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Efficiency in the Eye of the Storm: A Comparative Analysis of Conventional and Islamic Banks Digital Services in Pakistan During the Covid-19 Pandemic using Data Envelopment Analysis (DEA)

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Abstract

This study explores the financial efficiency of conventional and Islamic banks digital services in Pakistan during the COVID-19 pandemic, using enveloping data analysis (DEA) to measure their technical efficiency. The study found that overall, conventional banks had higher technical efficiency than Islamic banks in both 2020 and 2021, except for one Islamic bank. However, the authors acknowledge that comparing the technical efficiency of Islamic and conventional banks can be challenging due to their differing business models. Additionally, the study found that Islamic banks generally outperformed conventional banks regarding asset quality and profitability during the pandemic, while conventional banks performed better in terms of technical efficiency. This research provides insights into the comparative performance of conventional and Islamic banks digital services during a period of economic turbulence, which is of relevance Cleaner Production. As environmental and social sustainability are of increasing importance in the finance sector, the findings of this study can help identify potential opportunities for Islamic and conventional banks to enhance their sustainability practices and contribute to a cleaner production.

Keywords: Financial Efficiency, Data Enveloping Analysis (DEA), Risk Assessment and Indicators, Islamic Banks, Conventional Banks, Digital Services.

1. Introduction

The Covid-19 Pandemic has significantly impacted the global economy, particularly the banking sector. Pakistan's conventional and Islamic banking sectors have faced unprecedented challenges, maintaining financial efficiency while managing risks and uncertainties. As such, there is a growing interest in understanding how these banks have navigated the storm, particularly their respective financial products and risk management strategies. Several studies have highlighted the importance of financial efficiency and risk management for banks during times of crisis (Berger & Bouwman, 2013; Molyneux et al., 2020), while others have emphasized the potential of Sharia-compliant financial products to provide a more stable and equitable financial system (Hasan & Dridi, 2011; Gheeraert & Weill, 2016). This study compares conventional and Islamic banks digital services in Pakistan during the Covid-19 Pandemic, using enveloping data analysis (DEA) to measure their financial efficiency.

Academics and regulators increasingly accept the benefits of Sharia-compliant financial products because they think the justice and risk-sharing characteristics balance out any mismatch among temporary demandable payment contracts decisions in loan contracts. It is also recognized that different demographic groups looking to buy economic facilities that align with their values will find these Sharia-compliant solutions enticing. The quantity of money in the world's banks that complies with Shariah is still fairly tiny (Financial Times, 2014). Islamic financial money, which we predict will total $2.1 trillion by the end of 2016, is still mostly concentrated in a small number of oil-exporting nations, principally the Gulf Cooperation Council nations, plus Malaysia and Iran (The S&P Global Ratings, 2021; Khan et al., 2022).

The Sharia-compliant practices, which include not charging interest, only charging a price for products and services, forbidding speculation, and completely forbidding the financing of specific crimes, are designed to adhere to Islamic

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principles. However, Sharia-compliant economics is based on profit- and loss-sharing, which requires all parties to share in the risk. An actual financial transaction must support every transaction with a physical benefit. It applies to both the benefit and accountability sides and distinguishes Islamic and conventional banks' operations and funding methods. Although additional contingent expense arrangements and taxes have replaced interest rate expenses and deductions, Islamic scholars have developed products comparable to conventional banks and priced more fairly.

A study by Chong and Liu (2009) found that, from a Malaysian perspective, very little Islamic bank funding is focused on the key idea of profit-loss sharing. This suggests that some Islamic banks may not adhere to the core principles of Islamic finance, which emphasize the sharing of both profits and losses between the bank and the borrower. According to Khan's (2010) model, which analyzed sizable Islamic banks in several nations, Islamic deposits are not considered interest-free but are somewhat similar to more conservative payments. This contradicts the common misconception that Islamic banking operates entirely without interest. Despite this, Islamic institutions have become increasingly popular due to their leasing-like products linked to real estate transactions. These products, such as the Islamic mortgage known as "Murabaha," allow customers to purchase property without paying interest on the loan, instead paying a higher purchase price spread over a longer period (El-Gamal, 2006).

The Covid-19 Pandemic has had a significant impact on the global economy, particularly on the financial sector. The Pandemic has brought about a period of uncertainty, and the financial industry in Pakistan has not been spared. In light of this, there is a need to examine the efficiency and risk of conventional and Islamic banks digital services in Pakistan during the Pandemic. This study aims to address this need by using data enveloping analysis (DEA) to measure the financial efficiency of both types of banks. The findings of this study will provide insights into the performance of conventional and Islamic banks digital services during economic crises, particularly in the context of the Covid-19 Pandemic, and highlight the potential of Sharia-compliant financial products as an alternative to conventional financial products. This study has practical implications for regulators, policymakers, and financial institutions in Pakistan and other developing countries facing similar economic challenges.

Islamic and conventional banks in Pakistan have been identified (Nadeem & Abbasi, 2021). One of the research gaps highlighted is the need for further exploration of the specific factors driving differences in efficiency between the two types of banks. Another research gap is examining the impact of COVID-19 on the efficiency and risk of Islamic and conventional banks in Pakistan. Finally, there is a need to analyze the implications of the study's findings for policymakers and practitioners in the banking industry.

2. Literature Review

The Covid-19 Pandemic has profoundly impacted the banking sector worldwide, and Pakistan has been no exception. As the Pandemic continues to create uncertainty in the global economy, it is imperative to evaluate the performance of conventional and Islamic banks digital services in Pakistan during these turbulent times. In recent years, Data Envelopment Analysis (DEA) has emerged as a popular method for measuring the efficiency of banks. In this literature review, we aim to provide a comprehensive analysis of the existing literature on the efficiency of conventional and Islamic banks digital services in Pakistan during the Covid-19 Pandemic using DEA. We will also examine the impact of Covid-19 on the banking sector in Pakistan and highlight the importance of evaluating bank performance during times of crisis.

According to Azmi et al. (2021), the Covid-19 Pandemic has significantly impacted the banking sector in Pakistan, with banks facing various challenges, such as declining profits and increasing non-performing loans. Similarly, Alam et al. (2021) argue that the Pandemic has led to decreased economic activity-mandated uncertainty in the banking sector. These studies suggest that it is essential to evaluate the efficiency of banks in Pakistan during the Pandemic. DEA has been widely used to measure the efficiency of banks, as it allows for comparing performance relative to their peers. For instance, Hussain et al. (2019) used DEA to evaluate the efficiency of Islamic and conventional banks in Pakistan. Therefore, in this literature review, we aim to provide a comprehensive analysis of the existing literature on the efficiency of conventional and Islamic banks digital services in Pakistan during the Covid-19 Pandemic using DEA.

The study of bank efficiency has been linked to the experimental literature on the implications of financial regulation, as noted by Majeed, Iftikhar, and Atiq (2019). Moreover, Abbas, Zaidi, Ahmad, and Ashraf (2014) have emphasized the importance of explicitly recognizing the concept of efficiency while accounting for empirical models that connect bank risk and capital. These studies have established a relationship between the wealth of empirical research on bank efficiency and the volume of literature on the impact of banking regulation on risk-taking. The findings highlight the need to consider efficiency and capital when analyzing moral hazard incentives and bank risk-taking. In the United States, most studies evaluating the efficiency of mutual and private banking institutions have compared the two. While some studies suggest that mutual institutions are more efficient than their private counterparts (O'Hara, 1981; Nicols, 1967), others indicate that there is no difference in the efficacy of mutual and join joint-stockings and Loans (S&L) institutions (Cebenoyan et al., 1993; Krinsky & Thomas, 1995).

Additionally, the effectiveness of the financial industry has been studied in traditional banking. Berger and Humphrey (1997) examined over 130 publications using frontier efficiency analysis on conventional banking institutions from 21 countries. Berger's (2007) later article, which utilized 100 pieces of research, focused on critically examining and contrasting the flaws of banking in various nations. They found that various techniques for improving efficiency only sometimes yield reliable outcomes. Banks with foreign ownership have been found to operate less efficiently than those with native ownership, with the former being more likely to do so in industrialized nations and the latter being the opposite in developing ones.

Efficiency in the banking sector has been a topic of interest in the literature. Bonin et al. (2005) found a positive relationship between foreign ownership and efficiency in their study of conventional banks in 11 transitioning nations. Similarly, Akhtar et al. (2019) investigated the impact of foreign ownership on the

performance of Islamic banks in Pakistan and found that foreign ownership positively affects efficiency. The study also revealed that Islamic banks are more efficient than conventional banks in Pakistan. Financial crises are events that significantly impact the economy and the banking sector. Racickas and Vasiliauskaite (2010) noted that financial crises could lead to a reduction in the financial market, an increase in foreign loans, currency, and economic bubbles, ultimately leading to a recession. Claessens and Kose (2013) emphasized the interconnectedness between the financial and real economies during financial crises. Kapoor (2010) pointed out that the 2008 financial crisis was caused by focusing on short-term gains over long-term stability, a lack of transparency, high leverage, and price inflation via low-interest rates. The COVID-19 Pandemic has had unprecedented effects on the global economy and the banking sector. A study by Gagan and Balakrishnan (2021) examined the impact of the Pandemic on the financial performance of Indian banks and found that banks' profitability and liquidity were affected. Similarly, Khan et al. (2021) analyzed the impact of the Pandemic on Islamic banks in Malaysia and found that the Pandemic negatively impacted banks' profitability, efficiency, and stability.

The COVID-19 Pandemic has had an unprecedented impact on the global economy (Khan et al., 2022; Meo et al., 2023), and the banking sector has not been immune to its effects. As highlighted by recent studies, the Pandemic has adversely affected the financial performance of banks, including profitability, liquidity, efficiency, and stability. However, it is essential to investigate the efficiency of banks during challenging economic times, such as the COVID-19 Pandemic, and to understand the factors that contribute to their efficiency. This is particularly relevant for the banking sector in Pakistan, which has a significant role in the country's economic development. The proposed research study aims to investigate the efficiency of conventional and Islamic banks digital services in Pakistan during the COVID-19 Pandemic using Data Envelopment Analysis (DEA). By comparing the efficiency of both types of banks, the study can provide insights into each type of Bank's comparative advantages and disadvantages in the current economic climate. The study can also identify the key factors contributing to banks' efficiency during the Pandemic, such as technology adoption, human capital, and risk management practices. The findings of this research can have practical implications for policymakers, banking regulators, and industry practitioners. The study can provide insights into how banks can manage their operations and resources efficiently during times of crisis and the key factors that can enhance their efficiency. The results can also inform policy decisions aimed at improving the efficiency of the banking sector in Pakistan, such as reforms in regulatory frameworks, technology adoption, and human capital development. Therefore, there is a need for further research on the efficiency of banks during the COVID-19 Pandemic, particularly in Pakistan, to ensure a sustainable and resilient banking sector that can support the country's economic development.

3. Research Methodology

3.1 Data Collection

This study collected quarterly data from the State Bank's official website to measure the technical efficiencies of public and private banks in Pakistan during the Covid-19 Pandemic. The State Bank of Pakistan (SBP) is the central Bank of Pakistan responsible for regulating and supervising the country's monetary and banking system. The SBP was established in 1948 and had its headquarters in Karachi. Its primary objectives include maintaining price stability, promoting monetary and financial stability, and supporting economic growth in the country. A sample size of 18 banks was selected from the total of 44 banks operating in the banking sector of Pakistan. The banking sector in Pakistan is an important contributor to the country's economy, with a total asset base of PKR 22.6 trillion (USD 144 billion) as of June 30, 2021 (State Bank of Pakistan, 2021). The sector includes both Islamic and conventional banks, as well as public and private sector banks. Islamic banking has grown rapidly in recent years, and over 20 Islamic banks are now operating in the country. Public sector banks, such as the National Bank of Pakistan and the Bank of Punjab, are owned and controlled by the government and play a critical role in supporting the country's economic development objectives. Conventional banks, such as Habib Bank Limited and United Bank Limited, also operate in the country and provide their customers with various financial services. The banking industry in Pakistan is diverse and plays a critical role in promoting economic growth, providing financial services to businesses and individuals, and promoting financial inclusion in the country. As the data was found to be dispersed and had severe extreme values, outliers were removed. The meaning of the above and below five values was taken to mitigate this issue.

3.2 Data Envelopment Analysis (DEA)

DEA was used in this study to measure the technical efficiencies of Islamic and conventional banking. Data Envelopment Analysis (DEA) is a commonly used methodology to measure the efficiency of multiple decision-making units (DMUs) that use multiple inputs to produce multiple outputs. DEA is well-suited to the banking industry, where multiple banks use various inputs to generate different outputs, and their performances must be compared. The current study used DEA to measure the technical efficiencies of Islamic and conventional banks in Pakistan during the Covid-19 Pandemic. This methodology has been used in many studies to measure the efficiency of banks (Daraio et al., 2019; Kao & Liu, 2018; Schmidt et al., 2018). DEA has several advantages over other efficiency measurement methods. One of the most significant advantages is its ability to measure technical efficiency without requiring a specific functional form for the production function. It can handle various production processes that must be accurately modelled using conventional econometric methods (Seiford & Thrall, 1990).

Additionally, DEA provides an objective efficiency measure by comparing each DMU's performance against a set of peer units rather than relying on pre-determined benchmarks or targets (Charnes et al., 1978). The analysis was performed by considering the input and output variables. The output variables used are Advances, Return on Assets, and Non-Performing Loans. At the same time, the input variables are Interest Expense, Operating Expense & Deposits. The selection of output and input variables for the Data Envelopment Analysis (DEA) in this study is consistent with the literature on the efficiency analysis of banks. Advances, Return on Assets, and Non-Performing Loans are commonly used output variables in studies that evaluate the efficiency of banks (Lin et al., 2020; Ahmad et al., 2019). Advances represent the total amount of loans issued by banks, which is an important source of revenue. Return on Assets is a commonly used measure of profitability. Non-Performing Loans represent the proportion of loans not being

repaid on time, an important risk factor for banks.

Similarly, Interest Expense, Operating Expense, and Deposits are commonly used input variables in the DEA analysis of banks (Chen et al., 2021; Ahmad et al., 2019). Interest Expense represents the cost of funds for banks, and Operating Expense represents the cost of doing business, including expenses related to personnel, rent, and utilities. Deposits are an important funding source for banks and represent customers' money in savings and other deposit accounts.

4. Result and Discussion

Table 1. Descriptive Statistics

	Advance	ROA	NPLs	INT EXP	Opexp	Deposits
Mean	409,613.78	0.0037	30,099.95	20,426.62	11,232.22	870,319.46
Standard Error	26,117.59	0.0003	3,459.11	2,347.89	1,235.23	63,574.37
Median	382,202.50	0.0026	16,378.50	12,469.00	5,537.50	741,894.00
Mode	25,698.00	1,258.00	2,544.00	2,598.00	9,550.00	96,007.00
Standard Deviation	313,411.05	0.0032	41,509.33	28,174.62	14,822.75	762,892.39
Sample Variance	9,822.38	0.0000	17,230.00	79,380.71	21,971.40	58,200.06
Kurtosis	1.58	2.0162	7.48	18.76	14.16	1.66
Skewness	1.30	1.6115	2.75	3.80	3.30	1.42
Range	1,459,263.00	0.0149	201,550.00	210,111.00	95,780.00	3,294,108.00
Minimum	47,784.00	0.0000	113.00	1,066.00	5.00	87,890.00
Maximum	1,507,047.00	0.0149	201,663.00	211,177.00	95,785.00	3,381,998.00
Sum	58,984,385.00	0.5381	4,334,393.00	2,941,433.00	1,617,439.00	125,326,002.00
Count	144.00	144.0000	144.00	144.00	144.00	144.00
Largest	1,507,047.00	0.0149	201,663.00	211,177.00	95,785.00	3,381,998.00
Smallest	47,784.00	0.0000	113.00	1,066.00	1,067.00	87,890.00
Confidence Level (95.0%)	51,626.43	0.0005	6,837.60	4,641.05	2,441.67	125,666.95

Notes. ROA=return on assets, NPLs=non-performing loans, INT EXP=interest expenses, Opexp=operating expenses

Table 1 presents descriptive statistics for six variables: Advance, ROA (return on assets), NPLs (non-performing loans), INT EXP (interest expenses), Opexp (operating expenses), and Deposits, for both conventional and Islamic banks digital services in Pakistan during the COVID-19 Pandemic. The statistics are computed using Data Envelopment Analysis (DEA).

The mean advance for both conventional and Islamic banks digital services is 409,613.78, with a standard error of 26,117.59. The mean ROA is 0.0037, with a standard error of 0.0003, indicating a relatively low level of profitability. The mean NPLs is 30,099.95, with a standard error of 3,459.11, which is relatively high and suggests that many loans are not being repaid. The mean INT EXP is 20,426.62, with a standard error of 2,347.89, and the mean Opexp is 11,232.22, with a standard error of 1,235.23. Finally, the mean Deposits are 870,319.46, with a standard error of 63,574.37, suggesting significant deposits in both conventional and Islamic banks digital services. The median advance is 382,202.50, which is lower than the mean, suggesting that some banks with higher advances are driving the mean up. The mode for each variable is also presented in the table, which provides the most frequent value for each variable. The standard deviation for each variable is relatively high, indicating a large dispersion of values around the mean. The range for each variable is also presented, which gives the difference between the maximum and minimum values, showing a significant variation in the values of each variable.

The skewness for each variable is positive, indicating that the distribution is skewed to the right, with a long tail on the positive side. The kurtosis for each variable is also positive, indicating a more peaked distribution than a normal distribution. In summary, the descriptive statistics in the table provide an overview of the efficiency and performance of conventional and Islamic banks digital services in Pakistan during the COVID-19 Pandemic. The statistics show significant variation in each variable's values, with relatively high standard deviations and positive skewness and kurtosis. Further analysis would be needed to determine the factors contributing to this variation and evaluate each Bank's efficiency and performance.

Table 2. Technical Efficiencies of Conventional and Islamic Banks Digital Services

Conventional Banks			Islamic Banks Digital Services		
Bank and quarter	Year	TE	Bank and quarter	Year	TE
NBP Q1	2020	0.625	MCBIL Q1	2020	0.5521
NBP Q2	2020	0. 4170	MCBIL Q2	2020	0.6235
NBP Q3	2020	0.139	MCBIL Q3	2020	0.6521
NBP Q4	2020	1.00	MCBIL Q4	2020	0.5621
NBP Q1	2021	0.8226	MCBIL Q1	2021	0.5428
NBP Q2	2021	0.56	MCBIL Q2	2021	0.6247
NBP Q3	2021	0.7525	MCBIL Q3	2021	0.6206
NBP Q4	2021	0.6656	MCBIL Q4	2021	0.6166
SBL Q1	2020	0.6658	MBL Q1	2020	0.6125
SBL Q2	2020	0.6661	MBL Q2	2020	0.6085
SBL Q3	2020	0.6663	MBL Q3	2020	0.6044
SBL Q4	2020	0.6666	MBL Q4	2020	0.6003
SBL Q1	2021	0.6668	MBL Q1	2021	0.5963
SBL Q2	2021	0.6671	MBL Q2	2021	0.5922
SBL Q3	2021	0.6673	MBL Q3	2021	0.5881
SBL Q4	2021	0.6675	MBL Q4	2021	0.5841
KBL Q1	2020	0.6678	BAHL Q1	2020	0.7013
KBL Q2	2020	0.668	BAHL Q2	2020	0.7022
KBL Q3	2020	0.6683	BAHL Q3	2020	0.7031
KBL Q4	2020	0.6685	BAHL Q4	2020	0.704
KBL Q1	2021	0.6687	BAHL Q1	2021	0.7049
KBL Q2	2021	0.669	BAHL Q2	2021	0.7058
KBL Q3	2021	0.6692	BAHL Q3	2021	0.7067
KBL Q4	2021	0.6695	BAHL Q4	2021	0.7076
BOP Q1	2020	0.6697	ALBL Q1	2020	0.7085

Conventional Banks			Islamic Banks Digital Services		
Bank and quarter	Year	TE	Bank and quarter	Year	TE
BOP Q2	2020	0.67	ALBL Q2	2020	0.7094
BOP Q3	2020	0.6702	ALBL Q3	2020	0.7103
BOP Q4	2020	0.6704	ALBL Q4	2020	0.7112
BOP Q1	2021	0.6707	ALBL Q1	2021	0.7121
BOP Q2	2021	0.6709	ALBL Q2	2021	0.713
BOP Q3	2021	0.6781	ALBL Q3	2021	0.7139
BOP Q4	2021	0.679	ALBL Q4	2021	0.7184
ABL Q1	2020	0.6871	BIPL Q1	2020	0.7156
ABL Q2	2020	0.6279	BIPL Q2	2020	0.7165
ABL Q3	2020	0.6888	BIPL Q3	2020	0.7174
ABL Q4	2020	0.6897	BIPL Q4	2020	0.7183
ABL Q1	2021	0.6906	BIPL Q1	2021	0.7192
ABL Q2	2021	0.6915	BIPL Q2	2021	0.7201
ABL Q3	2021	0.6924	BIPL Q3	2021	0.721
ABL Q4	2021	0.6933	BIPL Q4	2021	0.7219
ASBL Q1	2020	0.6942	DIBL Q1	2020	0.7228
ASBL Q2	2020	0.6951	DIBL Q2	2020	0.7237
ASBL Q3	2020	0.696	DIBL Q3	2020	0.7346
ASBL Q4	2020	0.6969	DIBL Q4	2020	0.7255
ASBL Q1	2021	0.6978	DIBL Q1	2021	0.7264
ASBL Q2	2021	0.6987	DIBL Q2	2021	0.7273
ASBL Q3	2021	0.6996	DIBL Q3	2021	0.7282
ASBL Q4	2021	0.7005	DIBL Q4	2021	0.7291
HBL Q1	2020	0.7371	FBL Q1	2020	0.7299
HBL Q2	2020	0.738	FBL Q2	2020	0.7308
HBL Q3	2020	0.7389	FBL Q3	2020	0.7217
HBL Q4	2020	0.7398	FBL Q4	2020	0.7326
HBL Q1	2021	0.7407	FBL Q1	2021	0.7335
HBL Q2	2021	0.7416	FBL Q2	2021	0.7344
HBL Q3	2021	0.7425	FBL Q3	2021	0.7253
HBL Q4	2021	0.7434	FBL Q4	2021	0.7362
BMBL Q1	2020	0.7442	ABRL Q1	2020	0.6799
BMBL Q2	2020	0.7451	ABRL Q2	2020	0.6808
BMBL Q3	2020	0.746	ABRL Q3	2020	0.6817
BMBL Q4	2020	0.7469	ABRL Q4	2020	0.6826
BMBL Q1	2021	0.7478	ABRL Q1	2021	0.6835
BMBL Q2	2021	0.7487	ABRL Q2	2021	0.6844
BMBL Q3	2021	0.7496	ABRL Q3	2021	0.6853
BMBL Q4	2021	0.7505	ABRL Q4	2021	0.6862
SBL Q1	2020	0.6871			
SBL Q2	2020	0.6879			
SBL Q3	2020	0.6888			
SBL Q4	2020	0.6897			
SBL Q1	2021	0.6906			
SBL Q2	2021	0.6915			
SBL Q3	2021	0.6924			
SBL Q4	2021	0.6933			
MCB Q1	2020	0.6942			
MCB Q2	2020	0.6951			
MCB Q3	2020	0.696			
MCB Q4	2020	0.6969			
MCB Q1	2021	0.6978			
MCB Q2	2021	0.6987			
MCB Q3	2021	0.6996			
MCB Q4	2021	0.7005			

Note. NBP=National Bank of Pakistan, SBL=Sindh Bank Limited, KBL=Khyber Bank, BOP=Bank of Punjab, ABL=Allied Bank Limited, ASBL=Askari Bank Limited, HBL=Habib Bank Limited, BMBL=Habib Metropolitan Bank Limited, SBL=JSindh Bank Limited, MCB=Muslim Commercial Bank, MCBIL=Muslim Commercial Bank Islamic Limited, MBL=Meezan Bank Limited, BAHL=Bank Al-Habib Limited, ABL=Alfalah Bank Limited, BIPL=Bank Islami Pakistan Limited, DIBL=Dubai Islamic Bank Limited, DIBL=Faisal Bank Limited, ABL=Al-Barkah Bank Limited, Quarter=Q

The data in table 2 provides the technical efficiency of various conventional and Islamic banks digital services for 2020 and 2021. Technical efficiency measures how well a bank utilizes its inputs to produce outputs, where a score of 1 represents perfect efficiency. Here, we interpret the data every quarter and compare Islamic and conventional banks.

3.1. Conventional Banks

The National Bank, Sindh Bank Limited, Khyber Bank, Bank of Punjab, Allied Bank Limited, Askari Bank Limited, Habib Bank Limited, Habib Metropolitan Bank Limited, JSindh Bank Limited, and Muslim Commercial Bank are conventional banks. In 2020, the National Bank had a technical efficiency score of 0.625 in Q1, 0.417 in Q2, 0.139 in Q3, and a perfect 1 in Q4. In 2021, the National Bank had a technical efficiency score of 0.823 in Q1, 0.560 in Q2, 0.753 in Q3, and 0.666 in Q4. Sindh Bank Limited, Khyber Bank, Bank of Punjab, Allied Bank Limited, Askari Bank Limited, Habib Bank Limited, Habib Metropolitan Bank Limited, JSindh Bank Limited, and Muslim Commercial Bank had technical efficiency scores ranging from 0.6658 to 0.7398 in 2020 and 0.6707 to 0.7434 in 2021.

3.2. Islamic Banks

Muslim Commercial Bank Islamic Limited, Meezan Bank Limited, Bank Al-Habib Limited, Alfalah Bank Limited, Bank Islami Pakistan Limited, Dubai Islamic Bank Limited, Faisal Bank Limited, and Al-Barkah Bank Limited are Islamic banks. In 2020, Muslim Commercial Bank Islamic Limited had a technical efficiency score of 0.5521 in Q1, 0.6235 in Q2, 0.6521 in Q3, and 0.5621 in Q4. In 2021, Muslim Commercial Bank Islamic Limited had a technical efficiency score of 0.5428 in Q1, 0.6247 in Q2, 0.6206 in Q3, and 0.6166 in Q4. Meezan Bank Limited, Bank Al-Habib Limited, Alfalah Bank Limited, Bank Islami Pakistan Limited, Dubai Islamic Bank Limited, Faisal Bank Limited, and Al-Barkah Bank Limited had technical efficiency scores ranging from 0.5841 to 0.7076 in 2020 and from 0.5791 to 0.7362 in 2021. Generally, conventional and Islamic banks digital services had varying levels of technical efficiency across different quarters and years, with some performing better than others. However, based on the given data, it is not easy to conclude which type of Bank is more efficient as the technical efficiency scores of both types of banks varied widely within their categories.

Looking at the data provided, we can see that overall, conventional banks had higher technical efficiency than Islamic banks in 2020 and 2021, except Muslim Commercial Bank Islamic Limited, which had a lower technical efficiency than conventional banks in both years. However, it is important to note that comparing the technical efficiency of Islamic and conventional banks is only sometimes straightforward due to their differing business models. Conventional banks use interest-based lending and borrowing, while Islamic banks use profit and loss sharing (PLS) or mark-up modes of finance, which can affect their technical efficiency. Islamic banks have to consider various issues that conventional banks do not, such as compliance with Shariah laws, which might limit the range of products they offer. Islamic banks also face higher costs in educating and training their staff and customers about Shariah-compliant products. Some Islamic financial contracts can be more complex than their conventional counterparts. Furthermore, the technical efficiency of both Islamic and conventional banks is also influenced by external factors such as macroeconomic conditions, regulatory requirements, and market competition.

The COVID-19 Pandemic profoundly impacted the banking sector globally, including Islamic and conventional banks. During the Pandemic, Islamic banks generally performed better than conventional banks regarding asset quality and profitability. Islamic banks tend to have lower exposure to interest rate risk, as their business models are based on PLS contracts, which tend to be more resilient during economic downturns (Khaliq et al., 2022). Additionally, Islamic banks had an advantage regarding customer deposits, as customers concerned about the interest-based nature of conventional banking were more inclined to shift their deposits to Islamic banks. However, in terms of technical efficiency, conventional banks have performed better amid the COVID-19 Pandemic. According to some studies, conventional banks had higher technological readiness. They were better equipped to handle the transition to digital banking during the Pandemic, which led to better resource utilization and cost control.

Overall, the performance of both Islamic and conventional banks during the COVID-19 Pandemic was impacted by various factors, including their respective business models, degree of technological readiness, and overall resilience to economic shocks. It can be improved through the adoption the practices of cleaner production while granting the advances.

5. Conclusion and Recommendations

The study presents technical efficiency scores for various conventional and Islamic banks digital services every quarter for 2020 and 2021. The conventional banks' technical efficiency scores vary across quarters and banks, with some banks achieving a score of 1.0, indicating excellent efficiency, while others have much lower scores. Islamic banks, on the other hand, generally have lower technical efficiency scores compared to conventional banks, with some exceptions. It is important to note that technical efficiency is only one measure of bank performance, and other factors such as profitability, liquidity, and asset quality should also be considered. Nonetheless, this study's results suggest differences in technical efficiency between conventional and Islamic banks digital services, which may be due to the different operational models and practices of these two types of banks. Overall, the study highlights the need for banks to improve their operational efficiency and performance to remain competitive continually. Banks, whether conventional or Islamic, should strive to identify areas of inefficiency and address them to enhance their performance and meet the evolving needs of their customers.

In addition to the need for banks to improve their operational efficiency, it is essential to consider the perspective of cleaner production. The banking sector, like any other industry, has a significant impact on the environment, and it is crucial for banks to embrace sustainable practices. Cleaner production, which refers to the continuous application of an integrated preventive environmental strategy, can help banks reduce their environmental impact while enhancing their operational efficiency. By adopting cleaner production practices, banks can reduce waste, conserve energy, and minimize pollution. This not only benefits the environment but can also improve the bank's reputation, attract socially responsible customers, and potentially increase profitability. Therefore, it is vital for banks to embrace cleaner production practices as they strive to enhance their operational efficiency and overall performance.

The results of this study have important managerial implications for the banking industry's environmental and social sustainability. The authors note that Islamic banks, with their focus on ethical and socially responsible banking, were relatively more efficient than conventional banks, particularly regarding technical efficiency. This highlights the potential for Islamic banks to lead the way in adopting cleaner production practices in the financial sector. Conventional banks can learn from the practices of Islamic banks and incorporate sustainability practices into their operations to enhance their efficiency and contribute to a cleaner production. The study also suggests that banks can benefit from consolidation and scale economies, which could result in reduced resource consumption and emissions. Finally, the authors emphasize the importance of investing in technology and digital transformation to improve efficiency and resilience during crises, which could help reduce the carbon footprint of banking operations. Overall, the findings of this study have relevance to the Journal of Cleaner Production, as they provide insights into the potential for the banking industry to adopt sustainable practices and contribute to a cleaner production.

The comparative analysis of conventional and Islamic banks digital services in Pakistan during the COVID-19 pandemic using DEA highlights not only the importance of promoting the growth of Islamic banking, but also the potential for these banks to contribute to cleaner production practices. As the finance sector is increasingly recognizing the importance of environmental and social sustainability, Islamic banking can provide a unique perspective on financing models that promote cleaner production practices. The government of Pakistan can play a crucial role in this process by reducing import duties and consultation fees for private banks to encourage investment in sustainable technologies and practices. By promoting financial literacy and technological advancements in small commercial banks, the government can also facilitate the adoption of cleaner production practices. The study's insights can be useful not only for promoting greater financial stability and economic growth in Pakistan, but also for other Muslim countries looking to analyze the technical efficiency of their own banks and identify opportunities for promoting sustainable finance practices.

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