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Assessing Pakistani Bank's Efficiency, A Data Envelopment Analysis Study on Post-M&As

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Abstract

Large-scale M&A involved in the banking sector as the primary target have been initiated by nations globally throughout the last decade of the 20th century. A merger is a corporate restructuring tactic that has a wide range of effects on the business's performance. This study analyzed the impact of M&A on the banking industry in Pakistan from 2007 to 2017, covering four years before and after (-4, +4 years) each M&As and calculated the average efficiency score for before and after merger periods. To examine the impact of merger and acquisition on bank efficiency, this study employs DEA method in R software under both CRS and VRS. Three different input and output frameworks are applied to estimate each bank technical efficiency, pure technical efficiency and scale efficiency. The results reveal a mixed impact of M&As on banks efficiency. The result reveals that few banks showed improve efficiency after M&A technique, while many banks face increased inefficiency after M&As. However, In conclusion the research findings depict that Pakistani Banks has not got any beneficial change after mergers and acquisitions (M&As).

Keywords Merger & Acquisition, Data envelopment analysis (DEA), TE, PTE, SE

Introduction

The performance of financial sectors plays a vital role in supporting the overall health and stability of a country's economy. One of the most important way that banks and other institutions can handle issues and size opportunities in the industry is through mergers and acquisitions , especially during periods of financial crises at both macro and micro-economic levels. For this reason, merging with or acquiring another institution can serve as a method to decrease costs, increase efficiency and income. This activity is frequently adopted to achieve growth (Palepu & Healy 2007). To achieve goals such as increase market visibility, profitability, and operational efficiency, these synergies require meticulous planning and the successful integration of the merging firms (Hankir et al. 2011). Panetta (2009) argued that mergers and acquisitions can lead to financial efficiencies and additional advantages, but they also present considerable obstacles that, if not handled correctly, can lead to increased credit risk.

A merger occurs when two or more entities collaborate through a purchase, with one entity retaining its own identity. While the others are dissolved. During this process, the deliberate exchange of stocks between the two parties is facilitated by cash payments to the combined firm. Acquisition is a technique by which a company buys either all or some of the ownership of another company. It is also known as a takeover. It might be friendly or hostile and entail purchasing the target company's assets, shares or both.

The aim of this study is to estimate the dynamics of M&A activity in Pakistan's banking sector and ascertain whether such activity affects the industry's overall efficiency.

The framework of this paper is as follows: The next section provides a review of the relevant literature. Section 3 Methodology and discusses Specification of input-output and Data source Section 4 Report of the empirical analysis and finally provide some concluding remarks.

Literature Review

DEA first introduced by Charnes et al. (1978) and further Proposed by Banker et al. (1984) is a broadly used non-parametric method for estimate the efficiency of decision-making units (DMUs), including banks. Several studies have used DEA to investigate the impact of M&As (Lozano et al. (2011); Wu et al. (2011); Li et al. (2019); Zhu et al. (2018); Li et al. (2020); Zhu et al. 2020). Scholars have examined and assessed the impacts of mergers and acquisitions (M&A) at commercial banks in great detail in domestic research. For instance, 冯世会 (2021) evaluated the effect of Jiangsu Bank merger and acquisitions from 2005 to 2019 using the three-stage DEA model and financial indicator analysis approach. He compared and explored the efficiency scale, the technical efficiency scale, and the comprehensive efficiency scale both before and after the merger. 李佳 (2022) conducted a thorough analysis of the function and significance of M&As during the reform period by measuring the productivity of Chinese banks have M&As from 2004 to 2018 using a two-stage DEA model. Various studies have employed different methodologies such as ratio analysis, DEA, SFA, and DFA to analysis the effectiveness of M&As in addressing bank issues, revealing mixed findings. Worthington (2001) reported that the credit union industry in Australia following mergers experienced improvements in both scale efficiency and pure technical efficiency. Knapp (2005) observed a negative response from the market to the announcements of bank mergers, with the earnings of bank holding companies stayed lower than the average in the industry following the merger. Altunbas (2008) noted a better performance of European banks following mergers, especially those involving international acquisitions. Same as, a slightly beneficial impact noted in terms of credit risk management. Mahmood (2012) investigate companies in Pakistan follow merger technique. This research focused on eight companies that underwent the M&A process in Pakistan between 2000 and 2002. The result indicates the positive impact on the stock prices of these companies. On the other hand, research by Bertrand (2012), Akben-Selcuk (2011) and Behr (2011), it was found that the technique of M&A negatively affected on the banks.

After review of the relevant literature carefully, confirm that any firm is affected by M&As. In a few cases, Mergers and Acquisitions improved financial performance. At contrast, we observed that M&A have also negative impact on financial performance. A review on the literature of M&As in Pakistan, Highlight a significant research gap. To address this, present study extends data and time period and using different input-output approaches based DEA method, to examine M&A is beneficial or not in Pakistani banking industry, covering both before and after merger periods.

Methodology

This study employs the broadly applied DEA model to assess the technical efficiency and its components of banks during both periods. Technical efficiency (TE) is increasing output requires either reducing another output or using more of at least one input and decreasing an input necessitates either using less output or more of another input. Scale efficiency (SE) in DEA assesses how effectively a decision-making unit (DMU), such as banks, operates at its optimal size to maximize efficiency. PTE shows how well management is able to turn inputs into outputs through good production planning. The output of a decision requires a series of decisions to complete the process from input to output. Therefore, units making such decisions are called Decision-Making Units (DMUs). Efficiency scores commonly range from 0 to 1, with a value of 1 indicating complete efficiency and a value of 0 representing total inefficiency. In 1957, Farrell established the foundation for assessing efficiency and productivity on a small scale by introducing the idea that efficiency separated into technical efficiency and allocative efficiency. Expanding upon Farrell's concepts, CCR utilized linear programming in 1978 publication "Measuring the efficiency of decision making units" to calculate the initial empirical production-technology frontier, known as CCR models. This model works well when each DMU is performing at its peak but it may not always be achievable. To address this problem, BBC (1984) developed an expanded model suitable for variable returns to scale. The BCC model is known as the scale situation. This model decomposes overall TE into two components: pure technical efficiency (PTE) and scale efficiency (SE).

To assess how well a DMU performs using this technique, Charnes et al. (1978) proposed the use highest ratio of weighted outputs to weighted inputs for that particular DMU, as long as this ratio

was not greater than the highest ratio among all other DMUs in the study, which should be less than or equal to 1. Consider N decision-making unit （DMUs) that producing O outputs using I inputs. Mathematically,

$$Max\ e^0 = \sum_{o=1}^{O} u_o^0 y_o^0 \ / \ \sum_{i=1}^{i} v_i^0 x_i^0 \qquad (1)$$

Subject to:

$$\sum_{o=1}^{O} u_o^0 y_o^n \ / \ \sum_{i=1}^{I} v_i^0 x_i^n \leq 1 \qquad (2)$$

Where n=1,2, 3, N; $u_o^0, v_i^0 \geq 0$; i=1,2, 3, I; o=1,2, 3, O

Where y_o^n known as output and x_i^n known as input, of the nth DMU, each nth DMU yielding N (u_o^0, v_i^0), weight sets. The DMU being measured is represented by index 0. the analysis is conducted for each DMU in the sample.

$$max\ h^0 = \sum_{o=1}^{O} u_o^0\, y_o^0 \qquad (3)$$

Subject to:

$$\sum_{i=1}^{I} v_i^0\, x_i^0 = 1 \qquad (4)$$

$$\sum_{o=1}^{O} u_o^0\, y_o^n \ - \ \sum_{i=1}^{I} v_i^0\, x_i^n \leq 0 \qquad (5)$$

$n = 1,2,3,\ldots,N \qquad v_i^0 \geq \varepsilon \qquad u_o^0 \geq \varepsilon$

$i \ = \ 1,2,3,\ldots,I \qquad O \ = \ 1,2,3,\ldots,O$

In DEA, the aim of ε is to confirm that all inputs and outputs are assigned positive weights, allowing for a mathematically solid assessment of efficiency for every DMUs. In DEA method if efficiency score Max $h^0 = 1$, the DMU^0 is 100% efficient. In contrast if $Max\ h^0 < 1$ indicate DMU^0 in efficient. The solution is solved N times to calculate an efficiency score for each DMU included in the sample (Table 1).

Table 1. Sample Banks Mergers & Acquisitions.

Sr.No	Banks engaged in M&A technique	Post-M&A Name
1	Askari Leasing Limited, Askari Bank Limited	Askari Bank Limited (2010)
2	The Royal Bank of Scotland Limited, Faysal Bank Limited	Faysal Bank Limited FBL (2011)
3	NIB Bank Limited, MCB Bank Limited	MCB Bank Limited MCB (2017)
4	HSBC and Meezan Bank Limited	Meezan Bank Limited MBL(2014)
5	Habib Bank Limited, Saif Power Limited	Habib Bank Limited HBL (2008)
6	My Bank Limited, Summit Bank Limited	Summit Bank Limited SBL (2011)
7	KASB Bank Ltd, Bank lslami Pakistan Ltd	Bank lslami Pakistan Ltd（2015）
8	PICIC Commercial Ban, NIB Bank Limited	NIB Bank Limited (2007)

Specification of Variables and Data Source

This study explores the influence of M&As on the bank efficiency. The group of banks sample for this study includes those that merged with or acquired other banks between 2007 to 2017.The banks are assessed 4 years before and 4 years after M&As and the mean efficiency scores for these periods are calculated. The data for Pakistani banks were collected from multiple sources, including the annual editions of the Banking Statistics published by the State Bank of Pakistan (SBP), the Pakistan Stock Exchange website, as well as the annual reports and official websites of the selected banks. The selection of inputs and outputs is based on three distinct approaches: the income-based model, the loan-based model, and the inter-mediation approach. These varied input-output models are utilized to assess efficiency from multiple perspectives. The income-based method examines the complex connections between financial input (net worth, expenses, and number of employees) and output (net earnings, interest revenue, and non-interest income). The loan-based model with interest expenses, interest income and non-interest income as inputs, along with loans & advances and investments as outputs, a model can assess the effectiveness of a bank in utilizing its expenses and diverse income streams to generate loans and investments. The inter-mediation method uses inputs such as total assets, operational costs, and deposits, along with outputs including loans, interest income, and non-interest income to assess the efficiency or performance of a bank or financial institution. The three input-output models mentioned above are employed to evaluate the efficiency of the selected banks

during both periods. These models not only secure bank financial stability but also detect specific areas where operational improvements can be made, thereby contributing to the overall health of the economy.

Data Analysis and Results

DEA is employed to evaluate the efficiency of firms following M&A technique. All financial statistics are reported in Pakistani Rupees (000), number of employees is recorded in absolute numbers.

The detailed result of income-based model are given in Table 2.

Table 2. Results based on income model.

Post-M&A name	Pre-Merger			During Merger			Post-Merger		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Askari Bank Limited	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.97	0.99
Faysal Bank Limited	0.99	0.99	0.99	0.99	1.00	0.99	1.00	1.00	1.00
MCB Bank Limited	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	0.99
Meezan Bank Limited	0.98	0.98	0.99	0.96	0.97	0.99	1.00	1.00	1.00
Habib Bank Limited	0.98	0.99	0.99	1.00	1.00	1.00	0.99	1.00	0.99
Summit Bank Limited	1.00	1.00	1.00	0.60	0.72	0.83	0.95	0.95	0.99
Bank lslami Pakistan Ltd	0.94	1.00	0.94	0.76	0.76	0.99	0.95	0.95	0.99
NIB Bank Limited	0.99	0.99	0.99	0.92	0.95	0.97	1.00	1.00	1.00

The income-based model delves into the complex connections among financial input (net worth, expenses, and the number of employees), and the output (net earnings, interest revenue, and non-interest income). Through examining this relationship, bank can acquire understanding about how their financial situations.

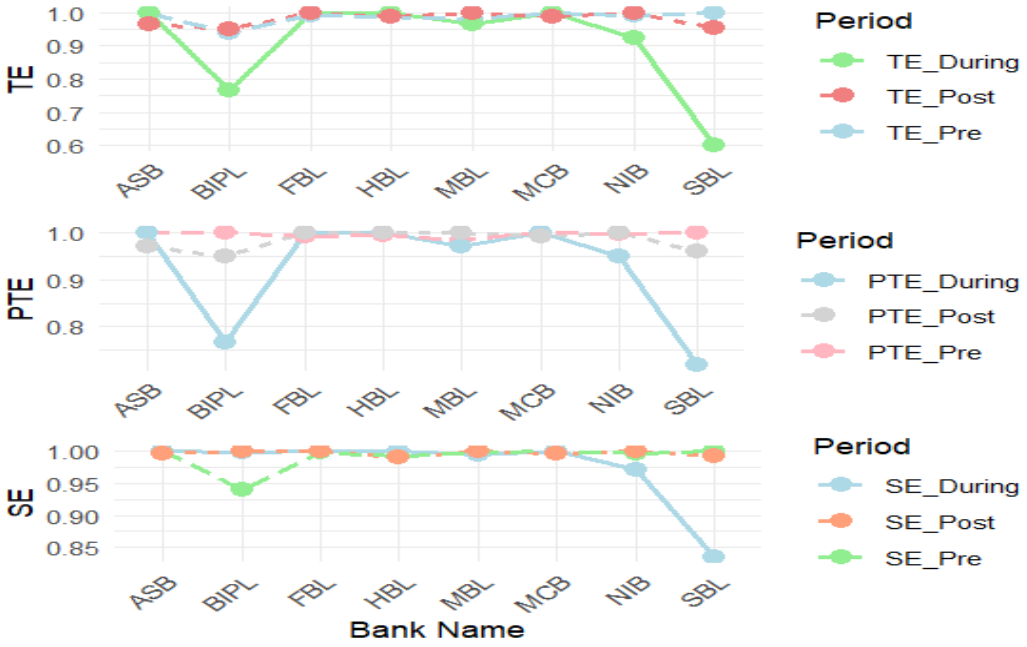

Fig 1. Results based on income model.

The results indicates in Fig 1 that the average efficiency scores of some banks before M&As (ABL, MCB and SBL) all demonstrated exceptional performance, with many reaching a score of 100% in efficiency. This score of 100% signifies that these banks were effectively utilizing their resources to generate income without any losses. But after the M&As these banks (ABL, MCB and SBL) exhibited inefficiency scores of 3.5%,1.2% and 4.7% respectively. In nearly all cases, inefficiency arises from scale inefficiency while PTE is at its peak in both scenarios. Scale inefficiency occurs when a bank operates at a non-optimal production scale. Factors contributing to scale inefficiency may include over staffing, unprofitable branches, a high volume of non-performing loans (NPLs), among others. In contrast Before the mergers and acquisitions (M&As), FBL, MBL, and NIB had inefficiency scores of 0.9%, 1.9%, and 0.9%, respectively. However, post-M&A analysis shows an improvement in their efficiency scores, indicating successful integration. On the contrary, After the merger of Saif Power Limited with Habib Bank Limited (HBL), the inefficiency of HBL

declines insignificantly from 1.3% to 1%. In the same way, the inefficiency of KASB Bank Ltd after having the merger of Bank Islami Pakistan Ltd decreased from 6% to 5%.

The results of Loan-based model are given in Table 3.

Table 3. Results based on the loan model.

Post-M&A name	Pre-M&A			During M&A			Post M&A		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Askari Bank Limited	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00
Faysal Bank Limited	0.98	1.00	0.98	1.00	1.00	1.00	0.99	1.00	0.99
MCB Bank Limited	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Meezan Bank Limited	0.99	1.00	0.99	0.97	0.97	0.99	0.98	0.96	0.99
Habib Bank Limited	0.78	0.96	0.82	1.00	1.00	1.00	1.00	1.00	1.00
Summit Bank Limited	0.95	0.99	0.95	1.00	1.00	1.00	0.73	0.99	0.77
Bank lslami Pakistan Ltd	0.99	1.00	0.99	1.00	1.00	1.00	0.95	0.99	0.96
NIB Bank Limited	0.54	0.98	0.55	0.05	0.20	0.25	0.07	0.82	0.08

The loan-based model with inputs as (interest expenses, interest income, non-interest income) and outputs as (loans and advances, investments) focuses on evaluating the efficiency of a bank's financial resource management. It can evaluate how efficiently a bank leverages its expenses and varied sources of income to produce loans and investments.

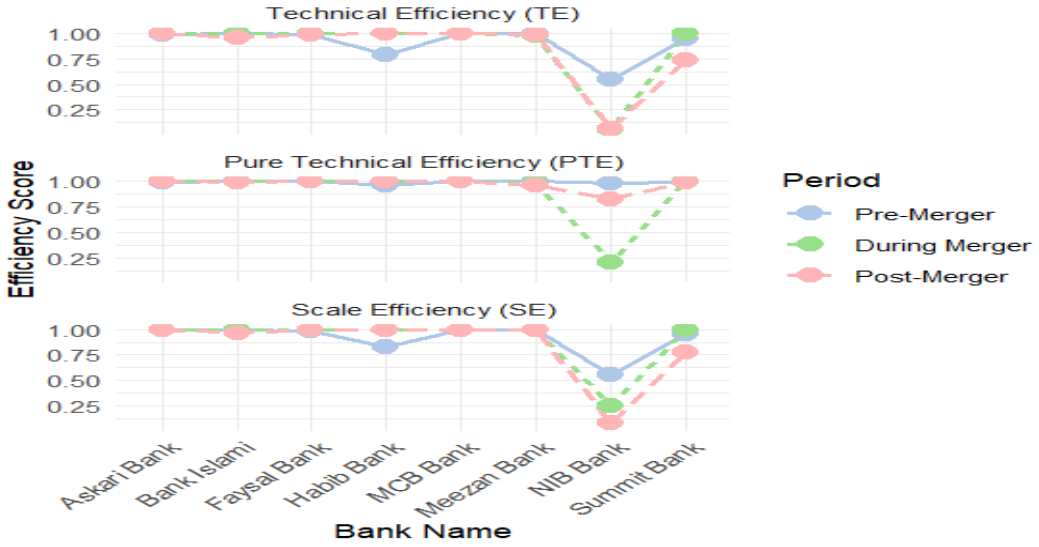

Fig 2. Results based on the loan model.

The findings show in Fig 2 that The post-merger inefficiency of Faysal Bank showed a slight improvement, dropping from 1.3% to 0.9%. This indicates that the merger positively affected Faysal Bank Limited's operational efficiency, resulting in a 0.4% reduction in inefficiency. Similarly, after the merger of MCB remain stable. Before and after the merger, assessments revealed that the banks maintained their efficiency, showing consistent operational performance throughout the merger process. Before M&A Askari Bank Limited and Habib Bank Limited (HBL) had inefficiency scores of 1.2% and 21.1%, respectively. However, post-M&A analysis shows an improvement in their efficiency scores, indicating successful integration. The analysis post-merger shows that Meezan Bank Limited's inefficiency rose slightly from 0.2% to 1.5% due to the merger with HSBC. Correspondingly, after the merger of SBL with an increase in technical inefficiency from 5% to 26.5%. The mergers and acquisitions (M&As) of Bank Islami also resulted in a slight rise in technical inefficiency, moving from 0.1% to 4.3%.Additionally, the merger of PICIC Commercial Bank with NIB Bank Limited led to a substantial rise in technical inefficiency, escalating from 45.2% to 93%.These results demonstrate the diverse effects on efficiency following mergers among various banks.

The results of Intermediation model are shown in Table 4.

Table 4.Results of the Intermediation model.

Post-M&A name	Pre-Merger			During Merger			Post-Merger		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Askari Bank Limited	0.99	1.00	0.99	0.92	1.00	0.92	0.74	0.95	0.77
Faysal Bank Limited	0.97	0.98	0.97	0.93	1.00	0.93	0.93	0.99	0.96

MCB Bank Limited	0.99	0.99	0.99	0.82	1.00	0.82	0.92	0.99	0.92
Meezan Bank Limited	0.95	0.96	0.99	0.91	0.95	0.96	0.89	0.96	0.92
Habib Bank Limited	0.95	0.99	0.96	1.00	1.00	1.00	0.98	1.00	0.98
Summit Bank Limited	1.00	1.00	1.00	0.77	1.00	0.77	0.88	0.95	0.92
Bank lslami Pakistan Ltd	0.97	0.97	1.00	0.87	0.99	0.88	0.98	1.00	0.98
NIB Bank Limited	0.98	0.99	0.99	0.92	0.92	0.99	0.94	0.96	0.97

The inter-mediation method, inputs like total assets, operational costs, and deposits, alongside outputs including loans, interest, and non-interest income, to assess the proficiency of banks in converting resources into fundamental financial assets and profit sources. The analysis assists in pinpointing optimal methods, enhancing outcomes, controlling the risks linked to lending and revenue creation, and upholding regulatory adherence. Ultimately, this assists banking institutions in improving their financial inter-mediation techniques to preserve steady profit margins.

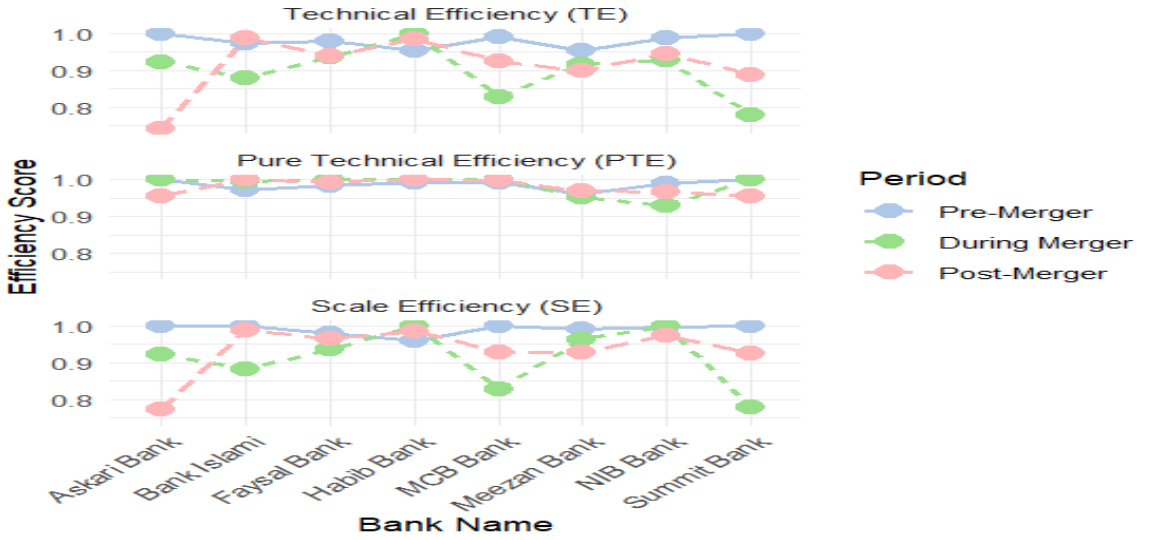

Fig No 3 The result of the Inter-mediation model

It is evident from the results Fig 3 showed that the outcomes of inter-mediation approach model reveal a varied pattern, with efficiency dropping in most instances and showing some cases of improvement. The inefficiency declines from 4.7% to 1.4% after the merger of Saif Power Limited with Habib Bank Limited. Same as, the inefficiency of Bank Islami Pakistan Limited declines from 2.7% to 1.3% after its mergers and acquisitions (M&As). In contrast pre-mergers and acquisitions (M&As), ABL, FBL, MCB , MBL, and NIB all had low inefficiency scores of 0.2%, 2.1%, 0.9%, 4.7%, and 1.3% individually. After post-mergers and acquisitions(M&As), inefficiency rates significantly increased to 25.9%, 6.1%, 7.5%, 10.2%, and 5.5% for these banks respectively, indicating significant operational challenges post-merger. Before the merger, Summit Bank was operating efficiently and achieving strong performance results. However, after merging, their efficiency dropped significantly. Summit Bank's inefficiency rose to 11.3%. These figures underscore a significant challenge in integrating operations post-merger, impacting their overall operational performance. The results from the three models (income-based, Loan-based and inter-mediation approach) typically show a decrease in bank efficiency after mergers acquisitions when compared to pre-M&As periods. However, this study does not examine the specific factors contributing to this decline in post-merger/acquisition effectiveness. Identifying these variables necessitates a more extensive investigation beyond the scope of the current research. A separate and comprehensive review is required to thoroughly analyze and comprehend the reasons behind the observed inefficiencies after merger and acquisition.

Conclusion

This study aims the effect of Mergers and Acquisitions (M&As) on the efficiency of Pakistani banks from 2007 to 2017. Technical efficiency (TE) and its components were measured using Data Envelopment Analysis (DEA), which was evaluated from three distinct angles: income-based, loan-based, and inter-mediation. The results reveal a mixed impact of M&A on banks efficiency. The income-based approach indicates that some banks Such as ABL, MCB was sufficient in pre-M&A period. But after M&A these banks were more inefficient than before with inefficiency mainly driven

by scale inefficiency which was in turn influenced by over-employment, unprofitable branches and high non-performing loans (NPLs). In contrast banks such as FBL and NIB originally lower efficiency scores indicated progressions after M&A which denotes the successful amalgamation and more effective use of resources. Similar trends were found in the loan-based and inter-mediation systems. The difficulties in operational integration after M&As were highlighted by the fact that, although a small number of banks showed small improvements, the majority either experienced no change at all or observed a decrease in efficiency.

In conclusion, overall results indicate that mergers and acquisitions did not lead to any significant improvement in the financial performance of Pakistani banks. The study's findings are consistent with previous research done in Pakistan on various banks, which showed either a degradation, no increase, or inconsistent outcomes for post-merger efficiency, for example (Obaid-ullah et al., 2010; Kousar & Saba, 2011).

The policy implications from this study are summarized as follows. Based on the findings of this study, it is recommended that the State Bank of Pakistan (SBP), as the regulator and supervisor of the banking sector, establish a comprehensive post-merger efficiency evaluation framework, incorporating DEA (Static) to monitor banks efficiency including technical efficiency (TE), pure technical efficiency (PTE), scale efficiency (SE). Such a framework would enable regulators to assess whether mergers and acquisitions achieve the expected operational improvements. In order to achieve maximum efficiency it is recommended that banks focus on integrating IT systems, upgrading core banking platforms, and adopting digital solutions.

By comparing the pre and post-merger periods, this study investigates whether M&A have an impact on banks performance and efficiency. It allows for future study on relevant topics including market share, consumer satisfaction, and technology adoption and offers empirical insights for scholars, executives, and banking professionals.

Due to data availability, only eight banks are included in the study. More banks and the financial industry may be included in future studies that use methods like Event Window, OLS, or DEA with Tobit regression to identify the causes of post-M&A inefficiencies and enhance bank performance.

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