E_{OTE})**	**Coef.**	**Std. Err.**	**T**	**P > t**
ΠROA	1.915344	1.131076	1.69	0.090*	ΠROA	1.915344	1.131076	1.69	0.090*
Consolidation Dummy (CD)	8.935263	9.22155	0.97	0.333	Consolidation Dummy (CD)	8.935263	9.22155	0.97	0.333
Interaction Term (CD* *ln*TA)	-0.6186858	0.6338659	-0.98	0.329	Interaction Term (CD* *ln*TA)	-0.6186858	0.6338659	-0.98	0.329
*Ln*TA	0.4900936	0.3314036	1.48	0.139	*ln*TA	0.4900936	0.3314036	1.48	0.139
Capital	0.2641123	0.0704051	3.75	0.000***	Capital	0.2641123	0.0704051	3.75	0.000***
Reserves	-0.1346389	0.1444697	-0.93	0.351	Reserves	-0.1346389	0.1444697	-0.93	0.351
Borrowings	0.0092632	0.0268078	0.35	0.73	Borrowings	0.0092632	0.0268078	0.35	0.73
Investment	-0.0127471	0.0131458	-0.97	0.332	Investment	-0.0127471	0.0131458	-0.97	0.332
Operating Profit	-0.7213196	0.8684141	-0.83	0.406	Operating Profit	-0.7213196	0.8684141	-0.83	0.406
Net in Income	0.0674437	0.5575972	0.12	0.904	Net in Income	0.0674437	0.5575972	0.12	0.904
ROE	-0.0402895	0.0723039	-0.56	0.577	ROE	-0.0402895	0.0723039	-0.56	0.577
CRAR	-0.0753449	0.0407592	-1.85	0.065*	CRAR	-0.0753449	0.0407592	-1.85	0.065*
Net NPA	0.3349402	0.4093273	0.82	0.413	Net NPA	0.3349402	0.4093273	0.82	0.413
ROA equation (dep var:	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**ROA equation (dep var:**	**Coef.**	**Std. Err.**	**T**	**P>|t|**

ΠROA)					**ΠROA)**				
EOTE	-8.271382	265.7775	-0.03	0.975	*EOTE*	-8.271382	265.7775	-0.03	0.975
Consolidation Dummy (CD)	8.937459	2.843259	0.03	0.975	Consolidation Dummy (CD)	8.937459	2.843259	0.03	0.975
Interaction Term (CD* *ln*TA)	-6.295135	200.0161	-0.03	0.975	Interaction Term (CD* *ln*TA)	-6.295135	200.0161	-0.03	0.975
*Ln*TA	5.054254	160.0391	0.03	0.975	*ln*TA	5.054254	160.0391	0.03	0.975
Capital	2.680617	85.3987	0.03	0.975	Capital	2.680617	85.3987	0.03	0.975
Reserves	0.3844356	9.787315	0.04	0.969	Reserves	0.3844356	9.787315	0.04	0.969
Borrowings	-0.0724314	2.004625	-0.04	0.971	Borrowings	-0.0724314	2.004625	-0.04	0.971
Investment	-0.151649	4.768246	-0.03	0.975	Investment	-0.151649	4.768246	-0.03	0.975
Operating Cost	-3.76516	113.7718	-0.03	0.974	Operating Cost	-3.76516	113.7718	-0.03	0.974
Operating Profit	-0.0573556	16.89734	0	0.997	Operating Profit	-0.0573556	16.89734	0	0.997
Net in Income	-1.432308	42.12085	-0.03	0.973	Net in Income	-1.432308	42.12085	-0.03	0.973
CRAR	-0.620385	19.93309	-0.03	0.975	CRAR	-0.620385	19.93309	-0.03	0.975
Net NPA	-2.313151	63.52478	-0.04	0.971	Net NPA	-2.313151	63.52478	-0.04	0.971
Equation	**RMSE**	**"R-sq"**	**F-Stat**	**P**	**Equation**	**RMSE**	**"R-sq"**	**F-Stat**	**P**
EOTE	1.817822	0.5389	60.83	0	*EOTE*	1.817822	0.5389	60.83	0
ΠROA	16.93134	-217.3203	0.29	1	ΠROA	16.93134	-217.3203	0.29	1
***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.									

SEM results using input-oriented OTE scores

The results indicate that the consolidation dummy (CD) has no significant impact on E_{OTE} and Π_{ROA}. Similarly, the interaction variable between consolidation and asset size is not significant for E_{OTE} and Π_{ROA}. These findings show that consolidation has little effect on efficiency and profitability. The SEM results reveal that banks' profitability (measured by ROA) is positively associated with banks' efficiency (measured by OTE) at a ten percent significance level, but not the reverse. Aside from that, looking at additional control variables, we find that bank capital and capital adequacy ratio are significant with E_{OTE} at the 1 percent and 5 percent levels, respectively, whereas CRAR shows a negative correlation with E_{OTE}.

SEM results using Output-oriented OTE scores

Table 3.6 right-hand panel displays the SEM estimate results for output-oriented EOTE and ΠROA. Furthermore, the null hypothesis that consolidation has an impact on bank profitability and efficiency is rejected. ΠROA significantly predicts EOTE at the 10% level, with a positive coefficient. However, EOTE was found to have no substantial impact on ΠROA. The output-oriented result in equation 1 showed that capital and CRAR were significant at the 1 percent and 10% levels, respectively. However, capital has a positive correlation of 0.26 on EOTE, but CRAR has a negative value of -0.07. Furthermore, additional exogenous variables were shown to be unimportant in predicting bank efficiency and profitability. The total results suggest that the coefficient of consolidation is positive but not statistically significant. The interaction term reports a negative coefficient but is inconsequential for efficiency. All variables are found to be statistically negligible in terms of ROA. These results were also seen in the right-hand panel of output-oriented efficiency.

3.3.2 SEM analysis 2: Endogenous variables EPTE and ΠROA

The SEM 2results are presented in Table 3.7, with input-oriented PTE in left panel and output-oriented PTE in right panel.

SEM results using input-oriented PTE scores

In equation 1, the simultaneous calculation of EPTE and ΠROA from Table 3.7 reveals a positive correlation between ΠROA and bank EPTE at a 5% significance level. The coefficient of consolidation dummy in determining PTE has been computed as -47.32, which is significant at the 5% level. However, the interaction dummy for consolidated banks' asset size is both positive and significant. Thus, contrary to our expectations, combined banks are much less efficient in terms of pure technical efficiency measures; yet, if consolidation results in larger asset sizes (as suggested by the interaction term), the impact is positive and considerable. Many other control variables, such as ln Total assets, Capital and Net interest income, bank borrowings, and office per employee, have been proven to have a positive coefficient and are statistically significant at conventional levels in influencing PTE. On the other hand, profit per employee is considerably and negatively related to PTE.

SEM results using output-oriented PTE scores

The relationship between output-oriented PTE and ROA, along with other control variables, is explained in the right panel of Table 3.7. The PTE equation shows that capital, net interest income, borrowings, office per employee ln TA, and the interaction term are all positively significant. The consolidation dummy was shown to be significant at the 5% level, but had a negative coefficient on EPTE. These findings are comparable to the input-oriented PTE discussed above, and they show that consolidation in general appears to have a negative influence on PTE, but if asset size increases as a result of consolidation, it has a favourable impact on PTE. The results also reveal that the profitability metric ROA is positive and substantial at the 5% level when determining PTE.

3.7 Simultaneous Equation results of E_{OTE} and Π_{ROA}

Input-oriented efficiency scores	Output-oriented efficiency scores

PTE equation (dep var: E_{PTE})	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**PTE equation (dep var: E_{PTE})**	**Coef.**	**Std. Err.**	**T**	**P>t**
ΠROA	5.753592	2.719333	2.12	0.034**	ΠROA	5.864115	2.716177	2.16	0.031**
Consolidation Dummy (CD)	-47.32631	22.17045	-2.13	0.033**	Consolidation Dummy (CD)	-48.83349	22.14472	-2.21	0.027**
Interaction Term (CD* *ln*TA)	3.44919	1.523941	2.26	0.024**	Interaction Term (CD* *ln*TA)	3.550328	1.522172	2.33	0.020**
*ln*TA	1.867511	0.7967608	2.34	0.019**	*Ln*TA	1.777929	0.7958361	2.23	0.025**
Capital	0.336254	0.1692679	1.99	0.047**	Capital	0.336161	0.1690715	1.99	0.047**
Reserves	0.2716586	0.3473342	0.78	0.434	Reserves	0.274927	0.3469311	0.79	0.428
Borrowings	0.2440534	0.0644514	3.79	0.000***	Borrowings	0.2441845	0.0643766	3.79	0.000***
Investment	0.0210889	0.0316052	0.67	0.505	Investment	0.020668	0.0315685	0.65	0.513
Operating Profit	-2.503395	2.087842	-1.2	0.231	Operating Profit	-2.591953	2.085418	-1.24	0.214
Net in Income	2.779085	1.340576	2.07	0.038**	Net in Income	2.799124	1.33902	2.09	0.037**
ROE	0.025739	0.173833	0.15	0.882	ROE	0.0145118	0.1736312	0.08	0.933
CRAR	-0.0567439	0.0979933	-0.58	0.563	CRAR	-0.0747734	0.0978795	-0.76	0.445
Net NPA	1.16432	0.9841049	1.18	0.237	Net NPA	1.099919	0.9829627	1.12	0.263
ROA equation (dep var: Π_{ROA})	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**ROA equation (dep var: Π_{ROA})**	**Coef.**	**Std. Err.**	**T**	**P>|t|**
EPTE	0.1417545	0.1685978	0.84	0.4	*EPTE*	0.1515715	0.1914292	0.79	0.428
Consolidation Dummy (CD)	6.878067	7.734962	0.89	0.374	Consolidation Dummy (CD)	7.503858	8.942497	0.84	0.401
Interaction	-	0.55295	-	0.364	Interaction	-	0.63888	-	0.393

Term (CD* *ln*TA)	0.5018329	96	0.91		Term (CD* *ln*TA)	0.5459021	43	0.85	
*ln*TA	-0.2537739	0.4033933	-0.63	0.529	*Ln*TA	-0.2628797	0.4394907	-0.6	0.55
Capital	-0.0422345	0.0806084	-0.52	0.6	Capital	-0.0476784	0.0922284	-0.52	0.605
Reserves	-0.0221069	0.130485	-0.17	0.865	Reserves	-0.0317832	0.1501914	-0.21	0.832
Borrowings	-0.0362276	0.0318894	-1.14	0.256	Borrowings	-0.0379952	0.03601	-1.06	0.291
Investment	-0.0034954	0.0045357	-0.77	0.441	Investment	-0.0034377	0.0048133	-0.71	0.475
Operating Cost	-0.0412233	0.2355033	-0.18	0.861	Operating Cost	-0.0248515	0.269394	-0.09	0.926
Operating Profit	0.4195623	0.2467132	1.7	0.089*	Operating Profit	0.4318677	0.2619649	1.65	0.099*
Net in Income	-0.4157372	0.3892685	-1.07	0.286	Net in Income	-0.4374033	0.4373281	-1	0.317
CRAR	0.0080746	0.0171021	0.47	0.637	CRAR	0.0113521	0.020807	0.55	0.585
Net NPA	-0.2207056	0.1575751	-1.4	0.161	Net NPA	-0.20027	0.190413	-1.05	0.293
Equation	**RMSE**	**"R-sq"**	**F-Stat**	**P**	**Equation**	**RMSE**	**"R-sq"**	**F-Stat**	**P**
EPTE	4.370408	0.6688	129.92	0	*EPTE*	4.365336	0.6645	127.18	0
ΠROA	0.6267094	0.7009	208.5	0	ΠROA	0.6654904	0.6627	184.9	0
***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.									

3.3.3 SEM analysis 3: Endogenous variables E_{SE} and Π_{ROA}

Table 3.8 shows the 3SLS estimation for simultaneous Scale Efficiency (SE) and ΠROA. The left panel displays the results for input-oriented SE, while the right panel displays the results for output-oriented SE.

SEM results using input-oriented SE scores

The results show that the consolidation dummy and interaction term have no significant effect on either endogenous

variable (ESE or ΠROA). Thus, consolidation and the asset size effect of consolidation are not important predictors of scale efficiency and profitability. Among other variables, profitability (ROA) is found to have a considerable impact (at the 10% level) on scale efficiency (ESE), whereas ESE is found to be inconsequential for ROA. Furthermore, bank capital and capital adequacy ratio are significantly related to ESE at the 1 percent and 5 percent levels, respectively, but CRAR has a negative relationship with ESE.

SEM results using output-oriented SE scores

When we used the output-oriented scale efficiency measure in the efficiency equation and ROA in the profitability equation of the SEM, we discovered no association between consolidation, efficiency, and profitability (right panel of Table 3.8).

Table 3.8 Simultaneous Equation results of ESE and ΠROA

Input-oriented efficiency scores 66's banks					**Output-oriented efficiency scores 66's banks**				
SE equation (dep var: E_{SE})	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**SE equation (dep var: E_{SE})**	**Coef.**	**Std. Err.**	**t**	**P>t**
ΠROA	2.035808	1.124712	1.81	0.070*	**ΠROA**	4.395759	1.590148	2.76	0.006***
Consolidation Dummy (CD)	2.979173	9.169727	0.32	0.745	Consolidation Dummy (CD)	-6.865715	12.96432	-0.53	0.596
-Interaction Term (CD* *ln*TA)	-0.1974578	0.6303037	-0.31	0.754	Interaction Term (CD* *ln*TA)	0.5757287	0.8911343	0.65	0.518
*ln*TA	0.0489959	0.3295412	0.15	0.882	*Ln*TA	-1.311435	0.4659111	-2.81	0.005***
Capital	0.2288638	0.0700094	3.27	0.001***	Capital	-0.0698633	0.0989805	-0.71	0.48
Reserves	-0.2285914	0.1436579	-1.59	0.112	Reserves	-0.6235911	0.2031106	-3.07	0.002***
Borrowings	-0.0015564	0.0266572	-0.06	0.953	Borrowings	0.0343645	0.0376884	0.91	0.362
Investment	-0.0137279	0.0130719	-1.05	0.294	Investment	-0.0042075	0.0184813	-0.23	0.82
Operating Profit	-0.82434	0.8635339	-0.95	0.34	Operating Profit	0.9547446	1.220879	0.78	0.434

	58								
Net in Income	0.1653929	0.5544637	0.3	0.765	Net in Income	-1.257746	0.7839104	-1.6	0.109
ROE	-0.0805464	0.0718975	-1.12	0.263	ROE	-0.126639	0.10165	-1.25	0.213
CRAR	-0.0760983	0.0405301	-1.88	0.060*	CRAR	-0.0104305	0.0573022	-0.18	0.856
Net NPA	0.0823034	0.407027	0.2	0.84	Net NPA	1.384788	0.5754618	2.41	0.016**
ROA equation (dep var: Π_{ROA})	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**ROA equation (dep var: Π_{ROA})**	**Coef.**	**Std. Err.**	**T**	**P>|t|**
ESE	-0.4913935	1.088772	-0.45	0.652	***ESE***	-0.4988501	1.509353	-0.33	0.741
Consolidation Dummy (CD)	3.30103	7.838763	0.42	0.674	Consolidation Dummy (CD)	-0.4927797	9.024947	-0.05	0.956
Interaction Term (CD* *ln*TA)	-0.2369102	0.5385596	-0.44	0.66	Interaction Term (CD* *ln*TA)	0.0639377	0.6827814	0.09	0.925
*ln*TA	0.1429055	0.2434678	0.59	0.557	*ln*TA	-0.4645454	1.651066	-0.28	0.778
Capital	0.1713771	0.3314266	0.52	0.605	Capital	0.0591831	0.1231685	0.48	0.631
Reserves	0.0655988	0.0855668	0.77	0.443	Reserves	-0.0270879	0.3462607	-0.08	0.938
Borrowings	-0.0184675	0.0243366	-0.76	0.448	Borrowings	-0.0111127	0.0229656	-0.48	0.628
Investment	-0.0122345	0.0215131	-0.57	0.57	Investment	-0.0108594	0.0256028	-0.42	0.671
Operating Cost	-0.4471868	0.5180114	-0.86	0.388	Operating Cost	-0.7137579	1.494826	-0.48	0.633
Operating Profit	0.29672	0.5412	0.55	0.584	Operating Profit	1.59642	3.5967	0.44	0.657

	64	7				9	13		
Net in Income	-0.1550978	0.3634222	-0.43	0.67	Net in Income	-1.004768	2.687168	-0.37	0.708
CRAR	-0.0370591	0.0858518	-0.43	0.666	CRAR	-0.0046683	0.0382145	-0.12	0.903
Net NPA	-0.5633304	0.5202534	-1.08	0.279	Net NPA	-0.2728858	0.2726569	-1	0.317
Equation	**RMSE**	**"R-sq"**	**F-Stat**	**P**	**Equation**	**RMSE**	**"R-sq"**	**F-Stat**	**P**
*Ln*SE	1.807606	0.5676	68.67	0	*Ln*SE	2.555625	0.5408	58.62	0
ΠROA	1.167505	-0.0381	60.08	0	**ΠROA**	1.594307	-0.9358	32.22	0.006
***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.									

3.4 Meta Analysis

Meta-analysis was done to determine correlation values for each factor based on existing study samples. Table 3.9 shows the correlation for the different variables. From the table 3.10, it shows that the r value of the internal resistance factor group is 0.1613 (Nri/N) with a standard deviation of 0.0152 based on $(N(ri-r)^2/N)$ so that it can be seen:

- Lower limit value = 0.1613 - (1.01 x 0.1526) = 0.0087
- Upper limit value = 0.1613 - (1.01 x 0.1526) =0.3154

Table 3.9 Different Variable Correlation

S. No	Variables	No. of Samples (N)	Correlation Coefficient (ri)
1	Capital	250	0, 150
2	Reserves	250	0, 130
3	Borrowings	250	0, 180
4	Investment	250	0, 160
5	Operating Cost	250	0, 175
6	Operating Profit	250	0, 155
7	Net in Income	250	0, 167
8	CRAR	250	0, 178
9	Net NPA	250	0, 157

Table 3.10 Estimated Correction of Variable Sampling Error

S. No	Variables	N	ri	Nri	r	ri-r	$(ri-r)^2$	$N(ri-r)^2$
1	Capital	250	0, 150	37500	0, 326	-0,176	30976	7744000
2	Reserves	250	0, 130	32500	0, 326	-0,196	38416	9604000

3	Borrowings	250	0, 180	45000	0, 326	-0,146	21316	5329000
4	Investment	250	0, 160	40000	0, 326	-0,166	27556	6889000
5	Operating Cost	250	0, 175	43750	0, 326	-0,151	22801	5700250
6	Operating Profit	250	0, 155	38750	0, 326	-0,171	29241	7310250
7	Net in Income	250	0, 167	41750	0, 326	-0,159	25281	6320250
8	CRAR	250	0, 178	44500	0, 326	-0,148	21904	5476000
9	Net NPA	250	0, 157	39250	0, 326	-0,169	28561	7140250
Total		2250	1452	363000	2934	-1482	246052	61513000

The variation in the value of the relationship between variable factors and barriers to public bank consolidations is 0.1613 with a value ranging from 0.0087 to 0.3154 at the 95% confidence level. Based on a comprehensive meta-analysis study, it can be seen that there is a significant relationship between different variable factors and barriers to the public bank consolidations in SMEs. Based on the study conducted, it can also be concluded that different variable factors' role is 0.085 or 8.5% in explaining the barriers to the public bank consolidations in SMEs.

Conclusion

This study examines the manner in which the consolidation affects the performance of India's nationalized public banks. The study selects the banks for inquiry using random sampling. Four hypotheses were tested using the student t-test and a multiple linear regression model. The data show a considerable difference in bank performance after the consolidation process. Furthermore, the study found that bank consolidation has a significant impact on the performance of deposit-taking banks. The fundamental purpose of this research is to look into the elements that influence profitability and efficiency, as well as how consolidation impacts the profitability and efficiency of Indian public banks. The Simultaneous Equation Method (SEM) and META Analysis are employed to determine the relationship between bank profitability, efficiency, and consolidation. The findings show that attempts to promote financial system stability and efficiency should consider the consolidation of banks as well as the increasing internationalisation of financial transactions. The analysis concludes that consolidation has boosted the overall efficiency of combined institutions.

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