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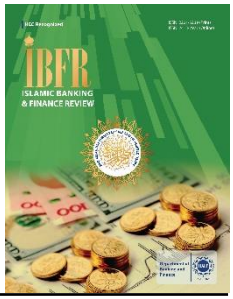

Title: **Modelling Islamic Banking Efficiency by Decomposing using DEA Bootstrapping Analysis**

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Modelling Islamic Banking Efficiency by Decomposing using DEA Bootstrapping Analysis

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Abstract

The current study aimed to determine the efficiency of the Islamic banking industry in Pakistan. It used the bootstrap DEA approach for the time period 2008-2018. The said approach removes the biases and errors by replicating the data generating process and using actual measurements for each sample. The study found that the mean value of various efficiencies for Islamic banks (IBs) in Pakistan is greater than 1, so these banks are running optimally. However, BankIslami Pakistan needs to increase its efficiency because it functions much below its optimal level. This study adds excellent value to the literature by opening a new direction for investigating the IBs in Pakistan and analyzing their performance. Only a few studies have been conducted on this topic before and these are not related to the Pakistano context.

Keywords: data envelopment analysis (DEA) approach, efficiency, Islamic banks (IBs), Pakistan

Introduction

The commercialization of Islamic finance industry (IFI) began in the 1970s. IFI has expanded at a double-digit rate since its inception. In both the Islamic world and non-Muslim countries, Islamic financial sector is booming. Its overall worth and year-on-year (y-o-y) growth has continued. The combined value of IFI's three key sectors (Islamic banking, *Sukuk*, and Islamic funds) is 2.44 trillion dollars in 2019, up from 2.19 trillion dollars in 2018.

Furthermore, IFI grew by 11.4% year-on-year in 2019, compared to 9.6% between 2017 and 2018. Given the pandemic, geopolitical considerations, and weakening of local currencies against U.S. dollar, this

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rise is extremely impressive. IFI assets grew even faster at 12.7% in 2019 as compared to 0.9 percent in 2018. Its total assets grew from 1571.3 trillion USD in 2018 to 1765.8 trillion USD in 2019 (Board, 2020).

Islamic banking in Pakistan started with Meezan Bank Limited. in 2002. During the early period of Islamic banking in Pakistan, the pace of development of IFI was slow, although it gradually increased with time. The assets showed an increase of 2.03% from January 2020 to March 2020, which amounted to approximately 76 billion Pakistani rupees and made up the total asset value of 3,360 billion Pakistan rupees. The deposits showed an increase of 40 billion Pakistan rupees (1.5%) in the same period. Total deposit now stand at 2,692 billion Pakistan rupees. The market share of deposits and assets of IFI in the overall banking industry of Pakistan account for 16.9% and 15.2%, respectively (Islamic Banking Bulletin, 2020).

The splendid growth in Islamic banking assets and financing during the last decade throughout the world, especially in Pakistan, is explained by the built-in characteristics of Islamic banking, which makes it immune to financial crisis. Furthermore, the increase can also be beneficial in developing *Sukuk* and Islamic capital market (ICM). These two sectors are fundamental for growth in IFI.

There are 428 Islamic Banks (IBs) operating globally and several Pakistan-based banks also offer Islamic services via Islamic windows (Alqahtani & Mayes, 2018). Five (5) full-fledged IBs operate in Pakistan. These banks make up a modest part of Pakistan's total banking system. Furthermore, relatively few studies have been undertaken to assess their technical performance. This analysis uses data of the five (5) IBs operating in Pakistan for the period 2008-2018 in order to address this research gap. Yearly data of these banks was collected from their regularly scheduled annual reports on their websites. This study used the bootstrap Data Envelopment Analysis (DEA) method (Simar & Wilson, 2000), a reliable method for correcting estimation bias and generating confidence periods for the computed efficiency points at the required efficiency level.

Literature Review

The concept of efficiency is an economic concept that could be defined and explained through particular ways and theories. Efficiency generally refers to obtaining high-quality products and services in a timely manner using minimal resources (Sharma et al., 2013). Morever, in economic theory,

efficiency is explained in two ways: efficiency as an economic concept and efficiency in production. Efficiency in production is a micro concept, while efficiency as an economic concept has a broader scope. The concept of porduction relates to the way different inputs are added and mixed to obtain an output. Efficiency in production is related to the production process in which cost and revenue are generated to determine a firm's efficiency level.

In recent decades, various studies have been conducted to evaluate the efficiency of IBs using several different models and concepts, such as non-parametric and parametric models, as well as the concepts of profit efficiency, cost efficiency, revenue efficiency, technical efficiency (Brown, 2003; Hassan, 2006; Noor & Ahmad, 2012; Sufian, 2006; Tahir & Haron, 2010), and many others. However, literature review shows that only a few studies examined the efficiency of IBs in Pakistan.

Some studies measured the overall technical efficiency of IBs in the MENA region (Mustapha Ben Hassine, 2014). These studies discovered that pure technical inefficiency, induced by managerial underperformance, turned into the leading cause of the technical inefficiency of IBs, instead of scale inefficiency resulting from inefficient decisions regarding the scale of operations. The same result was confirmed by (Yudistira, 2004), which is one of the first studies conducted to evaluate the efficiency of IBs. The study used DEA to test the technical efficiency of 18 banks operating in East Asia, Middle East, G.C.C. countries, and Africa from 1997 to 2000.

By applying a similar methodology and technique adopted by Yudistira (2004), Sufian and Akbar (2009) discovered that IBs are affected by pure technical inefficiency more than scale inefficiency from 2001 to 2006. These outcomes were verified by (Hassine & Limani, 2014). They adopted the same technique to analyze the data of 22 banks for the years 2005-2009. They found that IBs are mainly affected by pure technical inefficiency rather than scale inefficiency.

Srairi et al. (2012) also applied the DEA approach to evaluate the efficiency of IBs of the G.C.C. region. They discovered that pure technical inefficiency is the primary cause of technical inefficiency rather than scale inefficiency. Pure technical efficiency was estimated to be 29.3%, whereas scale inefficiency was approximately 17%. Aghimien et al. (2016) found that IBs functioned at optimal scale efficiency over their research period (2007-2011), implying that they are scale efficient. Furthermore, the study

revealed that IBs failed to adequately manage their resources, implying a period of pure technical inefficiency.

Rahim (2015) used the DEA technique to analyze the efficiency of IBs in Malaysia for the period 2008-09. According to the study report, Malaysian IBs were inefficient in terms of profit in the said period as opposed to cost and revenue. Ada and Dalkilic (2014) conducted another study for the same purpose involving 19 nations from different continents, including North Africa, Asia, and the Middle East. The study covered the years 1998-2011. The authors discovered that the efficiency of IBs was enhanced in Malaysia and Turkey using the DEA method.

Kamarudin et al. (2014) used the DEA technique to assess the efficiency of ten (10) Islamic and conventional banks operating in Malaysia in 2011. They found CBs more efficient than their Islamic counterparts. Similarly, Ahmad and Abdul-Rahman (2012) employed the DEA technique to compare the efficiency of Islamic and conventional banks in Malaysia for the period 2003-2007. The findings were consistent with the study of Kamarudin (2014), indicating that mainstream banks were more efficient than IBs for the said period.

Ahmad et al. (2008) used the DEA technique to assess the efficiency of IBs in Malaysia for the period 1997-2003 but found CBs to be more efficient. Similarly, Safiullah (2021) assessed the efficiency and financial stability of conventional and Islamic banks for a group of 28 nations. The study spanned the years 2003-2018. The author determined that IBs had 5.3% greater stability than regular banks after using the meta frontier stability function technique based on the stochastic frontier framework.

Post Financial Crisis Era and Banking Efficiency (Comparison of IBs and CBs)

Following the global financial crisis 2008, financial experts are increasingly interested in learning more about the benefits of Islamic banking in terms of its efficiency, financial stability, and risk management. According to the analysts, IBs often function in nations with a sizeable Muslim population and carry a lower credit risk than regular banks (Abedifar et al., 2013).

According to the research on G.C.C. countries, the profit and revenue collecting activities of IBs differ from CBs (Shah et al., 2021). Apparently, efficiency in income collection is essential for IBs (Khediri et al., 2015).

Furthermore, Kamarudin et al. (2014) discovered that IBs are more liquid, lucrative, and well-funded due to a lack of assets. According to the authors, both types of banks are distinct in terms of credit and bankruptcy risk but not in terms of profit. According to Bourkhis and Nabi (2013), the recession of 2008 sparked a surge in interest in Islamic banking because many regular banks collapsed during the crisis. However, the research found that the effect of recession on the health of conventional and Islamic banks was not very different.

Comparing the efficiency of Islamic and conventional banks in Europe, it was determined that IBs are technically more efficient than CBs, although this efficiency has no impact since it is nullified by the far worse allocative efficiency. IBs have a low cost efficiency (Ahmad & Luo, 2010). From the standpoint of profit, Ariss (2010) calculated worldwide market competitiveness of the banking business. The findings showed that despite IBs having a higher percentage of assets dedicated to financing activities than CBs, the latter remain more competitive than IBs.

The following study may be used to draw two essential points: firstly, competition is more important than profit margin and it forces the bank to engage more in risk-taking behaviour; secondly, an increase in the bank's risk-taking behaviour does not necessarily imply an increase in its risk profile, since it can be offset by increasing the bank's equity capital and liquidity base (Tomak, 2013). The above explanation illustrates the implications for the capital level of IBs if basal ll is fully implemented. The IBs struggle to satisfy their liquidity and capital requirements. According to Alqahtani and Mayes (2018), no substantial difference was found in stability and performance between commercial and Islamic banks throughout the global financial crisis. During the final stages of the crisis, IBs suffered more since only smaller IBs demonstrated excellent stability, while central IBs performed on par with their conventional counterparts.

According to Johnes et al. (2014), IBs operate akin to CBs with regard to gross efficiency, with their high net efficiency attributable to superior management skills. According to Beck et al. (2013), IBs' operations and operational handling are not as different from regular banks as is commonly presumed. For managing expenditures, Doumpos et al. (2017) observed that the previous study used a multiclient area technique that covered most of the performance indicators, such as quality, liquidity, capital strength, and management quality. Their findings showed that the difference in total

financial efficiency between the two banking methods is statistically negligible. This research also demonstrated that numerous country-specific characteristics impact the bank's financial strength. These characteristics or variables include government effectiveness andsound regulations. According to Johnes et al. (2014), the efficiency and convergence rates of Islamic and conventional banks are substantially different. Wanke et al. (2019) explained that origin, bank type, and ownership in the MENA area have varied effects on the balance sheet, profit rate, and financial health indicators. According to the findings, regulatory and cultural impediments only exist at the country level.

The above review indicates that technical efficiency is mainly driven by pure efficiency rather than scale efficiency. As per the researchers knowledge, there is no study avaiable on this topic in the Pakistani context. Hence, this work constitutes a valuable addition to the literature and also has ramifications for IBs in Pakistan.

Methodology

Concerning the above discussion, the studies mentioned earlier used the DEA approach. It indicates that the negative effect of random error was not removed and biased results were generated. The literature also concluded that the estimated efficiency scores were relevant to the sample variation. Simar and Wilson (2000) provided a robust method that gives an efficiency score and solves the above stated biasness issue.

Bootstrapping is based on the idea of repeatedly simulating the data generating process and applying the original estimator to each simulated sample. Subsequently, the estimated data depicts the original estimate.

Data and Variables

Data

The data used in our analysis consists of different inputs (fixed assets, labour and outputs obtained from the financial statements of the selected IBs of Pakistan. Data was collected for the time period 2008-2018 for five (5) full-fledged IBs operating in Pakistan, including Meezan Bank Limited, BankIslami, MIB Islamic Bank, Dubai Islamic Bank, and AlBaraka Bank.

Variables

The variables used to calculate the efficiency of the five (5) selected IBs of Pakistan were 'input' and 'output'. Two approaches have been used in the literature to explain the banks' input and output: the intermediation approach and the production approach (Fethi & Pasiouras, 2009; Sharma et al., 2013). The intermediation approach considers the bank as an intermediary that collects funds from the savers. It passes them to the borrowers, and , while loans and other income generating assets as output (Sealey & Lindley, 1977). In contrast, the production approach considers the bank as a production unit that produces loans and deposits as outputs by using labour and capital as inputs.

According to (Berger & Humphrey, 1997), the intermediation approach is the preferred over production approach because it takes the bank as a whole unit, while the production approach is suitable for examining bank branches (Aghimien et al., 2016; Mobarek, 2014; Sufian & Noor, 2009; Yudistira, 2004). So, keeping in view the literature, this study used the intermediation approach and viewed the bank as an intermediary that produces outputs, such as earning assets (Y1) including investment in securities, real estate, properties, and companies, as well as total loans (Y2) which include *Ijara, Murabaha, Mudarabah,* and *Musharakah*. The current study used three inputs: fixed asset (X1), which is equal to the book value of a fixed asset such as a plant, equipment, and machinery; labour (X2), which is equal to the amount the staff is paid as salary; and total deposit (X3), which is equal to the fund deposited in the bank by different banks and customers.

Results

Before analyzing the results, some terminology and abbreviations need to be explained.

- Bank 1 = Meezan Bank Limited
- Bank 2 = AlBaraka Bank
- Bank 3 = MIB Islamic Bank
- Bank 4 = Dubai Islamic Bank
- Bank 5 = BankIslami Pak

Year 1 = 2008 to Year 11 = 2018

Effch = Efficiency Change

TEchch = Technical efficiency change

Pech = Pure efficiency change

Sech = Scale efficiency change

Tfpch = Total factor productivity change

Table 1

Overall Efficiency Scores Per Year Per Bank

Year	Banks	Effch	TEchch	Pech	Sech	Tfpch
Year 2	1	2.510	0.432	1.325	1.894	1.083
Year 2	2	1.288	0.447	1.000	1.288	0.576
Year 2	3	2.730	0.363	1.986	1.375	0.991
Year 2	4	2.961	0.222	1.000	2.961	0.657
Year 2	5	1.000	0.270	1.000	1.000	0.270
Year 3	1	1.571	0.592	1.000	1.571	0.930
Year 3	2	1.000	0.852	1.000	1.000	0.852
Year 3	3	1.499	1.008	1.217	1.231	1.511
Year 3	4	1.000	0.967	1.000	1.000	0.967
Year 3	5	1.000	1.914	1.000	1.000	1.914
Year 4	1	1.000	0.939	1.000	1.000	0.939
Year 4	2	0.906	0.977	1.000	0.906	0.886
Year 4	3	1.000	1.073	1.000	1.000	1.073
Year 4	4	1.000	0.972	1.000	1.000	0.972
Year 4	5	1.000	0.277	1.000	1.000	0.277
Year 5	1	1.000	3.616	1.000	1.000	3.616
Year 5	2	1.104	0.892	1.000	1.104	0.985
Year 5	3	1.000	0.962	1.000	1.000	0.962
Year 5	4	1.000	0.959	1.000	1.000	0.959
Year 5	5	1.000	18.226	1.000	1.000	18.226

Year	Banks	Effch	TEchch	Pech	Sech	Tfpch
Year 6	1	1.000	1.222	1.000	1.000	1.222
Year 6	2	1.000	23.940	1.000	1.000	23.940
Year 6	3	1.000	1.174	1.000	1.000	1.174
Year 6	4	1.000	1.219	1.000	1.000	1.219
Year 6	5	1.000	0.106	1.000	1.000	0.610
Year 7	1	1.000	1.164	1.000	1.000	1.164
Year 7	2	1.000	0.148	1.000	1.000	0.148
Year 7	3	0.776	1.043	1.000	0.776	0.809
Year 7	4	1.000	1.390	1.000	1.000	1.390
Year 7	5	1.000	1.186	1.000	1.000	1.186
Year 8	1	1.000	1.032	1.000	1.000	1.032
Year 8	2	1.000	1.024	1.000	1.000	1.024
Year 8	3	0.825	1.371	0.643	1.284	1.131
Year 8	4	1.000	1.401	1.000	1.000	1.401
Year 8	5	0.852	1.207	1.000	0.852	1.028
Year 9	1	0.700	0.407	1.000	0.700	0.285
Year 9	2	1.000	1.508	1.000	1.000	1.508
Year 9	3	1.197	0.898	1.224	0.978	1.075
Year 9	4	1.000	0.909	1.000	1.000	0.909
Year 9	5	1.174	1.022	1.000	1.174	1.199
Year 10	1	0.791	1.349	1.000	0.791	1.066
Year 10	2	0.623	0.507	1.000	0.623	0.316
Year 10	3	1.121	1.190	1.226	0.914	1.331
Year 10	4	1.000	2.682	1.000	1.000	2.682
Year 10	5	1.000	1.467	1.000	1.000	1.467

Year	Banks	Effch	TEchch	Pech	Sech	Tfpch
Year 11	1	1.069	1.051	1.000	1.069	1.123
Year 11	2	1.605	2.2926	1.000	1.6056	4.697
Year 11	3	0.890	1.078	0.803	1.109	0.960
Year 11	4	1.000	1.210	1.000	1.000	1.210
Year 11	5	0.504	1.259	0.721	0.669	0.635

The above table shows the efficiency scores of the five (5) IBs of Pakistan for the time period 2008-18. The data for year one is not included because of the limitation of the DEA technique, which removes the data of the first year. Efficiency change shows how efficiently the bank uses its input to create output. If the value of technical efficiency is greater than one, it exhibits the use of resources on an optimal level in the banking system. Technical efficiency is further divided into scale efficiency and pure efficiency. If the value of pure efficiency is greater than one, it indicates that the decision making body is informed by the previous mistakes. If the value of scale efficiency is greater than one, it indicates that management isperforming at the optimal level. The total factor productivity change explains the amount of output that can be produced from a certain amount of input. In year 2, efficiency change, pure efficiency, and scale efficiency remained above 1, indicating that banks efficiently converted the input into output. While technical efficiency and total factor productivity remained less than 1, which indicates that banks were unable to produce the optimal output from the given input.

Similarly, the data shows that every bank performed optimally in year six except BankIslami Pakistan, which performed poorly in technical efficiency and total factor productivity. The change in technical efficiency could be increased by 90%, while the total factor productivity could be enhanced by 40% in the case of BankIslami Pakistan. Moreover, the data shows that in the last year, BankIslami performed worst on every frontier, while MIB Islamic Bank performed better only in terms of technical efficiency and scale efficiency. Efficiency change could be increased by 11%, while pure efficiency changes by 20% percent, and total factor productivity changes by 4%.

Summary of Annual Means

Table 2

Summary of Annual Means

Year	Effch	TEchch	Pech	Sech	Tfpch
2	1.921	0.335	1.213	1.583	0.643
3	1.187	0.988	1.040	1.141	1.173
4	0.980	0.767	1.000	0.980	0.752
5	1.020	2.223	1.000	1.020	2.267
6	1.000	1.347	1.000	1.000	1.347
7	0.951	0.783	1.000	0.951	0.745
8	0.932	1.196	0.915	1.018	1.115
9	0.997	0.875	1.041	0.957	0.872
10	0.888	1.262	1.042	0.853	1.121
11	0.949	1.383	0.897	1.059	1.312

The accompanying table depicts the results of various efficiency scores for the five (5) IBs during the course of the respective year. These figures represent the average value of all banks for each year. The banks did not perform well in 2011, 2014, and 2016, which is clearly depicted by their efficiency values. In 2011, efficiency could be increased by 2% percent, technical efficiency changed by 24%, scale efficiency changed by 2%, and total factor productivity changed by 25%. Similarly, in 2014, efficiency change could be increased by 5% percent, technical efficiency changed by 22%, scale efficiency changed by 5%, and total factor productivity changed by 26%.

Furthermore, in 2016, efficiency change could be increased by 1%, technical efficiency changed by 13%, scale efficiency changed by 5%, and total factor productivity changed by 13%. Pure efficiency change around the year remained greater than 1, which indicates that the banks' learning process continues. However, scale efficiency change in different years remained less than 1, which indicates that banks did not perform optimally in case of large scale operations. The efficiency change was also worst in some years as compared to others.

Summary of Banks Means

Table 3

Summary of Banks Means

Banks	Effch	TEchch	Pech	Sech	Tfpch
1	1.088	0.970	1.029	1.058	1.055
2	1.026	1.104	1.000	1.026	1.132
3	1.121	0.969	1.065	1.053	1.086
4	1.115	1.034	1.000	1.115	1.153
5	0.934	0.971	0.968	0.965	0.907
Mean	1.054	1.008	1.012	1.042	1.063

The above table shows the scores of the various efficiency measures for the five (5) IBs of Pakistan. From the above table, it is clear that the first four (4) banks performed optimally during the selected time period. Almost every value is greater than 1, which indicates that the banks were running optimally. In contrast, the fifth bank, namely BankIslami Pakistan, performed worst overall. Efficiency change could be increased by 7%, technical efficiency change by 3%, pure efficiency change by 4%, scale efficiency change by 4%, and total factor productivity change by 10%. However, the overall mean value for these banks remains greater than 1. So, it can be concluded that Pakistani IBs are running optimally. Hence, they do not face any efficiency problems faced by the IBs of MENA and the G.C.C. region (Aghimien et al., 2016; Hassine & Limani, 2014; Srairi et al., 2012). Scale and pure technical efficiency are not discussed because the mean values of their efficiency scores are greater than 1, as shown in the table.

Conclusion and Implications

The current study strived to evaluate the efficiency of the five (5) full-fledged Pakistani IBs, namely Meezan Bank Limited, AlBaraka Bank, MIB Islamic Bank, Dubai Islamic Bank, and BankIslami Pakistan. Data was collected for the time period 2008-2018. Overall, the results showed that the banks' efficiency remained greater than 1 keeping in view every efficiency parameter, including efficiency change, technical efficiency change, pure efficiency change, scale efficiency change, and total factor productivity

change. Furthermore, this phenomenon is depicted by the mean value as well. However, BankIslami Pakistan performed subpar in every efficiency parameter. So, if it manages to run itself optimally, these efficiency scores could be improved.

We conclude that the Islamic banking industry is running smoothly and showing continuous growth, a fact also reflected by the efficiency scores. Policymakers and the Board of Directors (BOD) of BankIslami need to implement a more robust management policy in order to tackle the ongoing efficiency problem.

This study explained the current performance of Islamic banking industry in Pakistan regarding its efficiency. It also pointed out which banks performed exceptionally well and which did not during the study period. Future studies could be conducted in this field to explain the core reason why some banks show extraordinary efficiency scores and others do not. Future studies may also explain the competitive pressure that results in their decreased performance.

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