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Benchmarking Performance using Data Envelopment Analysis: A Case of the Banking Sector of Pakistan

Abstract: *Customers' needs drive the competitive nature of today's business environment. To achieve desired outcomes, resources must be transformed effectively and efficiently. Performance evaluation is one of the most important benchmarking tools for modern businesses due to sophisticated technologies, computerized processes, communication, and fierce competition. The study analyzed the performance of 26 commercial banks from 2008 to 2016. Efficiency and effectiveness were calculated using data envelopment analysis (DEA). The results showed that the sub-optimal performance of banks was caused mainly by ineffectiveness compared to Efficiency. Banks were further categorized into four groups based on their average efficiency and effectiveness scores into Ace, Underdogs, Lucky, and Unlucky. This matrix suggests that banks in the Lucky quadrant should improve Efficiency, those in the Unluck group should diversify, and those in the Underdogs quadrant should merge. Banks in the Lucky, Unlucky, and Underdog quadrants should emulate the Ace quadrant's success.*

Key Words: Data Development, Analysis, Banking Sector, Benchmarking

Introduction

A competitive business environment today is driven by customers' needs. Obtaining desired outcomes requires the effective and efficient transformation of resources. For a business to maximize its output (goods or services), it is crucial to allocate the minimum number of resources (inputs). By eliminating inefficient processes and procedures, organizations can achieve their goals by reducing input costs and enhancing outputs. There is no doubt that performance evaluation is one of the most important benchmarking tools in today's business environment, where sophisticated technologies, computerized processes, communication, and fierce competition are all part of the day-to-day operations of a company. As a result of global competition, businesses need to improve their efficiency to survive and prosper. As a result of evaluating the performance of a business, it is possible to identify the needs of the customers, the strengths and weaknesses of the organization, and how to improve the operations to develop new products and services that meet these needs.

It is a widespread practice to measure inputs and outputs as part of performance evaluation and benchmarking. Despite the numerous input-output measures present in this method, in addition to the difficulty of determining if resources were used efficiently, this method raises serious concerns. Even though it is possible to identify and categorize the Best Practice Frontier, it is not possible to evaluate

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financial performance solely based on single measures. A variety of different techniques can be used to approximate the best practice frontier, which can be helpful in determining whether there is a relationship between different measures of performance and the best practice frontier and for determining the relationship between the two. Using this method, it is possible to assess how a particular business unit is currently operating internally and then compare that with similar business units to determine their best practice frontier over a longer period of time.

For benchmarking and performance evaluation, Data Envelopment Analysis is commonly used as a tool. It is used to measure the performance of business units by using multiple inputs and multiple outputs as inputs. Each business unit in the DEA determines whether there are resources (inputs) available and how those resources can be converted into desired products or services (outputs) by the unit. In the field of business operations, DEA has been recognized as a reliable method to model business operations by a number of researchers in the field. It has been found to be effective in many fields, including education, healthcare, transportation, manufacturing, and market research, whether the organization is for-profit or non-profit.

The economic growth and prosperity of a country are dependent on the financial sector. Managing and controlling the country's financial requirements makes it the backbone of the economy. Among all the financial sectors, the banking sector plays a pivotal role in contributing to the overall development of the sector, which leads to the growth of the economy. It is important for banks to provide a balanced form of the money supply to organizations so that they may survive and grow economically in a sustainable manner. Further, the development of a country's economy depends heavily on the functioning of an efficient banking system. An economy may experience a decline in economic growth if its banks are not performing well, which in turn may cause financial repression and instability in the financial sector. Moreover, it can have a detrimental effect on the survival of banks. It is, therefore imperative that banks function efficiently to ensure a sound financial system and to promote the smooth running and growth of an economy.

Problem Statement

Pakistan has seen a meaningful change in its banking environment following reforms in the financial sector. These financial reforms are expected to enhance efficient and effective resource utilization, as well as healthy competition. Consequently, banks have been forced to better utilize their resources, which is crucial to their survival. It is, therefore, increasingly significant to evaluate commercial banks' performance precisely and accurately. Pakistan's banking literature focuses exclusively on assessing banks' Efficiency in terms of resource utilization (operating Efficiency), ignoring their ability to achieve predefined policy objectives (effectiveness). Therefore, it has become increasingly important to measure banks' Efficiency and effectiveness. Measuring commercial banks' Efficiency and effectiveness is essential to determining whether their performance will improve following financial reforms.

Study Objective

In the present study, the purpose is to investigate and benchmark the Efficiency and effectiveness of commercial banks in Pakistan in the first and second stages by using Data Envelopment Analysis. In the third stage, the efficiency and effectiveness scores of sampled banks from the first and second stages are classified based on Boston Consulting Group's (BCG) matrix.

Literature

Whenever an organization is evaluated and gauged for its performance, Efficiency, and effectiveness both play a fundamental role (Mouzas, 2006). In both profit-oriented and non-profit-oriented firms, performance could be measured as a combination of Efficiency and effectiveness. There is, however, some inconsistency in the existing literature regarding the application of these terms, namely Efficiency

and effectiveness. While each of these terms stands for a distinct meaning and differs from each other, managers do not differentiate between them and consider them synonymous. According to Drucker (1977), Efficiency refers to "doing things right" whereas effectiveness refers to "doing the right thing." Efficiency is determined by an organization's ability to produce its output(s) with the fewest inputs possible.

Market success is not guaranteed by Efficiency but by operational excellence in utilizing resources. According to Laffy and Walters (2016), Efficiency is primarily about minimizing costs and allocating resources between a variety of alternatives. Speaking of effectiveness,, Keh et al. (2006) stated that an organization's effectiveness is based on its ability to accomplish its pre-established goals and objectives. According to Asmild et al. (2007), a firm's effectiveness depends on how well it aligns its goals with its objectives. An organization's effectiveness can be evaluated by how well it achieves its policy targets. Ozcan (2008) elaborated that despite their importance in determining performance, Efficiency and effectiveness can influence one another. The effectiveness of an organization might be affected by its Efficiency or might affect its Efficiency. Further, it may affect the effectiveness of the organization as a whole. He further explained that organizations may be efficient in resource utilization, but this does not guarantee effectiveness measures, and the same is true of organizations that are effective but inefficient.

In their study of profit-oriented organizations, Ho and Zhu (2004) divided overall organizational performance into efficiency and effectiveness measurements. In the same vein, Mouzas (2006) examined the impact of different levels of Efficiency and effectiveness on organization performance, concluding that emphasizing Efficiency and ignoring effectiveness leads to short-lived profitability. In contrast, ignoring efficiency measures and focusing more on effectiveness may lead to unsuccessful expansion. The study suggested that to achieve sustainable growth, both measures must be equally emphasized. An inspection of the empirical literature provides that most of the studies on performance measurement focus merely on the operational (technical) Efficiency of an organization(s), and the aspect of operational effectiveness is usually ignored. Nevertheless, in recent years, there exists a few studies which explicitly recognized Efficiency and effectiveness as two mutually exclusive components of the overall performance of an organization.

Using data envelopment analysis (DEA), Kumar and Gulati (2010) evaluated 27 Indian public sector banks based on efficiency and effectiveness scores. Compounding both scores yield overall performance. The results show that high-efficiency banks are not always associated with high effectiveness. Moradi-Motlagh and Babacan (2015) used data envelopment analysis (DEA) to examine Australian banks' profitability based on effectiveness, efficiency and risk measures. The input and output variables were derived from the Dupont model. According to the DEA results, large banks are more effective than small banks. Small banks, on the other hand, are more efficient than large ones. A higher risk-taking attitude is also linked to the profitability of some banks. Moreover, small banks have higher average risk scores than large banks, according to the results.

In a comparative study of Islamic and traditional banks in Pakistan, Abbas et al. (2016) discovered that Efficiency is positively related to age, loan ratios, and capitalization. Profitability and other operating income, however, have an indirect relationship. Industry-specific and macroeconomic factors do not significantly affect Efficiency. A positive and meaningful relationship exists between age, capitalization, size, non-markup expenditures and effectiveness. Inflation and market concentration have negative effects on Islamic banks' effectiveness, while the GDP growth rate exhibits a positive effect.

A study by Zizka (2017) evaluated the Efficiency and effectiveness of urban transport corporations. Non-parametric DEA was used to assess the Efficiency and effectiveness of the transport process, the consumer process, and the

overall business process (cost efficiency). Low scale efficiency was the major cause of inefficiency in transport companies. Results show that both Efficiency and effectiveness are affected by population size, history, and conventions. Singh and Jha (2017) examined the Efficiency and effectiveness of 15 important State transport undertakings (STU) based in India from 2003-04 to 2013-14. The evaluation was conducted using the DEA method. The Efficiency and effectiveness of STUs are strongly correlated. A negative relationship was found between STUs size and returns to scale; large firms showed decreasing returns to scale while small firms showed increasing returns to scale. As a result, changes in the size of a firm can lead to positive outcomes.

Methodology

Research Design

Data envelopment analysis (DEA) was used to analyze Efficiency and effectiveness scores for commercial banks in Pakistan. This approach was originally proposed by Farrell (1957). In contrast, the DEA approach today is derived from Charnes et al. (1978). It calculates the performance of similar units, called DMUs, using multiple metrics to determine their performance. Sherman and Gold (1985) were the first to employ this method in the banking industry, and it has been used for efficiency scores computation in numerous banking studies (Andries, 2011; Haralayya & Aithal, 2021; Horvatova, 2018; Kočišová, 2013). As a result of its many advantages, DEA was found to be more preferred in banking than its proximate rival, stochastic frontier analysis (SFA). As production in banking generally involves multiple inputs and outputs, DEA has the advantage of processing multiple inputs and outputs at once. This approach does not make assumptions about predefined production functions. This technique compares each bank to all other banks in the sample, with the only requirement being that they fall within or below the efficient frontier. Additionally, this method is useful for small samples, considers quantity information completely and does not require problematic pricing information nor restrictive behavioural assumptions. Decision-making units that fall outside of the efficient frontier are considered relatively inefficient. DMU's efficiency scores are based on their distance from efficient frontiers. Efficiencies are calculated by comparing weighted outputs with weighted inputs and range from 0 to 1. It is referred to an efficient DMU if it takes a relative efficiency score of 1 or 100%, while an inefficient DMU is one that scores less than 1 or 0 in comparison to other DMUS being tested.

Input-output Variables

DEA technique requires multiple input and output variables to compute the relative performance of a decision-making unit (DMU). There is no procedure under this technique for the selected variables, and it depends solely on the discretion of the researcher or analyst. The choice of input-outputs in production enterprises can be made easily compared to service organizations. It becomes somewhat difficult in services business in general and banking companies in particular. However, the previous academic research literature provides some approaches widely used in the evaluation of banks' performance. Two such approaches, namely production and intermediation, are generally employed to select a combination of input-output variables. This study adopted the intermediation approach for variable selection due to its wide application the banking literature. For the "efficiency" parameter of performance, three inputs (Loanable funds, Capital, and Labour) and two outputs (Investments and Advances) were used while in the second stage, two inputs (Investments and Advances) and two outputs (non-Interest expenses and Non-Interest revenues) were considered for computing “effectiveness”. Further details can be seen in figure 1.

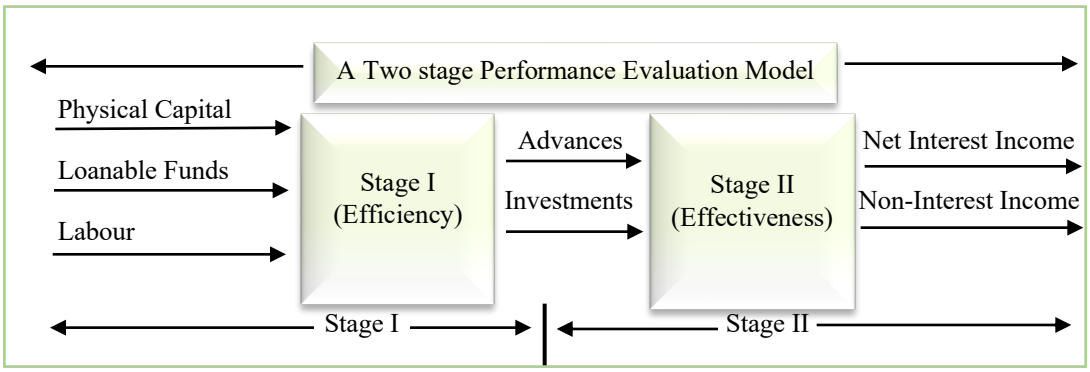

Figure 1. Two stage DEA model for Efficiency and effectiveness
Source: Kumar and Gulati (2010)

Measurement Model

The study opted separate generic-DEA model proposed by Charnes, Cooper and Rhodes (CCR) (1978). This model was applied to measure both Efficiency and effectiveness using the CCR technique with input-orientation The mathematical formulation of input-oriented CCR model is given under figure 2.

$$\theta^* = \min \theta$$
$$\sum_{j=1}^{n} \lambda j \; x_{ij} \leq \theta x_{io} \qquad i = 1,2,\ldots\ldots\ldots,m;$$
$$\sum_{j=1}^{n} \lambda j \; y_{rj} \geq y_{ro} \; r = 1,2,\ldots\ldots\ldots,s;$$
$$\lambda j \geq 0$$

Figure 2. Input-oriented CCR model for Efficiency

θ^* = Efficiency score;
x_{io} = ith input of bank under evaluation;
y_{ro} = rth output of bank under evaluation;
λ = non-negative vector input and output variables
The efficiency score (θ^*) thus obtained ranges from "0 to 1". A bank scoring 1 would be classified as efficient while bank with a score of less than 1 would be termed as inefficient.

Sample and period of study

The sample of the study comprises of 25 commercial banks operating in Pakistan for period 2008-2016 were taken.

Data analysis and Findings

The analysis was performed in two stages. In the first place, Efficiency was computed using input-oriented CCR model with three inputs (loanable funds, Labour, and Capital) and two outputs (Advances, and Investments). In the second stage, the effectiveness was computed using Advances, and Investments as inputs and non-interest income and net interest income as outputs. In the third stage, the overall performance of commercial banks was calculated by taking the product of efficiency and effectiveness scores. The descriptive statistics are provided in table 1 while scores for Efficiency, effectiveness, and overall performance are presented in table 2.

Table 1. Descriptive Statistics

Statistic	Efficiency	Effectiveness	Overall Performance
Mean	0.910	0.648	0.590
S.D	0.093	0.201	0.019
Median (Q2)	0.931	0.624	0.581
Minimum	0.674	0.322	0.217
Maximum	1.000	1.000	1.000
Q1	0.877	0.551	0.502

Statistic	Efficiency	Effectiveness	Overall Performance
Q3	0.965	0.738	0.665

Table 1 shows that efficiency scores on average stood at 91 % and the inefficiency accounts for 9% (1-0.91=.09). it shows that average outputs (Advances and Investments) produced by commercial banks could be produced with 9% less inputs (Loanable funds, Labour, and Capital). In other words, it can be interpreted as the current level of inputs could produce 9% more outputs than currently produced. In terms of effectiveness, the average score remained at 65% (mean= 0.648) leaving inefficiency gap 35% (1-0.648), which implies that current outputs of net interest income and noninterest income could be attained by using 35% less inputs than used. The overall performance, which is the product of Efficiency and effectiveness, remained at 59%. The low overall performance is associated with a low level of effectiveness.

Table 2. Performance of Commercial banks: Period 2008-2016

Code	Banks	Efficiency	Effectiveness	Overall Performance
FWB	First Women Bank Ltd.	0.92	0.75	0.69
NBP	National Bank of Pakistan	0.97	0.76	0.73
BOK	The Bank of Khyber	0.95	0.53	0.51
BOP	The Bank of Punjab	1.00	0.52	0.52
ABK	Albaraka Bank (Pakistan) Ltd.	0.84	0.48	0.40
ABL	Allied Bank Ltd.	0.90	0.64	0.57
ASK	Askari Bank Ltd.	0.89	0.51	0.45
BAH	Bank Al-Habib Ltd.	0.92	0.49	0.45
BAF	Bank Alfalah Ltd.	0.84	0.60	0.50
BIP	Bank Islami Pakistan Ltd.	0.79	0.65	0.52
DIB	Dubai Islamic Bank Pakistan Ltd.	0.78	0.80	0.63
FYB	Faysal Bank Ltd.	0.96	0.73	0.71
HBL	Habib Bank Ltd.	0.95	0.64	0.61
HMB	Habib Metropolitan Bank Ltd.	0.98	0.55	0.54
JS	JS Bank Ltd.	0.87	0.59	0.52
MCB	MCB Bank Ltd.	0.93	0.76	0.71
KASB	KASB Bank	0.84	0.57	0.48
MBL	Meezan Bank Ltd.	0.77	0.73	0.56
NIB	NIB Bank Ltd.	0.99	0.48	0.48
SMB	Samba Bank Ltd.	1.00	0.58	0.58
SKB	Silk Bank Ltd.	0.92	0.68	0.62
SB	Soneri Bank Ltd.	0.89	0.56	0.49
SCB	Standard Chartered Bank (Pakistan) Ltd.	0.97	0.96	0.93
SUM	Summit Bank Ltd.	0.91	0.55	0.50
UBL	United Bank Ltd.	0.92	0.74	0.68
CITI	Citi Bank	0.96	1.00	0.96

Table 2 presents score of Efficiency, effectiveness, and overall performance for individual commercial banks. The first two parameters were calculated by input-oriented CCR method while overall performance was measured by the product of the two. Only two banks (SMB and BOP) exhibited high performance in terms of Efficiency as their efficiency score equals 1. It means that these banks have employed their valuable resources

more cautiously compared to counterparts in the banking industry. However, it is worth mentioning that none of the banks achieved a score equal to 1 when it comes to effectiveness. It implies that commercial banks remained ineffective in achieving their set targets or objectives. This led to low overall performance of these banks as none of the banks secured a score of 1.

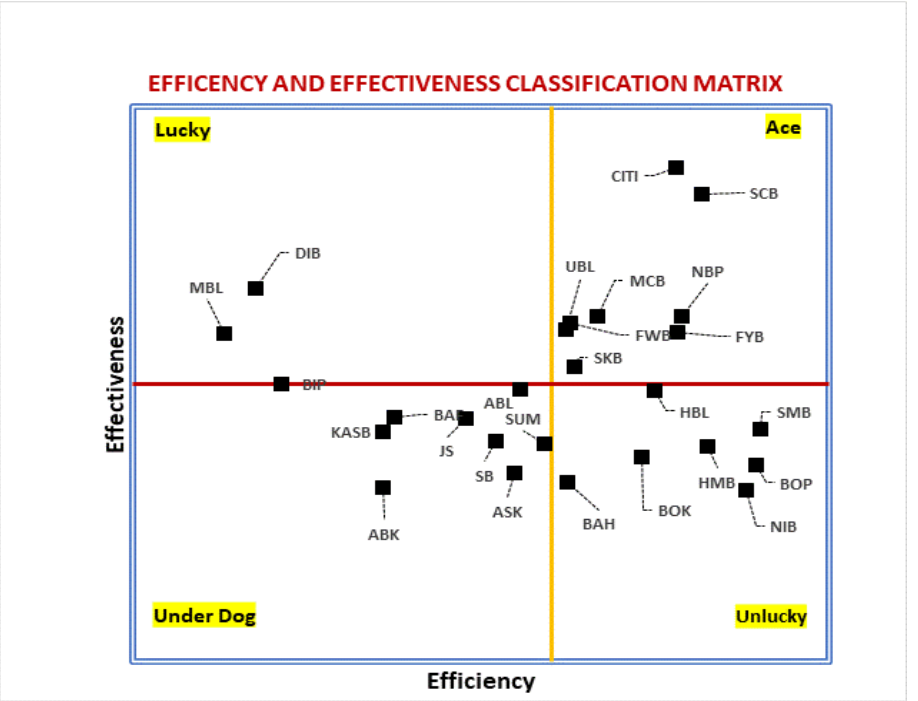

Figure 3: Efficiency and Effectiveness Matrix

Classification of Banks: Boston Consulting Group Matrix (BCG)

This section presents the classification of banks into four groups based on DEA scores of efficiencies and effectiveness. The four groups were designated as Ace, Underdogs, Lucky, and Unluck. This procedure was initially proposed by Boston Consulting Group (BCG) and has been used widely in the academic fraternity. This procedure was adopted in the present study to classify banks into four quadrants (groups). The banks with above average Efficiency and effectiveness scores were placed in the "Ace" quadrant. the banks in the underdog group contained those with below average Efficiency and effectiveness. The "Lucky" quadrant consists of those having below average Efficiency but above average effectiveness scores. The fourth group, designated as "Unlucky", contained those banks which have achieved above average efficiency score but remained below average in terms of effectiveness. The cutoff points for classification of banks on efficiency and effectiveness scores were 0.91 and 0.65 respectively. The classification matrix under BCG is displayed in figure 3. The horizontal and vertical lines in the figure 3 shows the cutoff points/lines for effectiveness and Efficiency, respectively.

To reduce primary input wastage, Lucky Group banks must revamp their resource utilization processes. The high effectiveness scores in this quadrant are probably due to a highly favorable atmosphere. In order to improve Efficiency, banks from the "Lucky" quadrant must be considered. By improving banks'

Efficiency, they will be able to earn more. Banks in the "underdog" quadrant lack vigor in terms of resource efficiency. These banks are characterized by poor resource utilization and could be potential merger targets. In the same way, banks in the "Unlucky" quadrant operate in an unfavorable environment. In this class, banks can improve their effectiveness values by adopting diverse product mixes and business strategies. Conversely, banks in the "Ace" group generate income and utilize resources efficiently. Banks experiencing inefficiency and ineffectiveness can learn from them. Exemplary banking practices and flagship units can be found in this quadrant.

Conclusion

The study focused on evaluating the performance of 26 commercial banks for the period 2008 to 2016. Data envelopment analysis (DEA) method was used to compute Efficiency and effectiveness. The results revealed average scores of efficiencies, effectiveness, and overall performance at 91%, 65% and 59% respectively. It can be concluded from these results that the low performance of commercial banks is mainly contributed by ineffectiveness despite better efficiency position. However, In the second stage, the sampled banks were placed into four groups (Ace, Underdogs, Lucky and Unlucky) on the analogy of BCG matrix based on average Efficiency and effectiveness scores under BCG matrix. based on the BCG matrix, it is recommended that banks in the Lucky quadrant need to focus on efficiency improvement, the unlucky group need to adopt a diversification strategy, and the banks underdogs quadrant are more suitable for merger. However, banks in Ace quadrant showed exemplary performance and should be followed by banks from Lucky, Unlucky, and underdogs quadrants.

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