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PRIMARY RESEARCH

Comparative Analysis of Technical Efficiency for Islamic versus Conventional Banks and its Determinants in Pakistan

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Abstract. The purpose of this study is to analyze the Technical Efficiency (TE) of Islamic banks and conventional banks in Pakistan by using Data Envelopment Test (DEA). We also used TOBIT analysis to identify the determinants of efficiency in the banking industry. Twenty banks have been selected from the banking industry, from which ten banks are Islamic banks or banks which have Islamic branches, and ten banks are conventional banks. Panel data are used for the period 2007-2015. Overall, it is concluded that conventional banks are technically more efficient than Islamic banks. Accordingly, the censored TOBIT regression indicates that the ownership, liquidity, bank size, and capital adequacy ratios are the main determinants of overall TE for the banks.

KAUJIE Classification: L25
JEL Classification: G21

INTRODUCTION

Banking industry is flourishing in Pakistan day by day nourished with new financial services in the economy. Firstly, the bond market in Pakistan is not as developed as the equity market in the country, thus intensifying the significance of the banking sector. Secondly, due to China Pak Economic Corridor (CPEC), the competition among the banking industry is increasing. As a result, the performance analysis in the banking industry has to be an integral part of their management practices. The top management requires to identify and desires to remove the fundamental causes of inefficiencies to enable the banking industry gain the competitive advantage and to meet the current and prospective challenges. Islamic banking evolved approximately four decades ago and got popularity the world over. This element induced a major financial tool in the modern economies and, hence, contributed to development of the banking industry. Conventionally, banking performance is evaluated through profitability measures. For this purpose, a number of financial ratios are used to

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analyze different aspects of the banking operations, but such analysis produced insignificant results regarding the identification of benchmark policies and the computation of overall performance of the banking system.

Charnes, Cooper, and Rhodes (1978) introduced DEA as an alternative to the conservative banking management tools in complex operational environments. DEA allows handling the multiple inputs and outputs along with Decision Making Unit (DMU) in an easy manner and requires no prior assumption. Hence, DEA is the most important technique to analyze the performance in the banking industry literature.

In the first instance, we analyzed the TE of Islamic and conventional banks in Pakistan. To overcome the deficiencies of traditional DEA, we used the TE models. In the second instance, we used Tobit model to identify the determinants of efficiency in the banking industry. The first segment of this study covers the basic introduction briefly. The second section comprises literature review, while the following section covers the data and methodology. The fourth section covers the results and discussion, and in the fifth section, conclusion and policy implication are discussed.

LITERATURE REVIEW

A vast literature on measuring the efficiency of banks is globally available; however, there are few studies which measure efficiency, specifically with reference to DEA in Pakistan. More specifically, we are interested in the efficiency and effectiveness of Islamic banks to support the development and growth of the economy as explained by Johnes, Izzeldin, and Pappas (2014), Mokhtar, Abdullah, and Alhabshi, (2008), and Saeed, Ali, Adeeb, and Hamid (2013), who concluded that conventional banks are more efficient than Islamic banks. Drake, Hall, and Simper (2006) concluded that the smaller banks are less efficient than the larger banks. However, the fast growth of Islamic banking, especially in the economies of Islamic countries like that of Pakistan, Saudi Arabia, Malaysia, Qatar, Turkey, UAE, Iran, and Indonesia, has enabled the research world to debate on such efficiency and its derivers. A number of past studies, e.g., Ahmad and Noor (2011); Rahman and Rosman (2013); and Rosman et al. (2014) have focused only on Islamic banks for performance efficiency.

Singh and Fida (2015) investigated the pure technical and scale efficiency of Omans commercial banks through DEA approach. The study observed that scale inefficiency on grounds of overall technical inefficiency is higher than the pure technical inefficiency. Results indicate that a decrease in returns to scale causes major form of scale inefficiency. In Oman, Ahli and Dhofar banks showed consistent and more efficient performance during the study. However, Omans largest bank, the Muscat bank suffered from the decreasing returns to scale. The efficiency scores were tested through Tobit model with the explanatory variables of profitability, liquidity, capital adequacy, and bank size.

Majeed and Zanib (2016) analyzed the efficiency of pure Islamic banks and conventional banks with Islamic branches with that of the conventional banks in Pakistan. Banking efficiency was measured through scale efficiency, pure and total TE. Results indicated that pure Islamic banks were less efficient than conventional banks regarding pure and total TE outcomes, but conventional banks having Islamic branches had impressive scale efficiency

than conventional banks during 2007-2014.

Tesfay (2016) studied efficiency determinants of Ethiopian commercial banks by taking data of eight banks for the period 2003-2012. DEA was used to measure the efficiency of individual banks and investigate the efficiency determinants through Tobit model. Outcomes revealed that liquidity and deposit variables were significantly and positively related to efficiency of commercial banks.

After critical review of the literature, it is disclosed that there is a lack of in-depth studies regarding efficiency and its determinants in Pakistan for the banking industry. Therefore, this study is an attempt to contribute in to the literature by comparing and evaluating the efficiency performance and to identify the factors of efficiency of Islamic and conventional banks in Pakistan for the period 2007-2015.

DATA AND RESEARCH METHODOLOGY

Twenty banks have been selected from the banking industry in Pakistan, out of which ten banks are Islamic banks or conventional banks having stand-alone Islamic banking system, collectively termed as 'Islamic Banking Institutions (IBIs), while the other ten are conventional banks for comparison. For this study, we used panel data for the period 2007-2015 to evaluate the efficiency performance and to identify the factors of efficiency for banking industry in Pakistan.

DEA Methodology

DEA is a non-parametric technique based upon linear programming by taking optimized weighted output/input ratio of each provider to create an efficiency frontier (Charnes et al., 1978). This technique evaluates the efficiency by using an input-oriented CRS model. On the other hand, Banker, Charnes, and Cooper (1984) assumed Variable Returns to Scale (VRS) and decomposed overall TE into two segments, Scale Efficiency (SE) and Pure Technical Efficiency (PTE). They divided TE based on an input-oriented and output-oriented approach. Whereas, an input-oriented method targets to reduce the input amount up to maximum extent for a given level of output, the output-oriented approach maximizes output levels at a given level of input.

CRS Model

The below model is a linear program developed in restricting the denominator of the objective function to unity. Therefore, further constraint is added into the problem; the linear program is formed as under:

$$\text{Max}\, E_r = \frac{\sum_{n=1}^{m} y_j z_{jr}}{\sum_{m=1}^{o} x_i w_{ir}} \tag{1}$$

Subject to:

$$\sum_{m=1}^{o} z_m w_{mr} = 1, \tag{2}$$

$$\sum_{n=1}^{m} y_n z_{nr} - \sum_{m=1}^{o} z_m w_{mr} \leq 0, \tag{3}$$

$$y_n z_m \geq 0 \tag{4}$$

$n = 1, 2, 3....1, m = 1, 2, 3....o$ and $r = 1, 2, 3....s$.

By solving the above linear programmed equation, we get efficiency score (T_E) for bank r, where $0 \leq T_E \leq 1$.

The VRS Model

It is assumed that CRS model works well when all the banks operate at their maximum level of scale. Practically, it is not viable due to a number of financial constraints, imperfect competitions, and government regulations that may be a hurdle for operating banks at their maximum level of scale. However, Banker et al. (1984), proposed an extended form of VRS model. The CRS model can be simply changed with addition of the convexity constraint (weights of Ψ sum equal to 1) considered for VRS.

The DEA problems can be derived for input-oriented model as:

$$\text{Min}_{\Psi\eta}(\eta) \tag{5}$$

Subject to:
$Y\Psi \geq Y_n$
$\theta X_n - X\Psi \geq 0$
$\beta 1\Psi' = 1$
$\Psi \geq 0$

In the same way DEA output oriented problem can be resolved as

$$\text{Max}_{,\Psi\lambda}(\lambda) \tag{6}$$

Subject to:
$Y\Psi \geq Y_n$
$X_n - X\Psi \geq 0$
$\beta 1'\Psi = 1$
$\Psi \geq 0$

In the above problem, the $\beta 1$ is a $\beta^* 1$ vector and the TE score under VRS is in equivalence or higher than the score as obtained through CRS model. $\beta 1\Psi = 1$ is the convexity constraint that counts an inefficient bank regarding a benchmarked opposition with the other bank of parallel size.

TABLE 1
Input and output variables for DEA analysis

Variables	Inputs	Variables	Outputs
X1	No of Employees	Y1	Operating Income
X2	Capital Expenditure	Y2	Profit & Loss before taxation
X3	Operating Expenses	Y3	Investment
X4	Deposits	Y4	Total Advances
X5	Negativity Removal of Y1		
X6	Negativity Removal of Y2		

Tobit Model - Second Stage of DEA Analysis

Tobit regression model is expressed for this study in equation (1), where endogenous variable TEi* indicates the overall TE scores computed through DEA and the exogenous variables ROA, BC, LDR, Ln(TA), and CAR represent bank-specific variables taken for this study.

$$TE\ scores_i^* = \beta_1 + \beta_2 ROA_i + \beta_3 SO_i + \beta_4 LDR_i + \beta_5 Ln(TA)_i + \beta_6 CAR_i + \mu_{i'} \quad (7)$$

$TE\ scores_i = 0$ if $TE\ sores_i^* \leq 0$; $TE\ scores_i = TE\ scores_i^*$ if $0 < TE\ scores_i^* \leq 1$; $TE\ sores_i = 1$ if $1 < TE\ sores_i^*$.

The endogenous variable TEi^* scores lying between 0 and 1 is censored from left and right. In available literature, most of the authors have specified censored regression model (Tobit) for the second stage.

TABLE 2
Summary of variables

Variables	Computation
TE Scores (Efficiency)	(Through DAE computation)
Return on Asset (Profitability)	(Net Sales/Total Asset)
BC (Bank Classification)	Dummy Variable = [1 = Islamic Banks 0 = Conventional Banks]
Loan to Deposit Ratio (Liquidity)	(Advances/Total Deposit)
LN(TA) (Bank Size)	Natural Log of Total Asset
Capital Adequacy Ratio	(Total Equity/ Total Asset)

RESULTS AND DISCUSSION

Table 3 results indicate that four Islamic banks need an increase in the inputs to get better outputs while no conventional bank needs an increase in the input to sustain the efficiency. Three Islamic banks and one conventional bank need to decrease the inputs. However, three Islamic banks and nine conventional banks have to maintain their consistency in their existing proportion of inputs. It implies that conventional banks are more technically efficient than the Islamic banks for the period 2007-2015.

TABLE 3
Efficiency report of CRS input-oriented model: Islamic vs conventional banks

DMU No.	DMU Name	Input-Oriented CRS Efficiency	Sum of lambdas	RTS	Optimal Lambdas with Benchmarks
	Islamic Banks				
1	Meezan Bank Ltd.	0.93877	1.095	Decreasing	0.069
2	Albaraka Bank Pak. Ltd.	0.72791	0.272	Increasing	0.07
3	Dubai Islamic Bank Pak. Ltd.	0.8913	0.169	Increasing	0.035
4	Burj Bank Ltd.	0.89463	0.087	Increasing	0.077
5	Bank Alfalah Ltd.	0.80329	2.334	Decreasing	0
6	Bankislami Pak. Ltd.	0.69457	0.156	Increasing	0.059

TABLE 3 continue

DMU No.	DMU Name	Input-Oriented CRS Efficiency	Sum of lambdas	RTS	Optimal Lambdas with Benchmarks
7	Askari Bank Ltd.	0.97679	2.985	Decreasing	1.059
8	Habib Bank Ltd.	1	1	Constant	1
9	Bank Al-Habib Ltd.	1	1	Constant	1
10	The Bank of Khyber	1	1	Constant	1
	Conventional Banks				
11	First Women Bank Ltd.	1	1	Constant	1
12	National Bank of Pak.	1	1	Constant	1
13	The Bank of Punjab	1	1	Constant	1
14	Allied Bank Ltd.	1	1	Constant	1
15	Faysal Bank Ltd.	1	1	Constant	1
16	MCB Bank Ltd.	1	1	Constant	1
17	Soneri Bank Ltd.	1	1	Constant	1
18	Standard Chartered Bank Pak. Ltd.	1	1	Constant	1
19	Summit Bank Ltd.	1	1	Constant	1
20	United Bank Ltd.	0.95262	1.551	Decreasing	0.258

Table 4 results show the efficiency report for VRS input-oriented model and, hence, indicate that five Islamic banks and one bank from the conventional banks were not efficient for the period 2007-2015. VRS results confirm the CRS results and, hence, indicate that conventional banks are more efficient than Islamic banks which may be due to the reason that Islamic banks are replicating the conventional products while they cannot compete with their conventional counterparts due to their smaller size and a number of Sharī‘ah restrictions (Ayub & Paldi, 2015).

TABLE 4
Efficiency report of VRS input-oriented model: Islamic vs conventional banks

DMU No.	DMU Name	Input-Oriented VRS Efficiency	Optimal Lambdas with Benchmarks
	Islamic Banks		
1	Meezan Bank Ltd.	0.94223	0.08
2	Albaraka Bank Pak Ltd.	0.7775	0.014
3	Dubai Islamic Bank Pak Ltd.	1	1
4	Burj Bank Ltd.	1	1
5	Bank Alfalah Ltd.	0.82531	0.115
6	Bankislami Pak Ltd.	0.98591	0.521
7	Askari Bank Ltd.	0.99096	0.013
8	Habib Bank Ltd.	1	1
9	Bank Al-Habib Ltd.	1	1
10	The Bank of Khyber	1	1
	Conventional Banks		
11	First Women Bank Ltd.	1	1

TABLE 4 continue

DMU No.	DMU Name	Input-Oriented VRS Efficiency	Optimal Lambdas with Benchmarks
12	National Bank of Pak	1	1
13	The Bank of Punjab	1	1
14	Allied Bank Ltd.	1	1
15	Faysal Bank Ltd.	1	1
16	MCB Bank Ltd.	1	1
17	Soneri Bank Ltd.	1	1
18	Standard Chartered Bank Pak Ltd.	1	1
19	Summit Bank Ltd.	1	1
20	United Bank Ltd.	0.9765	0.447

Table 5 indicates input slacks for CRS model that exist either in input elements or in output elements and shows the elements that need to be rectified. However, inputs have greater importance for the slacks' values. It is because we have to redesign the policies in such firms with regard to the said input parameters. Output slacks indicate that the results are not due to these inputs only; it may be due to other elements as well.

TABLE 5
Input and output slacks CRS model: Islamic vs conventional banks

		Input Slacks					
DMU No.	DMU Name	X1	X2	X3	X4	X5	X6
1	Meezan Bank Ltd.	4809.52	0.0000	0.0000	20284340.48	0.0000	0.0000
2	Albaraka Bank Pak Ltd.	6663.88	297238.81	0.0000	0.0000	0.0000	166303.16
3	Dubai Islamic Bank Pak Ltd.	605.66	401645.17	35816.93	0.0000	0.0000	0.0000
4	Burj Bank Ltd.	374.03	0.0000	398901.07	0.0000	0.0000	425452.08
5	Bank Alfalah Ltd.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	Bank Islami Pak Ltd.	918.07	168318.67	213668.39	0.0000	0.0000	0.0000
7	Askari Bank Ltd.	354.04	183241.56	0.0000	11788443.21	0.0000	0.0000
8	Habib Bank Ltd.	0.0000	0.0000	0.0003	0.0029	0.0000	0.0000
9	Bank Al-Habib Ltd.	0.0000	0.0012	0.0000	0.0062	0.0000	0.0000
10	The Bank of Khyber	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
11	First Women Bank Ltd.	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
12	National Bank of Pak.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	The Bank of Punjab	0.0000	0.0000	0.0000	0.0009	0.0000	0.0000
14	Allied Bank Ltd.	0.0000	0.0000	0.0001	0.0035	0.0000	0.0000
15	Faysal Bank Ltd.	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
16	MCB Bank Limited	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	Soneri Bank Ltd.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	Standard Chartered Bank (Pak) Ltd.	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
19	Summit Bank Ltd.	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
20	United Bank Ltd.	1730.80	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE 5 continue

DMU No.	DMU Name	Inputs Need to Revisit	Output Slacks			
			Y1	Y2	Y3	Y4
1	Meezan Bank Ltd.	X1 and X4	0.0000	295244.24	0.0000	6556995.78
2	Albaraka Bank Pak Ltd.	X1, X2 and X6	20655.68	310683.31	0.0000	0.0000
3	Dubai Islamic Bank Pak Ltd.	X1, X2 and X3	0.0000	928699.22	4739336.68	0.0000
4	Burj Bank Ltd.	X1, X3 and X6	65067.72	225133.55	336753.95	0.0000
5	Bank Alfalah Ltd.		0.0000	2547115.18	0.0000	0.0000
6	Bank Islami Pak Ltd.	X1, X2 and X3	0.0000	1104139.35	0.0000	0.0000
7	Askari Bank Ltd.	X1, X2 and X4	1763501.21	2250707.36	0.0000	0.0000
8	Habib Bank Ltd.	- -	0.0000	0.0000	0.0000	0.0000
9	Bank Al-Habib Ltd.	- - -	0.0000	0.0001	0.0000	0.0046
10	The Bank of Khyber	- - -	0.0000	0.0000	0.0000	0.0000
11	First Women Bank Ltd.	- - -	0.0000	0.0000	0.0000	0.0000
12	National Bank of Pak.	- - -	0.0004	0.0000	0.0053	0.0000
13	The Bank of Punjab	- - -	0.0000	0.0000	0.0000	0.0000
14	Allied Bank Ltd.	- - -	0.0000	0.0000	0.0000	0.0000
15	Faysal Bank Ltd.	- - -	0.0000	0.0000	0.0000	0.0000
16	MCB Bank Limited	- - -	0.0000	0.0000	0.0005	0.0000
17	Soneri Bank Ltd.	- - -	0.0000	0.0000	0.0006	0.0000
18	Standard Chartered Bank (Pak) Ltd.	- - -	0.0000	0.0000	0.0002	0.0002
19	Summit Bank Ltd.	- - -	0.0000	0.0000	0.0004	0.0000
20	United Bank Ltd.	- - -	1489824.49	0.0000	5658368.32	0.0000

Table 6 indicates the input slacks for VRS model and shows the elements that exist in input elements or in output elements and need to be rectified. However, inputs have greater importance for the slack values, and VRS model produces little different results from the CRS model. However, output slacks indicate that the results are not due to these inputs only; it may be due to other elements as well.

TABLE 6
Input and output slacks VRS model: Islamic vs conventional banks

DMU No.	DMU Name	Input Slacks					
		X1	X2	X3	X4	X5	X6
1	Meezan Bank Ltd.	4885.08	0.0000	132172.13	20179795.89	0.0000	0.0000
2	Albaraka Bank Pak Ltd.	6905.08	297673.89	0.0000	0.0000	0.0000	1956.65
3	Dubai Islamic Bank Pak Ltd.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	Burj Bank Ltd.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	Bank Alfalah Ltd.	318.07	0.0000	0.0000	0.0000	0.0000	0.0000
6	Bank Islami Pak Ltd.	949.02	810829.10	0.0000	0.0000	0.0000	0.0000
7	Askari Bank Ltd.	2535.76	0.0000	0.0000	0.0000	0.0000	0.0000
8	Habib Bank Ltd.	0.0000	0.0000	0.0003	0.0038	0.0000	0.0000
9	Bank Al-Habib Ltd.	0.0000	0.0000	0.0000	0.0012	0.0000	0.0000
10	The Bank of Khyber	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
11	First Women Bank Ltd.	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
12	National Bank of Pak.	0.0000	0.0002	0.0003	0.0000	0.0000	0.0000
13	The Bank of Punjab	0.0000	0.0000	0.0000	0.0009	0.0000	0.0000
14	Allied Bank Ltd.	0.0000	0.0000	0.0001	0.0035	0.0000	0.0000
15	Faysal Bank Ltd	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
16	MCB Bank Ltd.	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
17	Soneri Bank Ltd.	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
18	Standard Chartered Bank (Pak) Ltd.	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
19	Summit Bank Ltd.	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
20	United Bank Ltd.	1752.30	407640.96	1918125.97	0.0000	0.0000	0.0000

TABLE 6 continue

		Inputs Need to Revisit	Output Slacks			
DMU No.	DMU Name		Y1	Y2	Y3	Y4
1	Meezan Bank Ltd.	X1,X2 and X4	0.0000	341460.80	0.0000	6241072.57
2	Albaraka Bank Pak Ltd.	X1, X2 and X6	0.0000	164371.67	0.0000	0.0000
3	Dubai Islamic Bank Pak Ltd.	- -	0.0000	0.0000	0.0004	0.0000
4	Burj Bank Ltd.	- -	0.0000	0.0000	0.0000	0.0000
5	Bank Alfalah Ltd.	X1	2524414.20	4564096.35	0.0000	0.0000
6	Bank Islami Pak Ltd.	X1, X2	75694.00	368847.30	4191099.86	6535107.47
7	Askari Bank Ltd.	X1	4279220.14	5965153.70	0.0000	0.0000
8	Habib Bank Ltd.	- -	0.0000	0.0000	0.0000	0.0000
9	Bank Al-Habib Ltd.	- - -	0.0005	0.0005	0.0000	0.0005
10	The Bank of Khyber	- - -	0.0000	0.0000	0.0000	0.0000
11	First Women Bank Ltd.	- - -	0.0000	0.0000	0.0000	0.0000
12	National Bank of Pak.	- - -	0.0000	0.0000	0.0016	0.0000
13	The Bank of Punjab	- - -	0.0000	0.0000	0.0000	0.0000
14	Allied Bank Ltd.	- - -	0.0000	0.0000	0.0000	0.0000
15	Faysal Bank Ltd.	- - -	0.0000	0.0001	0.0000	0.0000
16	MCB Bank Ltd.	- - -	0.0000	0.0000	0.0004	0.0000
17	Soneri Bank Ltd.	- -	0.0000	0.0000	0.0005	0.0000
18	Standard Chartered Bank (Pak) Ltd.	- - -	0.0000	0.0000	0.0000	0.0003
19	Summit Bank Ltd.	- - -	0.0000	0.0000	0.0004	0.0000
20	United Bank Ltd.	X1, X2 and X3	993582.70	1364431.99	0.0006	0.0000

Table 7 Below indicates the behavior of the data and measures the central tendency of the variables. It is evident that data are normally distributed as Jarqu Bera value has $p < 0.01$. TE and ROA are negatively skewed as indicated by Skewness results.

TABLE 7
Descriptive statistics

	TE	ROA	BC	Loan to Deposit Ratio	LN(TA)	CAR
Mean	0.943994	0.006081	0.500000	0.633476	18.95779	0.099810
Median	1.000000	0.007850	0.500000	0.641100	19.29360	0.081806
Maximum	1.000000	0.037200	1.000000	1.289700	21.33529	0.534196
Minimum	0.694569	-0.054100	0.000000	0.383600	15.73784	-0.032558
Std. Dev.	0.093226	0.015162	0.501570	0.143296	1.369883	0.075492
Skewness	-1.651777	-1.554664	0.000000	0.843524	-0.498677	2.596031
Kurtosis	4.407630	6.840135	1.000000	5.134118	2.353460	12.71585
Jarque-Bera	85.96594	162.7637	26.66667	49.33725	9.418201	809.0354
Probability	0.000000	0.000000	0.000002	0.000000	0.009013	0.000000
Sum	151.0391	0.972900	80.00000	101.3562	3033.246	15.96957
Sum Sq. Dev.	1.381877	0.036553	40.00000	3.264861	298.3761	0.906149
Observations	160	160	160	160	160	160

Table 8 indicates that TE is positively and significantly correlated with ROA; however, it is highly negatively associated with the nature of the bank Islamic or conventional (BC). The TE is positively related to Loan to deposit ratio and to total asset, whereas TE is negatively associated with capital adequacy ratio.

TABLE 8
Correlation matrix

	TE	ROA	BC	Loan to Deposit Ratio	LN(TA)	CAR
TE	1					
ROA	0.2635	1				
BC	-0.551	-0.1561	1			
Loan To Deposit Ratio	0.2282	-0.1710	-0.2952	1		
LN (TA)	0.3491	0.5105	-0.2389	-0.1268	1	
Capital Adequacy Ratio	-0.215	-0.099	0.16358	0.30459	-0.555	1

Table 9 indicates that BC, Loan to deposit ratio, Ln(TA), and Capital Adequacy Ratio have a significant impact on TE at $p < 0.05$. Further, all have a positive impact except BC. Hence, the censored TOBIT regression indicates that the bank classification, liquidity, bank size, and capital adequacy ratio are significant determinants of overall TE of the banks while due to classification structure, conventional banks have more TE.

TABLE 9
Tobit regression analysis

Dependent Variable: TE				
Method: ML - Censored Normal (TOBIT)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
ROA	-0.420434	0.467774	-0.898798	0.3688
BC	-0.063644	0.014034	-4.534992	0.0000*
Loan to Deposit Ratio	0.150524	0.051868	2.902073	0.0037*
LN(TA)	0.045461	0.001775	25.61730	0.0000*
Capital Adequacy Ratio	0.195464	0.096672	2.021922	0.0432*
Error Distribution				
SCALE:C(6)	0.080965	0.004526	17.88854	0.0000
Statistics				
Mean Dependent Var	0.943994	S.D. Dependent Var		0.093226
S.E. Of Regression	0.082528	Akaike Info Criterion		-2.114590
Sum Squared Resid	1.048863	Schwarz Criterion		-1.999271
Log Likelihood	175.1672			
Avg. Log Likelihood	1.094795	Hannan-Quinn Criter		-2.067763
Left Censored Obs	0	Right Censored Obs		0
Uncensored Obs	160	Total Obs		160

Figure 1 shows the gradients of the objective functions and behavior of each variable in a given panel for the years 2007-2015.

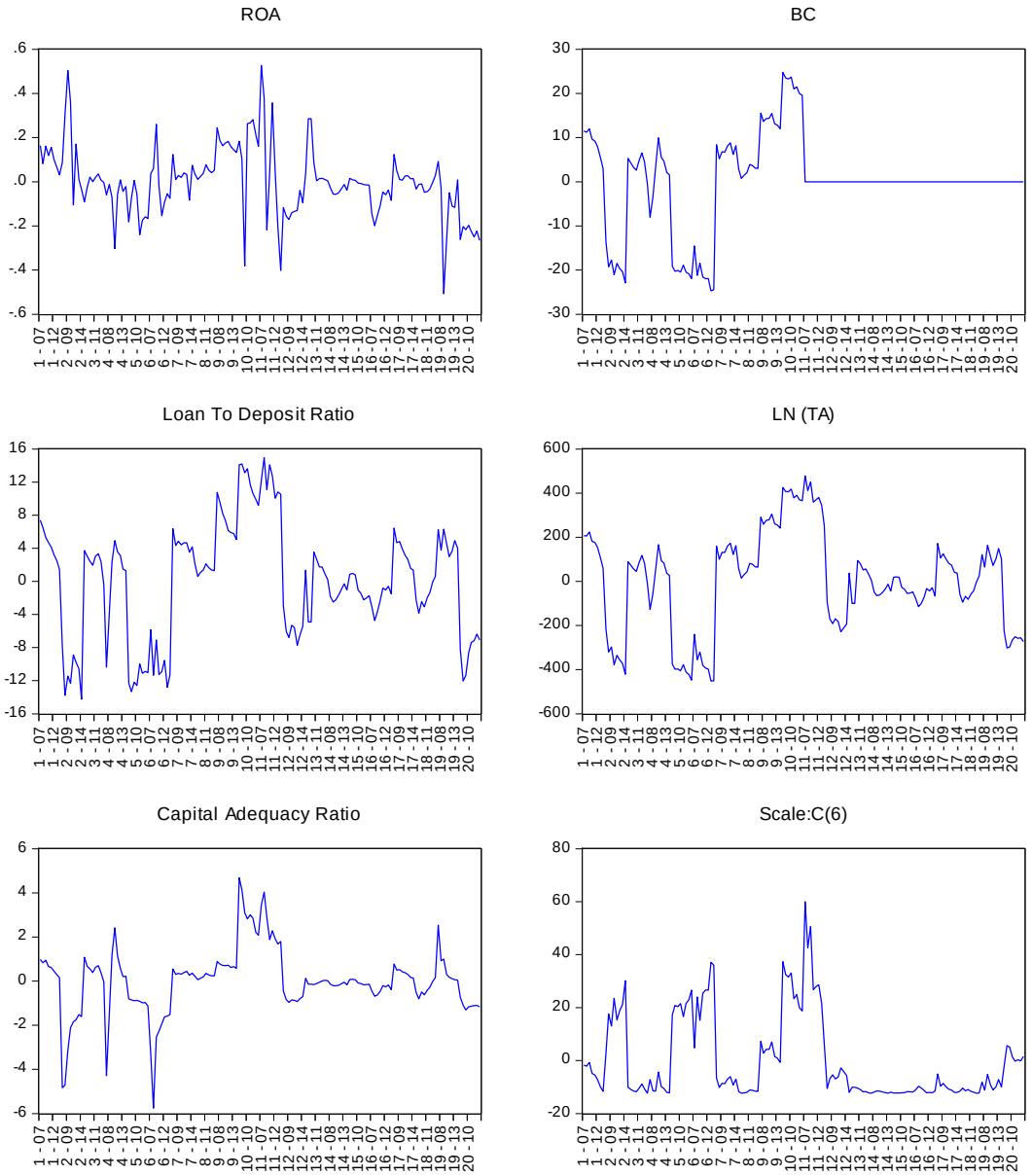

FIGURE 1. Gradient of the objective function

Table 10 indicates the results for a parametric statistical method known as the Wald test. The statistics below given express a relationship within or between the data items for the given parameters to be estimated from a given sample. The Wald test indicates the true value of the parameters based on the sample estimates. Here, the TE varies between the expressed determinants and the estimation indicates that each independent variable contributes to determining the efficiency.

TABLE 10
Wald test

Wald Test			
Test Statistic	Value	Df	Probability
F-statistic	3737.528	(5, 154)	0.0000
Chi-square	18687.64	5	0.0000
Null Hypothesis: C(2)=C(3)=C(4)=C(5)=C(6)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		-0.063644	0.014034
C(3)		0.150524	0.051868
C(4)		0.045461	0.001775
C(5)		0.195464	0.096672
C(6)		0.080965	0.004526
Restrictions are linear in coefficients.			

CONCLUSION

This study focuses on TE and factors' identification for Islamic and conventional banks in Pakistan. For this purpose, we selected twenty banks from the banking industry, ten IBIs, and ten conventional banks for the period of 2007-2015. DEA-CRS results reveal that four Islamic banks require an increase in the inputs to get better outputs, while no conventional bank needs further increase in the input to sustain efficiency. However, three Islamic banks and nine conventional banks have to be consistent in their existing proportion of inputs. Hence, it is seen that the conventional banks are more technically efficient than the Islamic banks for the period 2007-2015. Our results are coherent with the studies of Mokhtar et al. (2008), Johnes et al. (2014), Saeed et al. (2013), and Majeed and Zanib (2016). The results of input slacks for CRS model indicate that some input elements need rectification. Further, inputs have greater importance for the slack values. It is because we have to redesign the policies for such firms regarding the said input parameters. Output slacks indicate that the results are not due to these inputs only; it may be due to other elements as well. Further, the results of the efficiency report for DEA-VRS input-oriented model conclude that five Islamic banks had not been efficient, while one bank from conventional component was not efficient for the period 2007-2015. The inputs slacks for VRS model show the required elements that need to be rectified in-output. However, inputs have greater importance for the slack values and VRS model produces little different results from the CRS model. The policy needs to rectify such firms regarding the said input parameters. However, output slacks indicate that the results are not due to only these inputs; it may be due to other elements as well. Further, results conclude that the summary statistics for TE scores, ROA, BC, Loan to deposit ratio, bank size, and capital adequacy ratio indicate that the data distribution is normal. However, TE and ROA are negatively skewed.

The correlation results conclude that TE is positively and significantly correlated with ROA, but highly negatively associated with BC and capital adequacy ratio. Further, TE is positively related to Loan to deposit ratio and to total asset. The correlation results indicate that efficiency behaves in a positive manner if ROA increases as well as the ratio of (loan to deposit ratio) to total asset increases. TOBIT regression concludes that BC, Loan to deposit ratio, Ln(TA), and Capital Adequacy Ratio have a significant impact on TE. All have a positive impact except BC. Hence, the censored TOBIT regression indicates that the ownership, liquidity, bank size, and capital adequacy ratio are significant determinants of overall TE of the banks. However, results of the study by Tesfay (2016) show that liquidity and deposit variables are positively and significantly related to efficiency of commercial banks, whereas Singh and Fida (2015) indicate that profitability and liquidity are positively significant, but the bank size is an insignificant variable. Wald test results concluded that the TE varies with regard to the identified determinants of BC, Loan to deposit ratio, Ln(TA), and Capital Adequacy Ratio.

As a policy implication, it is suggested for policy-makers to focus on the related deficiencies which need to be taken care of in the Islamic banking sector. As a whole, the study suggests that there is a lot of room to improve efficiency of banks, particularly the Islamic banks, in Pakistan.

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