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Financial Ratios versus Data Envelopment Analysis: The Efficiency Assessment of Banking Sector in Bahrain Bourse

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Abstract: The paper examines the efficiency of banking sector in the Bahrain Bourse (2010-2013) using financial ratio analysis (FRA) and data envelopment analysis (DEA). For FRA, the current study has used six ratios to evaluate three characteristics of banks efficiency (profitability; liquidity and risk). The results of FRA do not provide sufficient and complete information on the efficiency of banks. The results of DEA in the current study are obtained through a software namely DEAP 2.1 version. Under this approach, the findings have revealed that 2 banks only are fully efficient in the period (2010 -2013). Besides, other banks are found inefficient with technical efficiency scores less than one. A major advantage behind using DEA approach to measure performance is to identify opportunities for possible efficiency improvements by looking at the differences between efficient banks and inefficient ones. DEA identifies the quantities of inputs that should be reduced and the quantities of outputs that should be increased to improve efficiency for banks with technical score less than one.

Keywords: Financial Ratios, Data Envelopment Analysis, Banking Sector, Efficiency Assessment.

1. INTRODUCTION

Increasing globalization has led to direct competition between banks in worldwide, consequently, the efficiency assessment of banks is an important issue. It demonstrates how shareholders and investors interests are affected and it informs on whether existing bank resources are used effectively and efficiently. Studying banking efficiency can be done in two ways: by use of traditional financial ratio analysis (FRA); or by frontier analysis methods such as data envelopment analysis (DEA). Kumbirai and Webb (2010) argue that financial ratios enable us to identify unique bank strengths and weaknesses, which in itself inform bank profitability, liquidity and credit quality. FRA is popular for a number of reasons: it is easy to calculate and interpret; it allows comparisons to be made between banks using benchmark or the average of the industry sector. FRA has been achieved a widespread use in practice. It is valuable tool of interpreting the financial statements that enables analysts to conduct a certain degree of comparison across firms of different sizes and of firms with the total industry (Emrouznejad and Cabanda 2010). On the other hand, a number of studies (Zhu,2000; Ho and Zhu 2004; Yu et al. 2014) argue that the usefulness of FRA to estimate and predict firm efficiency has failed because of the univariate nature of ratio analysis, which presents major limitations in assessing firm performance. One ratio cannot capture the complete picture of performance of such an organization over the breadth of its activities, and there is no criterion for selecting a ratio that is appropriate for all interested parties therefore, a lack of an objective standard for selecting the ratios would cause instability and could not satisfy the needs of all users (Ho and Zhu 2004). Findings show that, financial ratios can only be an appropriate method when firms manage a single input to generate a single output. FAR does not provide sufficient information when considering the effects of economies of scale and estimation of overall efficiencies measures. However, performance evaluation of organizations such as banks is more complex. Corporate performance is recognized as a multi-dimensional construct since it covers diverse and various

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variables (aside from financial ratios) (Zhu, 2000). For these reasons, DEA was introduced as an alternative approach for assessing the performance of such firms (Cooper et al. 2000; Yu et al. 2014). Charnes et al. (1978) was first time introduced an efficiency measurement technique which is known as DEA. This technique depends upon to analyze the functional relationship between inputs and outputs. It has proven to be an essential tool, because it measures relative efficiencies by using multi-inputs and multi-outputs.

The study is justified on the following grounds: it contributes to the accounting literature on the area of efficiency assessment of banks by applying and comparing two approaches (DEA– FRA) in a Bahraini environment. The empirical investigation of this study can hopefully benefit managers of inefficient companies to help them restructure their organizational scope and business style and review resource utilization for improving their performance. It may help in studying other financial sectors in the similar contexts as Gulf region. The current study is structured as follows: Section 2 provides a profile of banking sector in the Kingdom of Bahrain. Section 3 reviews the literature on performance assessment of banks. The sample selection and methodology are outlined in Section 4. Section 5 presents the results and statistical analysis of the study. The conclusions are reported in Section 6.

2. BANKING SECTOR IN THE KINGDOM OF BAHRAIN

The Kingdom of Bahrain has a geographical location between the Asian and European markets. Bahrain Bourse (BHB) is the focus of capital market activities in Bahrain. BHB was established as a shareholding company according to Law No. 60 for the year 2010 to replace Bahrain Stock Exchange (BSE). The Exchange officially commenced operations in June 1989 according to Amiri Decree No. 4 with 29 Bahraini shareholding companies listed. The only instruments traded at that time were common shares. In 1999, BHB implemented the Automated Trading System (ATS) to carry out the entire bourse's transactions electronically replacing the old manual system. In 2002, the legislative and regulatory authority and supervision of BHB was transferred from the Ministry of Commerce to the Central Bank of Bahrain (CBB). It is the sole regulator of Bahraini financial sector, covering the full range of banking, insurance, investment business and capital markets activities. According to Annual Report of Bahrain Bourse in 2013, the market capitalization of Bahraini public shareholding companies listed on BHB increased to BD6.96 billion compared to BD5.86 billion at the beginning of the year, posting an increase of 18.91%. The Commercial Banks Sector accounted for 46.72% of the total market capitalization, followed by Investment Sector by 24.27%, the Services Sector by 13.15%, Industrial Sector by 10.94%, the Hotels & Tourism by 2.52%, and Insurance Sector by 2.39%. Appendix (1) includes a list of listed banks with their codes in BHB.

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3. LITERATURE REVIEW

In the GCC[1] region, Johnes et al. (2009) compare the efficiency of 19 Islamic and 50 conventional banks using FRA and DEA (from 2004 to 2007). The results of FRA show that Islamic banks are less cost efficiency but more revenue and profit efficiency than conventional banks. While, the results of DEA suggest that average efficiency is significantly lower in Islamic than conventional banks. In the same line, Al-Maghaireh (2005) examines the performance of 3 Islamic banks and 5 non-Islamic banks, in the United Arab Emirates (UAE), in terms of profitability, liquidity, risk and solvency and efficiency during the period (2000-2004), using FRA. The study shows that the sample Islamic banks are relatively more profitability, less liquid, less risky, and more efficient compared to the UAE commercial banks. In Oman, Tarawneh (2006) measures the performance of commercial banks using FRA and ranked the banks based on their performance. Also, the study investigates the impact of asset management, operational efficiency and bank size on the performance of Oman commercial banks. The findings indicate that bank performance is strongly and positively influenced by operational efficiency, asset management and bank size.

[1] The GCC countries are: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE).

In South Africa, Kumbirai and Webb (2010) investigate the performance of South Africa's commercial banking sector for the period 2005- 2009. Financial ratios are employed to measure the profitability, liquidity and credit quality performance of five large South African based commercial banks. The study found that overall bank performance increased considerably in the first two years of the analysis. Oberholzer and Van der Westhuizen (2004) examine the efficiency and profitability of ten banking regional offices of one of South Africa's larger banks. This study suggests that using FRA such as conventional profitability and efficiency analyses can be used in conjunction with DEA. In Malaysia, Samad and Hassan (1999) apply FRA to evaluate the performance of a Malaysian Islamic bank over the period 1984-1997 and compare with 8 commercial banks in terms of profitability, liquidity, risk and solvency and community involvement compared with 8 commercial banks in terms of profitability, liquidity, risk and solvency and community involvement using ANOVA, T-test and F-test to determine the significance of the results. The study reports that Malaysian Islamic bank is relatively more liquid and less risky. In Turkey, Gökgöz (2014) analyses technical financial efficiencies and performances of 30 commercial and 13 development and investment banks in (2012-2013) using DEA besides, four fundamental bank performance indicators (net interest income, non-interest income, ROA and ROE). The results of the study show that commercial banks have shown higher technical financial efficiencies in comparison to development and investment banks. Therefore, Turkish banks require some improvements in input and output variables. In further, the DEA technique is regarded as a valuable quantitative tool for financial decision makers in analysing the financial efficiencies of the banks. Halkos and Salamouris (2004) apply DEA technique to measure the performance of the Greek banking sector for the time period 1997–1999. The results show that DEA can be used as either an alternative or complement to ratio analysis for the evaluation of an organization's performance. It also reports that the higher the size of total assets the higher the efficiency.

In UK, Emrouznejad and Cabanda (2010) evaluate the performance of 27 industries using six financial ratios including: cash position (cash/total assets), liquidity (current assets/current liabilities), working capital position (working capital/total assets), leverage (long-term liabilities/total assets), profitability (net income/total assets), and turnover (sales/total assets) by conducting two models. First model is the general non-parametric corporate performance and second is a multiplicative linear programming. The later model is found to be a more robust performance model than the standard DEA model. Liu et al. (2010) have used DEA compared the relative efficiency of manufacturing companies of China and Turkey). The inputs variables included: the number of employees, inventory turnover, receivable turnover, total asset/total debt, cash flow, current ratio, and property plant and equipment/total asset, whereas the outputs variables included net income per employee, sales growth, net income per share, and net profit before tax. The results indicate that, Chinese manufacturing firms are more highly efficient than Turkish manufacturing firms. Yu et al. (2014) introduce financial ratio analysis and the DEA model for assessing performance using panel data of 24 companies listed in the Taiwan Stock Exchange as top Taiwan computer manufacturing firms in the market. The result derived from the DEA approach shows that all firms achieved an acceptable overall level of efficiency during the testing period, with an average efficiency ranging from 0.94 to 1.00. The slack variable analysis identified possible ways to improve the performance of those inefficient firms. The results show that reduced investment in fixed assets followed by more non-operating revenue creation is the most effective method for improving the operational performance of inefficient firms. The financial ratio analysis shows that among the 24 analyzed companies, only four appear to satisfy the management efficiency criteria.

4. RESEARCH METHOD

This section discusses the empirical methods used to examine the efficiency in banking sector in the BHB (2010-2013) using two methods FRA and DEA. Besides, data collection and sample size are presented.

A) Financial ratio approach

This section of the study is devoted to presentation and discussion of the descriptive statistics for six financial ratios that were used to examine the efficiency of banking sector of BHB. With regard to profitability, three ratios were used. Firstly, return on assets (ROA) shows the ability of management to acquire deposits at a reasonable cost and invest them in profitable investments (Ahmed, 2009). This ratio indicates how much net income is generated per Bahraini Dinar (BD) of assets, the higher the ROA, the more the profitable the bank. Secondly, return on equity (ROE), it is a ratio that measures a firm's profitability and reveals how much profit a firm generates with the money shareholders have invested in it. Thirdly, earning per share (EPS) is a ratio that measures the profitability strength of one share. Moreover, liquidity ratio indicates the ability of the bank to meet its financial obligations in a timely and effective manner. Samad

(2004, p. 36) states that ‘‘liquidity is the life and blood of a commercial bank’’. Concerning liquidity, two ratios are used in the current study. The first ratio, total liquid assets to total assets, measures the ability of the bank to meet financial obligations as they become due in short- term. The second ratio is a commonly used statistic for assessing a bank's liquidity by dividing the banks total loans by its total deposits (LTD). If the ratio is too high, it means that banks might not have enough liquidity to cover any unforeseen fund requirements. Lastly, to measure the financial health of the bank, capital adequacy is applied to indicate the combined level of market risk and credit risk, which a bank is exposed to. The minimum acceptable level of this ratio is 8%, as set by the Basel Accord. However, the Central Bank of Bahrain has set a higher limit of 12% for banks operating in Bahrain. The data and definitions of the above six ratios in the current study are based on Investors' Guide of Bahrain Bourse in 2013 (www.bahrainbourse.com.bh). Table (1) shows the definitions of these financial ratios.

Table (1)* the definitions of financial ratios used in the current study

Ratios	Definitions
Return on assets (ROA) %	(net income excluding minority interest & extraordinary income) / total assets)* 100
Return on equity (ROE) %	(net income excluding minority interest & extraordinary income) / shareholders' equity)* 100
Earning per share (EPS) (BD)	(net income excluding minority interest & extraordinary income) / weighted average number of outstanding shares)
Liquidity ratio % LIQASS	total liquid assets to total assets
Liquidity ratio % LTD	total loans to total deposits
Capital adequacy ratio (CPD) %	(total capital/ total risk – weighted assets) * 100%.

*All definitions in Table (1) are based on Investors' Guide of Bahrain Bourse in 2013.

Table (2) shows the descriptive statistics for the financial ratios in banking sector. For this analysis, the results indicate that a bank (SALAM) seems to satisfy the management efficiency criterion. For instance, SALAM is considered more efficient on ROA; EPS, LIQASS and CPD (5.2350; 0.0505; 45.9025 and 45.3150 respectively). On the other hand, NBB is more efficient on ROE (16.6575).

Table (2)* the descriptive statistics for the financial ratios in banking sector

Banks		ROA	ROE	EPS	LIQASS	LTD	CPD
UOB	Av.	1.055	12.042	0.020	24.050	62.282	14.325
	Std.	0.183	2.0034	0.004	7.3963	8.8906	0.7365
SALAM	Av.	5.2350	12.1025	0.0505	45.9025	60.8250	45.3150
	Std.	2.88010	3.59665	0.06714	15.09796	26.37219	25.32052
BISB	Av.	1.8025	7.5975	0.0253	3.9875	67.7500	28.7575
	Std.	2.67229	14.39756	0.03632	1.22337	16.53547	11.26523
BBK	Av.	1.5425	14.5650	0.0405	20.9925	95.7575	19.2650
	Std.	0.29102	2.23983	0.00624	4.28965	8.27378	3.12553
KHCB	Av.	3.0175	7.0650	0.0025	2.9875	90.6800	37.6450
	Std.	2.71174	8.43824	0.00058	4.22339	3.74200	7.37000
NBB	Av.	2.0275	16.6575	0.0500	26.0050	71.7350	24.6475
	Std.	0.22648	0.77392	0.00476	3.64979	5.07306	4.61118
BSB	Av.	-0.4875	-2.3500	-0.0015	31.0025	58.2375	36.7650
	Std.	2.53563	10.24986	0.00998	7.59304	9.35607	10.21039
ITHMR	Av.	-0.0525	-3.8275	-0.0005	29.1548	42.9000	18.7650
	Std.	3.06164	19.62846	0.02641	6.15466	5.69499	7.41304

*All figures in Table (3) are based on Investors' Guide of Bahrain Bourse in 2013.

B) Data envelopment analysis (DEA) approach

Charnes et al. (1978) had first introduced DEA as a valuable non-parametric and mathematical programing methodology for determining the efficient frontier that depends on the selected input and output variables of the decision making units (DMUs). The principle form of DEA depends upon the constant returns to scale (CRS) assumption, and measures the technical efficiency. The original purpose of DEA was to evaluate the relative efficiency of non-profit organizations such as schools; hospital; universities. However, business firms; financial institutions and industries also use it to analyze monetary values (Erkut and Hatice, 2007). In DEA, each bank is assigned an efficiency score between 0 and 1, with higher scores indicating a more efficient bank, relatively to other banks in the sample. A number of studies have addressed DEA models and equations (see for example; Coelli, 1992; 1994; Fare, 1985; Farrell, 1957; Seiford, 1990; 1996). This study used the Charnes et al. (1978) of DEA model to evaluate the performance of listed Bahraini Banks.

The mathematical programming for the constant return to scale model (CRS) is

$$\max_{u,v}(\acute{u}y_i/\acute{v}x_i)$$

Subject to

$$\frac{\acute{u}y_j}{\acute{v}x_j} \leq 1, \quad j = 1,2,\dots,N$$

and

$$u, v \geq 0$$

Where y_i are outputs and x_i are inputs and this involves finding values for u and v such that the efficiency measure for the i-th DMU is maximized, subject to the constraint that all efficiency measures must be less than or equal to one. One problem with this particular ratio formulation is that it has an infinite number of solutions.

To avoid this one can impose the constraint $\acute{v}x_i = 1$, which provides:

$$\max_{u,v}(\acute{u}y_i)$$

Subject to

$$\acute{v}x_i = 1$$
$$\acute{u}y_j - \acute{v}x_j \leq 0, \quad j = 1,2,\ldots.N$$
$$u, v \geq 0$$

Using the duality in linear programming on can derive an equivalent envelopment for this problem as

$$\min_{\theta,\lambda}\theta$$

Subject to

$$-y_i + Y\lambda \geq 0,$$
$$\theta x_i - X\lambda \geq 0$$
$$\lambda \geq 0$$

where θ is a scalar and λ is a vector of constants.

C) Inputs and outputs selection

In order to conduct a DEA, the inputs and outputs need to be specified. Typically, either a production or intermediation approach is taken when conducting DEA to evaluate banking efficiency. Johnes et al. (2009, p.14) point out that in the production approach the bank is treated as a firm that provides services, such as loans, through the use of capital and labour inputs. Output is generally represented by the number of deposit accounts or transactions and inputs are defined as number of employees (labour) and capital expenditures on fixed assets (capital). In the intermediation approach, banks perform an intermediary role between borrowers and depositors and hence accept deposits and other funds in order to provide loans and alternative investments. Output is measured by interest income, total loans, total deposits and non-interest income, while inputs are usually represented by operating and interest costs.

The current study has used the intermediation approach to reflect banking activities. The choice of inputs and outputs in previous literature is different for example general and administration expenses are used in a number of studies as a proxy for labour input while other studies used different proxies for labour as employee numbers or expenditure on wages or number of labour hours. Also, some studies include equity as an input while others exclude this item. For example, Yu et al. (2014) use labour cost and average wage gained by employees per hour of work as inputs and the revenue and export revenue as outputs. While, the inputs variables included by Liu et al. (2010) are the number of employees, inventory turnover, receivable turnover, total asset/total debt, cash flow, current ratio, and property plant and equipment/total asset, whereas the outputs variables included net income per employee, sales growth, net income per share, and net profit before tax. In conclusion, previous studies affirm the application of DEA to assess firm efficiency by undertaking various process and models. They also differ on number and type of inputs and outputs. This means that the test for best specification with respect to the most appropriate variable for DEA is not identified well. Therefore, concerning the current study, the choice of inputs and outputs is selected by mix from previous literature (Drake and Hall 2003; Kamaruddin et al 2008; Abdul-Majid et al 2008; Johnes et al. 2009; Liu et al. (2010) Liu et al. 2010; Yu et al. 2014) and by data availability. Table (3) shows definitions of inputs and outputs for the current study.

Table (3) Definitions of inputs and outputs

Variable	Definition
Inputs 1.Total operating expenses (X1)	The year-end total amount of operating expenses from the income statement
2.total general & administrative expenses (X2)	The year-end total amount of general & administrative expenses from the income statement
3.Total liabilities (X3)	The year-end total amount of liabilities from the balance sheet.
4.Equity capital (X4)	The year-end total amount of owners' equity from the balance sheet.
Outputs 1.Total operating income (Y1)	The year-end total amount of operating income from the income statement
2.Reserves (Y2)	The year-end total amount of reserves from the balance sheet.
3.Investments (Y3)	Profits earned from the investment portfolio

D) Data collection and sample size

Data for this study were obtained from the database of the BHB; Investors' Guide of Bahrain Bourse in 2013 and from the annual reports of 8 listed banks in BHB (2010-2013). Market capitalization of banking sector in BHB represents 46% and includes 8 banks in 2013.

5. RESULTS AND ANALYSIS

The results of the DEA for the current study are obtained through a software namely DEAP 2.1 version. The statistical analysis was carried out with SPSS to the results obtained through DEA. Table (4) shows efficiency scores and ranks of banking sector in BHB (2010 - 2013). As shown in Table 4, technical efficiency analyses have shown that 3 banks (AUB; NBB and ITHMR) are efficient (with technical efficiency score equal one) in 2013 besides, the other 5 banks are inefficient with technical efficiency score less than one. In 2012, 4 banks (AUB; NBB and ITHMR; KHCB) are found efficient.

Table (4) the efficiency scores and ranks of banking sectors in Bahrain Bourse

Years	Banks (DUMs)	Technical efficiency from CRS DEA	Ranks
2013	AUB	1.000	1
	SALAM	0.854	2
	BISB	0.646	4
	BBK	0.565	5
	KHCB	0.698	3
	NBB	1.000	1
	BSB	0.344	5
	ITHMR	1.000	1
2012	AUB	1.000	1
	SALAM	0.838	3
	BISB	0.895	2
	BBK	0.703	4
	KHCB	1.000	1
	NBB	1.000	1
	BSB	0.284	5
	ITHMR	1.000	1
2011	AUB	1.000	1
	SALAM	0.448	4
	BISB	0.916	2
	BBK	0.400	6
	KHCB	0.441	5
	NBB	0.717	3
	BSB	0.209	7
	ITHMR	1.000	1
2010	AUB	1.000	1
	SALAM	1.000	1
	BISB	0.876	2
	BBK	0.396	3
	KHCB	0.352	4
	NBB	1.000	1
	BSB	0.316	5
	ITHMR	1.000	1

In 2011, 2 banks only (AUB and ITHMR) are found efficient. In 2010, 4 banks (AUB; NBB and ITHMR; SALAM) are found efficient. As given in Table 4, technical financial efficiency results have revealed that 2 banks only (AUB and ITHMR) are fully efficient during the study period from 2010 and 2013. Besides, 3 banks (BISB; BBK and BSB) are found inefficient and their technical efficiency scores are less than one in the period 2010 - 2013.

A major motivation behind measuring performance is to identify opportunities for possible efficiency improvements by looking at the differences between efficient banks and inefficient ones. To realize their potentials, the inefficient banks need to compare themselves with the best practice banks that ‘‘make-up” the efficient frontier. DEA analysis provides quantitative guidance for inefficient banks to be recognized as efficient frontier banks. Table 5 shows both original and projected values of the input of inefficient banks in 3013. For example, SALAM has inefficient technical score less than one (0.854) to improve its efficiency DEA analysis provides quantitative guidance for inputs. SALAM needs to reduce the original quantities of (X1, X2, X3 and X4) see Table (5) (22364.000; 7023.000; 636273.000; and 149706.000 respectively) to achieve the projected values (19100.805; 5998.254; 540596.465 and 80089.413). Similarly, others are inefficient banks in Table (5) (BISB; BBK; KHCB and BSB), they should do improvements to be efficient by decreasing their original input values and reach to projected values. Moreover, Table (6) provides a summary of projected values of the input of inefficient banks (from 2013 to 2010).

On the other hand, DEA identifies the quantities of outputs of banks that should be achieved to be efficient. Table (7) shows both original and projected values of the outputs of inefficient banks (with technical efficiency score less than one) in 3013. For example, SALAM; BISB; KHCB and BSB need to increase their output (Y2- Reserves) while BBK should increase output (Y3 – investments) to improve their efficiency. Table (8) presents a summary of output targets for inefficient banks in the period of 2010-2013.

Table (5) A summary of original and projected values of the input of inefficient banks in 3013

Year	Banks (DUMs)	Technical Efficiency Score	Type of inputs	Original value	Projected Value
2013	SALAM	0.854	X1	22364.000	19100.805
			X2	7023.000	5998.254
			X3	636273.000	540596.465
			X4	149706.000	80089.413
	BISB	0.657	X1	9711.000	6376.064
			X2	39055.000	10836.123
			X3	94231.000	61870.338
			X4	72859.000	24440.619
	BBK	0.571	X1	69340.000	37481.292
			X2	69340.000	39596.789
			X3	2206635.000	992962.166
			X4	85135.000	48616.565
	KHCB	0.708	X1	5070.000	3589.294
			X2	19038.000	8735.600
			X3	102838.000	72803.905
			X4	115416.000	24564.315
	BSB	0.681	X1	2172.000	1478.318
			X2	4104.000	2793.287
			X3	132200.000	57377.839
			X4	50000.000	34031.273

Table (6) A summary of projected values of the input of inefficient banks in the period of 2010-2013

Years	**Banks**	**X 1**	**X 2**	**X 3**	**X 4**
2013	SALAM	19100.805	5998.254	540596.465	80089.413
	BISB	6376.064	10836.123	61870.338	24440.619
	BBK	37481.292	39596.789	992962.166	48616.565
	KHCB	3589.294	8735.600	72803.905	24564.315
	BSB	1478.318	2793.287	57377.839	34031.273
2012	SALAM	15936.000	5131.000	574747.000	142577.000
	BISB	9812.000	43289.000	91156.000	72859.000
	BBK	41531.562	37945.957	1126541.094	61835.042
	BSB	972.874	3160.727	47705.427	19182.991
2011	SALAM	3655.251	3120.703	106956.324	54629.372
	BISB	10528.000	33325.000	83401.000	66235.000
	BBK	35584.590	24917.244	256873.754	34592.428
	KHCB	3526.962	7004.465	72461.156	24155.050
	NBB	11142.211	20285.631	511101.787	56497.516
	BSB	935.181	1721.818	21356.713	19321.927
2010	BISB	7082.000	11999.000	68578.000	60214.000
	BBK	22986.262	18959.773	314041.796	30607.655
	KHCB	2167.123	4397.148	25835.608	26965.665
	BSB	1039.839	2103.357	33522.717	20771.847

Table (7) A summary of output targets for inefficient banks in 2013

Year	Banks (DUMs)	Technical efficiency Score	Type of outputs	Original value	Projected Value
2013	SALAM	0.854	Y2	48922.000	53901.579
	BISB	0.657	Y2	27509.000	34485.434
	BBK	0.571	Y3	460548.000	463047.716
	KHCB	0.708	Y2	8484.000	40508.709
	BSB	0.681	Y2	871.000	20403.880

Table (8) A summary of output targets for inefficient banks in the period of 2010-2013

Years	Banks	Y1	Y2	Y 3
2013	SALAM	27224.000	53901.579	223383.000
	BISB	17394.000	34485.434	97418.000
	BBK	84923.000	118032.000	463047.716
	KHCB	12505.000	40508.709	108335.000
	BSB	6209.851	20403.880	22325.912
2012	SALAM	16711.000	55614.000	193516.000
	BISB	23892.000	67815.000	156353.000
	BBK	82422.000	109136.000	461253.665
	BSB	5646.794	20529.150	28026.000
2011	SALAM	14087.000	52483.000	126119.000
	BISB	44202.000	100212.000	108149.000
	BBK	150317.935	85829.000	312217.000
	KHCB	47728.000	44696.000	108783.000
	NBB	121345.808	139630.000	462395.518
	BSB	7817.000	19653.656	41255.000
2010	BISB	31696.000	126962.000	134195.000
	BBK	126369.000	117859.000	501484.597
	KHCB	29963.000	27556.000	77422.000
	BSB	10854.269	27126.752	54410.000

6. CONCLUSION

Increasing the financial efficiency of the banks has played a significant role in finance sector and emerging markets within the global economy. This empirical study examines the efficiency of banking sector in BHB (2010-2013) using FRA and DEA. Firstly, six fundamental financial ratios of bank performance (ROA; ROE; EPS; LIQASS; LTD and CPD) have been analysed via FRA. Secondly, DEA technique, a non-parametric and mathematical programming for determining the efficient frontier which depends upon the selected input and output variables of the banks, has been conducted. The results of FRA do not provide sufficient and complete information on the efficiency of banks. For DEA, the results of the current study are obtained through a software namely DEAP 2.1 version. Under this approach, the results have revealed that 2 banks only are fully efficient during the study period from 2010 and 2013. Besides, other banks are found inefficient with technical efficiency scores less than one. A major advantage behind using DEA approach to measure performance is to identify opportunities for possible efficiency improvements by looking at the differences between efficient banks and inefficient ones. DEA identifies the quantities of inputs that should be reduced and the quantities of outputs that should be increased to improve efficiency for banks with technical score less than one. The present paper contributes to the existing literature in the field of measuring bank efficiency, providing the empirical data on efficiency of banking sector in BHB. The research findings provide a background for further studies; in particular, the studies regarding the choice of DEA model's specification. The current study can be tested with more number of banks and number of observations in different sectors and countries. Despite the fact that the validity of the received results is disputable in some cases, DEA method provides wide opportunities for researchers to expand horizon of their studies in the area of performance measurement.

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Appendix (1)

No.	Name of the bank	Code
Commercial Banks Sector		
1	Ahli United Bank	AUB
2	AlSalam Bank	SALAM
3	Bahrain Islamic Bank	BISB
4	Bank of Bahrain and Kuwait	BBK
5	Khaleeji Commercial Bank	KHCB
6	National Bank of Bahrain	NBB
7	The Bahraini Saudi Bank	BSB
8	Ithmar Bank	ITHMR