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X-Efficiency Analysis of Islamic Banks in Pakistan

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ABSTRACT

This paper investigates the X-efficiency of Islamic banks in Pakistan from 2007 to 2020. Researchers aim to determine the efficiency of Islamic banks with respect to the utilization of available resources. The efficiency of the banking sector has been under scrutiny in recent years due to increased competition, deregulation, global financial crises, and the advent of Islamic banking. The study investigates the data of five functional Islamic banks in Pakistan. This study employs the Data Envelopment Analysis (DEA) method to evaluate the efficiency of the Islamic banking sector. The input and output variables are specified using an intermediation approach, in accordance with standard practices. The results indicate that Islamic banks in Pakistan are, on average, relevantly efficient. We found that among the five Islamic banks in Pakistan, the Meezan Bank has the greatest average cost, technical efficiency, and allocative efficiency. It becomes clear that the bank's size and longevity are the primary contributors to its top-tier performance and efficiency metrics. The study's results provide credence to the idea of economies of scale by showing that scale efficiency improves with bank size. These results call for regulatory considerations that acknowledge the influence of bank size on efficiency, suggesting that policies promoting growth might inadvertently enhance the sector's efficiency levels.

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Introduction

Banks play a crucial part in national growth and development. Gertler (1998); Levin (1997). Recent research has shown that a strong banking system contributes significantly to economic growth. Financial and economic development, as well as more efficient use of resources, need a robust banking and finance industry. To accelerate development, a country needs a modern financial system that encourages investment via the mobilization of savings, the identification of business possibilities, and the diversification of risk (Khan. et al., 2005). The efficiency of the banking sector has been under scrutiny in recent years due to increased competition, deregulation, global financial crises, and the advent of Islamic banking. Both developed and emerging nations are investing in banking sector reform to boost financial system performance and stability. Governments and policymakers have attempted many initiatives to improve the efficiency of the banking sector. The bulk of banking research has focused on studies analyzing the effectiveness of financial institutions, in particular the banking industry. Bank performance may be evaluated primarily via efficiency metrics (Mokhtar et al., 2006).

Scale efficiency and x-efficiency both exist in the academic literature. Scale efficiency was initially proposed by Farrell in 1957. Banks have economies of scale when they are able to grow production while simultaneously decreasing per-unit costs, as described by Yudisria (2003). Libenstein (1966) first proposed X-efficiency, the second kind of efficiency. Koopmans (1951) suggests that technical efficiency and allocative efficiency are the two halves of X-efficiency. X-efficiency is one of the most frequently utilized metrics in the research literature. Out of 130 studies conducted between 1992 and 1997 in 21 countries, 116 (or 66%) made use of the efficient cost frontier (Berger & Humphrey, 1997). Therefore, data analysis demonstrates that "cost frontier" methods are more reliable indicators of efficiency than monetary metrics.

With the passage of time, commercial banks' once-dominant position in the economy has diminished (Shahimim, 2006). Banks now provide a variety of non-traditional functions. The majority of a bank's revenue comes from charging fees. The activities that generate fee money affect the effectiveness of banks. Researchers have conducted other studies to evaluate the effectiveness of Islamic banking (Beck et al., 2013; Bitar et al., 2016). Studies comparing the performance and stability of Islamic and conventional banks were conducted by researchers (Chitak & Hesse´, 2010; Miah & Uddin, 2017; Paltrinieri et al., 2021; Hussain & Muhammad, 2022).

There are two main ways to figure out how efficient a bank is: the parametric and the non-parametric approaches. For both of them, you need to define a production cost function. The parametric method involves formulating and estimating a statistical function using econometrics. The non-parametric method, on the other hand, uses a linear boundary to surround experimental data points. This method is also known as "Data Envelopment Analysis" (DEA). This research exclusively adopts the non-parametric DEA to gauge the technical and economic efficiency of Islamic banks in the Pakistani context.

The central objective of the DEA is to identify entities operating at their efficient frontier and those falling short. A firm is deemed efficient if its input-output alignment lies on the DEA

frontier; conversely, inefficiency is indicated if the combination falls within the frontier. This study relies on the most recent published data available for the years 2007–2020, ensuring a contemporary assessment of Pakistani Islamic bank efficiency. Using a non-parametric method called Data Envelopment Analysis (DEA), this research aims to examine the X-efficiency of Pakistan's Islamic banking sector. Since most previous research has focused solely on the effectiveness of traditional banks, it seemed appropriate to investigate this phenomenon.

2.0 Literature Review

The performance measures of banks are the subject of a great deal of research. There are two kinds of efficiencies discussed in the research. Sealey & Lindley (1977) identified both scale efficiency and x-efficiency as important. Farrell (1957) initially established scale efficiency. Banks have economies of scale when they are able to grow production while simultaneously decreasing per-unit costs, as stated by Yudisria (2003). Libenstein (1966) proposed X-efficiency, which combines two types of efficiency—technical efficiency and allocative efficiency. Out of 130 studies conducted between 1992 and 1997 in 21 countries, 116 (or 66%) made use of the efficient cost frontier (Berger & Humphrey, 1997). Therefore, data analysis demonstrates that "cost frontier" methods are more reliable indicators of efficiency than monetary metrics. There is a lack of studies evaluating the effectiveness of Pakistan's banking system, particularly Islamic banking.

Furthermore, Niazi (2003) analyzed the development and performance indicators of commercial banks in Pakistan during the years 1990 and 2000. The bank's input-output variables were defined using a middle-ground strategy. Output variables were loans and advances, investments, and counter accounts, whereas input variables included labor, operational expense, physical capital, and financing expense. To examine how major economic variables affect financial performance, Akmal and Saleem (2008) investigated a pool of 30 financial institutions. To calculate the technological and scale efficiency, they adopted the data development analysis (DEA) method. The findings showed that banking productivity increased between 1995 and 2005. The study revealed that public and commercial banks in the same country as the study's location exhibited lower effectiveness compared to their foreign counterparts.

Moreover, Akhtar (2002) used data envelope analysis to examine the X-efficiency (allocative and technical) of a representative sample of 40 banks in Pakistan throughout the privatization process. The researcher's inputs included deposits and capital, while loans and advances and portfolio investments were the study's outcomes. Results from the research supported continuing efforts to privatize nationalized banks in Pakistan. This research measured the effectiveness of the Pakistani banking industry, although it was a cross-sectional analysis based on data from 1998. Using the Data Envelopment Analysis (DEA) method, Ahmed & Ahmed (2008) examine the technical efficacy of 38 commercial banks in Pakistan. The research revealed a wide range of technical efficiency scores (from 1.0 for the top 6 commercial banks in the sample to 0.011 for the worst commercial bank in the sample) among the sample's 33 commercial banks.

In addition, Sufian (2007) also compared domestic and international financial institutions to gauge the efficacy of Malaysia's Islamic banking system between 2000 and 2004. The findings demonstrate an increase in effectiveness among Malaysia's Islamic banks and a minor improvement in effectiveness among local banks compared to their overseas counterparts. Using financial ratio analysis and data envelopment analysis (DEA), Johns. et al. (2008) analyzed the performance of Islamic and conventional banks in the GCC area between 2004 and 2007. The results imply that Islamic financial institutions are less cost-efficient and more efficient at

generating revenues and profits. According to the DEA, Islamic banks are often less productive than their mainstream counterparts.

Moreover, Kammarudin, Safa, and Mohd (2008) undertook an in-depth review of Islamic banking's performance in Malaysia. The findings demonstrate that Islamic banks are more profitable due to their low operating costs. Similarly, using the non-parametric Data Envelopment Analysis (DEA) approach, Khalid, Hassan, et al. (2008) assessed the cost, profit, and revenue efficiency of 43 Islamic and 37 interest-based conventional banks across 21 countries from 1990 to 2005. Those nations include Bahrain, Kuwait, Jordan, Iran, and Saudi Arabia, as well as the United Arab Emirates, Qatar, Saudi Arabia, Turkey, Yemen, Labnan, Kuwait, and the United Arab Emirates.Usman (2010) divided commercial banks in Pakistan into three groups to analyze their efficiency: nationalized banks, local private banks, and international banks. He ran the technology's effectiveness from 2001 to 2008 via DEA. Findings revealed that international financial institutions are more efficient than their nationalized and domestic private sector counterparts. Scale inefficiency primarily drives overall technical efficiency.

Despite the rapid expansion of Islamic banking, only a few studies have attempted to quantify its benefits (Yudistira, 2003; Sufian, 2007). Studies evaluating the effectiveness of Islamic banks commonly use profitability as a metric. A study by Zuroh et al. (2015) indicated that sharia-based banks are much better at technical efficiency; however, they exhibit lower average cost efficiency than conventional banks, with cost inefficiency primarily attributed to allocative inefficiencies. Researchers have conducted numerous studies to assess the effectiveness of Islamic banking (Beck et al., 2013; Bitar et al., 2016). Studies comparing the performance and stability of Islamic and conventional banks have also been the focus of interest for the researchers (Chitak & Hesse´, 2010; Paltrinieri et al., 2021; Hussain & Muhammad, 2022; Miah & Uddin, 2017). A study by Haider et al. (2019) investigated 11 variables to check the competency of Malaysian Islamic Banks and Pakistan using DEA. The study found that the productivity of Pakistani Islamic banks is better than that of Malaysian banks. Hata et al. (2020) conducted research to analyze the cost function of 10 Malaysian Islamic Banks using the stochastic frontier method. The study indicated that labor and saving have a positive effect on the total cost, and the efficiency value of Islamic Banks is 85.7%, with an increasing value every year in observed data. In recent times, the effectiveness of the Islamic banking sector in the Southeast Asian area has been evaluated by Chowdhury and Haron (2021) using DEA. The findings demonstrated the steadily rising efficiency and output of Islamic banks in the South Asian area. Brunei's performance improved gradually; Malaysia's was stable, while those for the Islamic banks in the Philippines and Thailand both declined.

3.0 Methodology

There are two main ways to figure out how efficient a bank is: the parametric and the non-parametric approaches. For both of them, you need to define a production cost function. The parametric method involves formulating and estimating a statistical function using econometrics. The non-parametric method, on the other hand, uses a linear boundary to surround experimental data points. This method is also known as "Data Envelopment Analysis" (DEA). This research exclusively adopts the non-parametric DEA to gauge the technical and economic efficiency of Islamic banks in the Pakistani context. The central objective of the DEA is to identify entities operating at their efficient frontier and those falling short. A firm is deemed efficient if its input-output alignment lies on the DEA frontier; conversely, inefficiency is indicated if the combination falls within the frontier. This study relies on the most recent published data available for the year

2007, compiled by 2020, ensuring a contemporary assessment of Pakistani Islamic bank.

Tabel 1: Measurement of Variables

Variable symbol	Variable name	Description
TC	Total cost	Wage bill including director fee+ depreciation on fixed asset + interest paid on deposits
OUTPUTS:		
Y1	Loan and Advances	Total loan includes Loans and Advances: Lending to customer and financial institutions.
Y2	Total Investments	The amount of investment made by banks in government securities, T-bills, Debenture &other short term and long-term investments
INPUTS:		
X1	Labor	Salaries expenditure, employee benefits, retirement funds and allowance paid to the employees of banks/firm including director fee
X2	Fixed Capital	Net fixed assets (gross fixed asset minus depreciation expense), Property, plant and equipment
X3	Total deposits:	Short-term and long-term deposits, short-term and long-term savings deposits and fiscal deposits.
INPUT PRICES:		
W1	Prices of Labor	Total expenditure on employees such as salaries, employee benefits and reserve for retirement by total number of employees.
W2	Prices of Fixed Capital	Total expenditure on premise and fixed asset divided by total asset.
W3	Prices of deposits	Total interest expense on deposit and non-deposits funds divided by total deposits

Drawing from prior scholarly works (Hassan and Isik, 2002; Hassan, 2005), we model Islamic banks as multi-product entities engaged in the production of two distinct outputs through the utilization of three input variables. The outputs of the study are: (1) total investments; ii) total loans. Input vector consisting of three inputs such as: (I) labor; (ii) total deposits; and (iii) fixed assets.

Researchers collected data secondarily from the Bank Scope database from 2007 to 2020. Previous research on the effectiveness of the banking system mostly relied on data from Pakistan's Banking Statistics database. The country's official newspaper publishes Pakistan's banking data. However, the Banking Statistics of Pakistan do not provide the required input and output data for this research, leading to gaps. The researchers got around this by pouring into the financial records and annual reports of individual financial institutions.

Measurement of Efficiency

According to Farrell (1957), technical efficiency is the ability of an organization to achieve the same level of output with the least number of inputs or to maximize output from given sets of inputs. There are various ways to measure the technical efficiency of a company. The common method for calculating efficiency is:

Input/output = efficiency

If a company uses a single input to make a single output, it is simple to gauge its efficiency. However, most businesses use numerous inputs to achieve multiple outputs; thus, this approach is frequently insufficient. One can compute a firm's efficiency using the following method:

Calculating the efficiency of a firm:

Efficiency = $\sum W \underline{\mathbf{X_i}} / \sum w\mathbf{Y_i}$

Where Xi is the weighted sum of inputs and Yi is the weighted sum of outputs.

DEA Frontier Approach

Farrell (1957) created the first DEA method. In 1978, Charness, Rhoades, Cooper, and themselves employed the DEA method. It's a linear programming-based method for evaluating a company's capacity to manage expenses and maximize profits. The DEA method evaluates performance in terms of many inputs and outcomes. In order to calculate an envelopment surface with a value of 1, the DEA takes into account inputs and outputs. The DEA compares each company in the sample to the "best practiced" company using DEA metrics. The envelope's surface enterprises are the ones often thought to be the most productive. Companies with values lower than one are considered inefficient.

Constant Return to Scale (CRS) and Variable Return to Scale (VRS)

The DEA model utilizes both constant and variable returns to scale. Employing constant return to scale (CRS) helps make comparisons between small and large firms and banks when the sample is skewed due to the existence of small and large institutions. Constant return to scale (CRs) only works well when every decision-making unit (DMU) is performing at peak efficiency, which is the major limitation of CRs. Because of market imperfections and the recent financial crisis, it's probable that not all DMUs are performing at their full potential. Charness, Copper, et al. (1999) propose extending the CRS to the DEA model to introduce the variable return to scale (VRS).

Table 1: Efficiency of Banks

Years	T.E	A.E	C.E
2007	0.800	0.651	0.571
2008	0.964	0.915	0.879
2009	0.800	0.814	0.657
2010	1.000	0.870	0.870
2011	0.901	0.814	0.807
2012	1.000	0.756	0.756
2013	0.837	0.442	0.441
2014	0.968	0.953	0.929
2015	1.000	0.889	0.889
2016	1.000	0.871	0.871
2017	0.968	0.996	0.996
2018	0.914	0.789	0.737
2019	1.000	0.989	0.989
2020	1.000	0.981	0.981
MEAN	0.94	0.84	0.81

TABLE 2: EFFICIENCY MEASURES UNDER CRS AND VRS OF ISLAMIC BANKS IN PAKISTAN 2007-2020

Year	Meezan Bank			Dubai Islamic			Albarka			Bank Islami			BURJ Bank	
	CRS TE	**VRS TE**	**Scale**	**CRS TE**	**VRS TE**	**SCALE**	**CR TE**	**VRS TE**	**SCALE**	**CRS TE**	**VRS TE**	**SCALE**	**CRS TE**	**VRS TE**
2007	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	0.86	0.001	0.43
2008	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	0.59	0.87	1.00	1.00
2009	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.001	0.02
2010	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2011	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00
2012	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2013	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	0.95	0.85	1.00	1.00
2014	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.95	0.81	0.81	0.95	0.84	1.00	1.00

	Meezan bank			Dubai Islamic			Albarka			Bank Islami			MCB Bank		
Year	**CRS TE**	**VRS TE**	**CRS AE**	**CRS TE**	**VRS TE**	**CRS AE**	**CR TE**	**VRS TE**	**CRS AE**	**CR S TE**	**VRS TE**	**CR S AE**	**CR S TE**	**VTS TE**	**CRS AE**
2015	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	0.95	1.00	i.00	1.00	1.00	1.00	1.00
2016	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.93	0.84	1.00	1.00	0.872
2017	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.84	1.00	1.00	1.00	1.00
2018	1.00	1.00	1.00	1.00	1.00	1.00	.93	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2019	1.00	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2020	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mean	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	.97	0.93	0.97	0.96	1.00	1.00	0.98

The results of Islam provide cause for optimism. The findings indicate that Islamic banks in Pakistan are efficient in terms of technical and cost efficiency. Around 94% is a typical T.E. (technical efficiency) rating. Whereas the mean C.E. (cost effectiveness) is close to 81%, Indicating that allocative rather than technical inefficiencies are the primary cause of inefficiency, Pakistan's Islamic banking sector effectively allocates approximately 84% of resources. The Islamic banking industry in Pakistan is not performing at an ideal level, as shown by the sector's average scale efficiency of 77%. In general, the research found that Islamic banks' efficiency rose throughout the sample period from 2007 to 2020, with the exception of 2009. The global financial crisis may be to blame for 2009's decline in productivity.

The data demonstrate that Meezan Bank had the greatest average cost, technical efficiency, and allocative efficiency (1.0 or 100%) of every bank analyzed. According to the average value, Dubai Meezan Bank, Mcb Islamic, and Dubai Islamic Bank all do very well in terms of technological efficiency. Albarka Bank and Bank Islami, on the other hand, have respective technical efficiencies of 99.5% and 97.5% under VRS assumptions and 96.5 and 93.4% under CRS assumptions. The Burj Bank, previously known as the Dawood Islamic Bank, ranks last among the top five Islamic banks in terms of technical, cost, and allocative efficiency. A closer inspection of the data reveals a correlation between bank size and age and efficiency metrics, or top-level performance. Meezan Bank has the greatest allocative efficiency, whereas Burj Islamic Bank has the lowest. The growth of MCB Islamic Bank, founded after a demerger between MCB and NIB Bank, directly influences the performance in both technical and cost efficiency. The findings lend credence to the idea that economies of scale increase as bank size grows. Consistent with previous studies by Niazi (2010), Shahid et al. (2010), Beck et al. (2013), Bitar et al. (2016), Haider et al. (2019), Hata et al. (2020), etc., the findings of this investigation support earlier studies.

Conclusion

This study investigates Islamic banks' x-efficiency in Pakistan from 2007–2020. Unlike previous studies, this research employs the DEA method to evaluate the effectiveness of the Islamic banking sector. The input and output variables are specified using an intermediation approach, in accordance with standard practice and Islamic concepts. The results show that Islamic banks in Pakistan are, on average, quite efficient at what they do. Around 94% is a typical T.E. (technical efficiency) rating. Whereas the mean C.E. (cost effectiveness) is close to 81%, Indicating that allocative rather than technical inefficiencies are the primary cause of inefficiency, Pakistan's Islamic banking sector effectively allocates approximately 84% of resources. Upon further inspection, it becomes clear that the bank's size and longevity are the primary contributors to its top-tier performance and efficiency metrics. The study's results provide credence to the idea of economies of scale by showing that scale efficiency improves with bank size. When compared to Burj Islamic Bank, Meezan Bank is more effective overall. It is advocated that sharia-based banks in Pakistan be allowed to consolidate to increase efficiency and benefit economies of scale, as occurred when Burj Bank merged with Albarka Islamic Bank.

Only 11% of Pakistanis have access to banking services via traditional institutions; hence, the remaining 89% of the country's population still must be reached. Thus, Islamic financial institutions should expect a sizable customer base. People in rural regions are more likely to be dedicated to interest-free goods; hence, it is recommended that Islamic banks build offices there.

Research on banks' efficiencies is vital for both theory and practice. Managers, investors, and anybody else with an interest in the bank will find this report invaluable. The research findings give a roadmap for bank managers to follow as they assess the profitability, efficiency, and growth of their institutions over time. Therefore, bank managers can utilize the study's findings to assess the bank's performance over time. Investors and savers may both benefit from this study's findings. Investors and depositors may use the results of efficiency metrics to evaluate the bank's past and present performance and estimate the related risk.

Nafisa Awan: Problem Identification and Model Development
Moazzam Ali: Literature Review and methodology
Muhammad Adnan Khan: Data Analysis, Supervision and Drafting

Conflict of Interests/Disclosures

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