Universal Journal of Accounting and Finance 2(5): 121-128, 2014 http://www.hrpub.org
DOI: 10.13189/ujaf.2014.050201

Does Operating Efficiency Matter for the Returns of Banking Sector Stocks in Dhaka Stock Exchange?

Mohammad Akter Hossan[1], Mohammad Ziaul Hoque[1], Bishajit Dey[2]

[1]Department of Finance and Banking, University of Chittagong
[2]Dutch Bangla Bank Ltd, Bangladesh
*Corresponding Author : mahossan@yahoo.com

Abstract This study examines effect of operating efficiency on the returns of portfolios that are constructed for the banking sector stocks of Dhaka Stock Exchange of Bangladesh. For this purpose, this study firstly measures operating efficiency of the sample banks applying Data Envelopment Analysis (hereafter DEA) techniques. Secondly, sample banks are grouped into efficient and inefficient portfolios on the basis of these efficiency scores. Thirdly, Mann Whitney – U test is applied to test the alternative hypothesis that return of efficient portfolio is significantly different from the same of inefficient portfolio. Results of Mann Whitney – U test reject the alternative hypothesis. Therefore, this study observes no significant difference between returns of operationally efficient and inefficient portfolios in Dhaka Stock Exchange. Results of this study also find that inefficient use of inputs and unfavorable financial environment are the reasons of observing no significant difference between returns of portfolios.

Keywords DEA, Input - output, Banks, Efficient and Inefficient Portfolios

1. Introduction

Banks as financial intermediaries play a vital role in allocating individual and institutional savings to more productive investments. This role of banks improves economic growth of a country [1]. Therefore, efficient operation of banks in order to accelerate economic growth of a country receives a great deal of attention in the literatures. Especially after the structural changes such as deregulation, liberalization and introduction of new technologies in the banking sector [2-10]. According to Ikhide [11], studying efficiency of banks is given importance for several other reasons. Firstly, efficiency of banks provides liquidity, payments and safekeeping for depositors` and channeling these funds into investment and working capital requirements. Secondly, banks play special role in funding small businesses. Thirdly, banks ensure smooth functioning of payment system, which facilitates free flow of financial and real resources to their highest-returns uses. Fourthly, efficiency reduces spreads between lending and deposit rates. Fifthly, efficiency improves profitability, mobilizes more funds, offers better prices and service quality for consumers and provides greater safety and soundness of the financial system. Sixthly, efficiency ensures solvency of banks and the strength and soundness of the banking system which are essential to the performance of the entire economy. Therefore, operationally efficient banks are being rated high in the stock market and outperform operationally inefficient banks [12-14]. In addition, Pasiouras [15] finds a positive and statistically significant relationship between technical efficiency and stock returns while examining the association between efficiency of banks and performance of their stocks for a sample of ten listed commercial banks for the period of 2001-2005. These research findings reveal that bank efficiency is the significant information that determines stock returns, which is the main research motivation of this study to investigate if stock returns of operationally efficient banks are outperform operationally inefficient banks in the emerging stock market like Dhaka Stock Exchange of Bangladesh. This study also attempts to investigate sources of inefficiencies of sample banks.

Finally, this study is organized as follows. Section II focuses on the methodology of this study. Section III is about data used in this study. Section IV represents results and findings of this study. Section V represents conclusions based on the derived results and findings.

2. Methodology

Two types of efficiencies are found in the literatures of bank efficiency. One is scale efficiency and another is X – efficiency. Scale efficiency addresses whether or not a bank has the right size. In addition, it investigates the relationship between a firm's per unit average production cost and production volume. According to scale efficiency, a firm is said to be operating under economies of scale if the per unit

production cost declines with the increase of outputs. In contrast, a firm is said to be operating under diseconomies of scale if the per unit production cost begins to rise beyond a certain level of output. Diseconomies of scale may also arise when it becomes more costly to manage a very large firm or due to lack of strictness of management about maintaining higher standard. On the other hand, X-efficiency focuses whether or not a firm produces as efficiently as it possibly can for a given size. It is also called economies of scope. X – efficiency stems from technical efficiency and allocative efficiency. Technical efficiency measures the degree of waste and friction in the production process and allocative efficiency measures whether the right levels of various inputs are used. Therefore, a bank is said to be X-inefficient if the observed total operating cost is lower than the minimized cost [11]. In addition, measurement of efficiency falls into two broad categories such as parametric and non-parametric techniques. The parametric techniques consist of the stochastic econometric frontier approach (EFA), the thick frontier approach (TFA) and the distribution–free approach (DFA). In the parametric methods, a bank is labeled inefficient if its costs or profits are lower than the best practice bank after removing random errors. In contrast, non-parametric techniques include the data envelopment analysis (DEA) and the free disposable hull analysis (DHA). The nonparametric techniques generally do not take account of prices. They account only for technical inefficiency in using too many inputs or producing too few outputs. They do not also account for allocative inefficiency [11].

Traditionally banks focus on various profitability measures to evaluate their efficiency. Usually multiple ratios are used to focus on the different aspects of the operations. For this purpose, three types of operating ratios are being used in the analysis of bank performance. These are operating asset ratios, operating income ratios and operating equity ratios [11]. However, ratio analysis provides relatively insignificant amount of information when considering the effects of economies of scale, the identification of benchmarking policies, and the estimation of overall performance measures of firms. As alternative to traditional bank management tools, frontier efficiency analyses (FEA) allow management to objectively identify the best practices in complex operational environments [16]. On the other hand, most econometric studies in measuring bank output use aggregative indices like total assets, loans or deposits or the number of accounts as an index of bank output. However, none of these can sufficiently capture bank output defined as the value of services rendered by banks [11]. Compared to other approaches, data envelopment analysis (hereafter DEA) is a better way to organize and analyze data since it allows efficiency to change over time and requires no prior assumption on the specification of the best practice frontier [16]. According to Cooper et al. [17], DEA technique takes more than one input and output into account at the same time for a number of samples. Other advantages of using DEA are: firstly, it works well with small samples; secondly, it does not require any assumption about the distribution of inefficiency; thirdly, it does not require a particular functional form on the data in determining the most efficient decision making units [15]. Thus, DEA is considered to be an appropriate method for measuring the operational efficiency for the sample banks in this study. In addition, this study applies DEA model for multiple years in order to take changing nature of bank performance and stock return over time into account.

2.1. DEA Basics

The concept of DEA is introduced by Charnes et al. [18]. This model is also known as CCR model. In constructing DEA model, Charnes et al. [18] use linear programming concept to develop production frontiers and measures efficiency relative to the developed frontiers [15]. They also hire Farrell's notion of technical efficiency to several decision making units (hereafter DMU), in this study banks, with similar production inputs and outputs [18]. The DEA model of Charnes et al. [18] is input oriented model and based on constant return to scale (hereafter CRS). Therefore, the output of this model indicate overall technical efficiency of each DMU under the assumption of constant return to scale [15].. In order to discuss DEA model, consider a set of n DMUs (i.e. year) with DMU k having a production function $\left(X_i, Y_j\right)$. Here, $X_i = (x_1, x_2, \ldots\ldots, x_m)$ inputs and $Y_j = (y_1, y_2, \ldots\ldots, y_z)$ outputs. Let $U_i = (u_1, u_2, \ldots\ldots, u_m)$ and $V_j = (v_1, v_2, \ldots\ldots, v_z)$ be weight vectors to inputs and outputs, respectively. According to Charnes et al. [18], the objective function and the constraints of linear form of CCR model are as follows:

$$\text{Max} \sum_{j=1}^{z} v_j y_j \tag{1}$$

Subject to

$$\sum_{i=1}^{m} u_i x_{ia} = 1 \tag{2}$$

$$\sum_{j=1}^{z} v_j y_{jk} - \sum_{i=1}^{m} u_i x_{ik} \le 0, \; k = \{1,2,\ldots\ldots,n\} \tag{3}$$

$$-u_i \le -\varepsilon, i = \{1,2,\ldots\ldots\ldots m\} \tag{4}$$

$$-v_j \le -\varepsilon, j = \{1,2,\ldots\ldots\ldots z\} \tag{5}$$

In the above equation (2), a indicates DMU being evaluated and ε indicates the infinitesimal positive number. However, details of DEA method can be found in Charnes et al. 1978, Cooper et al. [19].

An extension of the above DEA model is suggested by Banker et al. [20] where they take variable return to scale (hereafter VRS) into account. Their model is known as the BCC model. The BCC model is output oriented DEA model. According to Banker et al. [20], the objective function and

constraint equations are as follows:

$$\text{Max} \sum_{r=1}^{z} u_r y_{ro} - u_o \quad (6)$$

Subject to,

$$\sum_{r=1}^{z} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} - u_o \le 0 \quad (7)$$

$$\sum_{i=1}^{m} v_i x_{io} = 1 \quad (8)$$

$$-u_r \le -\varepsilon \quad (9)$$

$$-v_i \le -\varepsilon \quad (10)$$

In the above model, u_0^* indicates an optimal value to be determined in equation (5). This value indicates return to scale possibilities. In addition, $u_0^* < 0$ implies local increasing return to scale (IRS); $u_0^* = 0$ implies local constant return to scale (CRS); and $u_0^* > 0$ implies decrease return to scale (DRS).

In addition, this study uses R-matrix in order to observe correlation between input and outputs before considering them for DEA models. This study also ensures the condition of a sufficient numbers of sample banks to check the efficiency discrimination of the DEA models in equation (11), which is suggested by Cooper et al. [17].

$$n \ge \max\{m \times s\} \quad (11)$$

Here, n= number of DMUs=50, m= inputs=3, s= outputs=4.

The main contribution of this section is that it considers global (CCR) and technical (BCC) efficiency of the sample bank for the sample period in order to construct portfolio with the banking sector stocks of Dhaka Stock Exchange. Efficiency issues of commercial bank are not considered so far as a base of portfolio construction which this paper does. In addition, as a base of portfolio construction how operating efficiency dominates over existing methods such as ratio analysis is mentioned in the methodology part of this study.

2.2. Portfolio Construction and Hypotheses

At first this study constructs two portfolios, efficient and inefficient, on the basis of scores of operating efficiency of sample banks for the sample period. For this purpose, this study calculates efficiency scores of each bank for each year of the sample period by applying both CCR and BCC models of DEA. In a particular sample year, a bank is to be included into 'efficient portfolio' if it has CCR or BCC score equals to 1 and a bank is to be included into 'inefficient portfolio' if it has CCR or BCC score less than 1. This procedure of constructing efficient and inefficient portfolio is followed for the sample period of this study. Details of which can be found in Appendix 2 of this study.

At second, this study calculates mean yearly stock return of efficient and inefficient portfolios in order to test the following alternative hypotheses for both CCR and BCC models.

H_{1CCR} **:** Return of operationally efficient portfolio is significantly different from the same of operationally inefficient portfolio.

H_{1BCC} : Return of operationally efficient portfolio is significantly different from the same of operationally inefficient portfolio.

At third, this study applies Mann Whitney – U test for testing above hypotheses. The reason to apply U-test is that data used in this study is not normally distributed according to Table 1. For this test, 'operating efficiency' of banks is considered as a group variable and 'stock return' of the same as a test variable.

At fourth, this study applies the relationship among scale efficiency (SE), CCR, and BCC efficiency scores [17] to formulate three rules to investigate sources of inefficiency of the sample banks for the sample period. For this purpose, the first decision rule applied in this study is that, a bank is said to be working in an unfavorable financial environment if it is CCR – and Scale – inefficient. Secondly, a bank is said to be inefficient itself rather than unfavorable financial environment if it is CCR and BCC-inefficient. Thirdly, a bank is said to be most productive user of inputs if it is a CCR – and BCC – efficient.

2.3. Data

Three approaches are found in banking literatures regarding definition of inputs and outputs. First approach is known as "production approach", second approach is known as "intermediation approach", third approach is known as profit – oriented approach [22, 23]. According to production approach, bank inputs are labor and capital and outputs are the number and type of accounts. The intermediation approach considers labor and capital as inputs and loans and other assets as outputs [22]. The profit – oriented approach considers cost components as inputs and revenue components as outputs [23]. Considering all three approaches, this study views labors in terms of number employees, fixed assets, and general expenses as inputs and deposits in amount, operating profit, investment, and loan and advances as outputs of sample banks in order to calculate operating efficiency. Data of inputs and outputs are collected from the annual reports of the sample banks for the year of 2008 to 2012. For this purposes, ten commercial banks are selected on the basis of availability of data. Therefore, this study uses input and output data for fifty (5×10) years. Details of data set can be found in Appendix 2 of this study. As for example, BA2008 in Appendix 2 means that Bank Asia Ltd. at 2008. On the other hand, this study uses mean yearly stock return data of each of these ten banks for the sample period.

3. Results

3.1. Summary Statistics and Correlation:

Table 1 shows the descriptive statistics of inputs and outputs, which reveals that the nature of data is non parametric because the values in this table shows high range (i.e. 6669) in the maximum and minimum values, high variations (i.e. 33089.1039) in the standard deviations. This type of data leads us to apply a non parametric model such as the DEA model. On the other hand, Table 2 observes correlation among inputs and outputs data in order to check association among them before applying the DEA model. It is found in Table 2 that correlation coefficients between inputs and outputs are positive. Such positive association among inputs and outputs justifies variables considered for DEA model of this study.

3.2. Operating Efficiency and Portfolio Return

The results of CCR model in Appendix 2 shows that fourteen out of fifty banks –years are found efficient. They are named as CCR – efficient banks –years and the rest nine inefficient banks are named as CCR – inefficient banks – years in this study. The CCR – efficient banks are Bank Asia2011, Prime Bank2008-2011, Trust Bank2012, Standard Bank2008-2010, Standard Bank 2012, Jamuna Bank2012, Exim Bank2010, Exim Bank2012. As mentioned in the methodology, these fourteen CCR – efficient banks-years constitute 'CCR – efficient portfolio' and the rest thirty six CCR – inefficient banks- years constitute 'CCR – inefficient portfolio'. The returns of these two portfolios are considered in this study to test whether or not they differ significantly from each other according to U-test. The test results are shown in Table 3. These results reject alternative hypothesis of this study (p=0.7377> 0.05), which means that stock return of 'CCR – efficient portfolio' is not significantly different from the same of 'CCR – inefficient portfolio'. That means operating efficiency of banks is not a determinant of stock returns in DSE.

Appendix 2 also shows the efficiency scores of BCC model. It reveals that seventeen out of fifty banks – years are found efficient. These seventeen banks – years are called BCC- efficient banks – years and the rest thirty three banks – years are called BCC – inefficient banks. The BCC – efficient banks – years are Bank Asia2011 Mercantile Bank2012, Prime Bank2008-2011, Dhaka Bank2008, Trust Bank2012, Standard Bank2008-2010, Standard Bank 2012, Jamuna Bank2012, Exim Bank2009 – 2010, Exim Bank2012.

Table 1. Summery Statistics of Input and Output Data

	Labor	Fixed Assets	General Expenses	Operating Profit	Total Investment	Loan and advances	Total Deposit
Max	7403	4584.547	5749.606	3662.183	49670.44	160889.8	182052.9
Min	734	115.2154	253.7048	182.6993	853.4581	19951.3	24099.82
Average	1744.8	1385.223	1984.915	1376.871	12724.76	65722.5	76859.13
SD	1578.272	1160.19	1254.271	816.9461	10557.8	29615.83	33906.05

Source: Authors

Table 2. Correlation matrix for inputs and outputs

	Labor	Fixed Assets	General Expenses	Operating Profit	Total Investment	Loan and advances	Total Deposit
Labor	1						
Fixed Assets	0.247784	1					
General Expenses	0.714387	0.549501	1				
Operating Profit	0.09719	0.372514	0.476435	1			
Total Investment	0.151566	0.643639	0.650003	0.326224	1		
Loan and adv	0.265424	0.650786	0.772332	0.702533	0.672161	1	
Total Deposit	0.277118	0.675963	0.78368	0.626524	0.734097	0.98451	1

Source: Authors

Table 3. Results of Mann Whitney – *U* test for CCR efficiency and stock returns of banks

Banks	**No. of Banks**	**Mean Rank**	**Sum of ranks**	**Mann Whitney Value**	**Asymptotic Significance at 95% confidence level**
Efficient	14	26.61	372.5	236.5	0.7377
Inefficient	36	25.07	902.5		
Asymptotic significance at 95% confidence level (2 tailed)= 0.7377(*p)* > 0.05					

Source: Authors

Similar to the case of CCR – efficiency, these BCC – efficient and – inefficient banks – years constitute 'BCC – efficient portfolio' and 'BCC – inefficient portfolio'; respectively. And their returns are considered to test whether or not they differ significantly from each other according to U-test. The test results in Table 4 reveals that stock return of 'BCC – efficient portfolio' and the same of 'BCC – inefficient portfolio' are not significantly different too.

Table 4. Results of Mann Whitney – *U* test for BCC efficiency and stock returns

Banks	No. of Banks	Mean Rank	Sum of ranks	Mann Whitney Value	Asymptotic Significance at 95% confidence level
Efficient	17	26.21	445.5	268.5	0.8059
Inefficient	33	25.14	829.5		
Asymptotic significance at 95% confidence level (2 tailed)= 0.8059(*p)* > 0.05					

Source: Authors

Therefore, this study finds that both input and output oriented operating efficiency are not found as determinants of stock returns in the stock market of Bangladesh. This finding is true at least for the sample banks and sample time period. Alternatively, it might be said from the results of Table 3 and Table 4 that investors of banking sector stocks in Bangladesh do not take operating efficiency into account while they are investing. Therefore, it can be said that operating efficiency of banks does not matter for the return of banking stocks in Bangladesh.

3.3. Sources of Inefficiencies

According the first rule of investigating sources of operating inefficiency as described in section 2.2, Appendix 3 reveals that, Bank Asia2008-2010, Bank Asia2012, Mercantile Bank2008–20011, Brac Bank2008–2012, Dhaka Bank2008 – 2012, Trust Bank 2008–2012, Social Investment Bank2008–2012, Standard Bank2011, Jamuna Bank2008–2011, Exim Bank2008–2009, Exim Bank2011 are working in an unfavorable financial environment. According to the second rule of inefficiency investigation, Bank Asia2008-2010, Bank Asia2012, Mercantile Bank2008–20011, Brac Bank2008–2012, Dhaka Bank2009 – 2012, Trust Bank 2008–2011, Social Investment Bank2008–2012, Standard Bank2011, Jamuna Bank2008–2011, Exim Bank2008–2009, Exim Bank2011 are also found inefficient itself in utilizing their inputs. From results of these two rules, it can be said that banks found working in an unfavorable financial environment are inefficient itself too. In addition, this study finds Bank Asia2011, Prime Bank2008-2012, Trust Bank 2012, Standard Bank2008-2010, Standard Bank2012, Jamuna Bank2012 Exim Bank2010, and Exim Bank2012, are the most productive user of inputs as per the third rule of inefficiency investigation.

4. Conclusions

This study applies the DEA model to measure and evaluate the operating efficiency of listed commercial banks in DSE. This study finds that returns of CCR – and BCC – efficient portfolios do not differ significantly from that of CCR – and BCC – inefficient portfolios. This study also finds that thirty three sample banks – years are operationally inefficient itself and they are working in an unfavorable financial environment in comparison with efficient sample banks. On the other hand, fourteen sample banks – years are found most productive users of inputs and all of them are found operationally efficient. The main limitation of this study is that it does not run regression model to take dynamic nature of operating efficiency into account in order to test to what extend operating efficiency play a role in expected return of banking sector stocks.

Appendix-1

Acronyms

BA	Bank Asia Limited
MBL	Mercantile Bank Limited
PRIB	Prime Bank Limited
BRCB	Brac Bank Limited
DB	Dhaka Bank Limited
TBL	Trust Bank Limited
SIBL	Social Investment Bank Limited
STBL	Standard Bank Limited
JB	Jamuna Bank Limited
EXIMB	Export Import Bank Limited

Appendix -2

CCR and BCC efficiency scores

Banks	Inputs			Outputs				CCR Efficiency Scores	BCC Efficiency Scores
	Labor	Fixed Assets	General Expense	Operating Profit	Total Investment	Loan &Advances.	Total Deposits		
BA2008	802	644.2500	987.6600	686.7040	6133.810	39974.9986	42435.2400	0.800228	0.847314
BA2009	1,031	1,018.3800	1512.4700	1327.1845	9663.090	50267.9200	54832.8200	0.733779	0.740833
BA2010	1,237	1,837.2840	2441.5451	1929.5822	12075.701	79504.2300	83601.2634	0.786907	0.791241

BA2011	1,270	4,584.5472	253.7048	1916.2144	1643.053	82819.9739	95131.0986	1	1
BA2012	1,485	4,520.4922	2768.8707	907.9970	25114.905	92328.8185	110061.7754	0.758671	0.810608
MBL2008	1,115	683.0000	1250.0166	615.8834	7690.120	41993.9500	46374.1800	0.648778	0.664425
MBL2009	1,303	1,032.8300	1580.2129	807.5169	9664.720	48295.5500	55553.0800	0.607025	0.643795
MBL2010	1,526	1,647.5800	1928.6856	1425.3384	10937.200	66377.7000	73739.3900	0.667566	0.714108
MBL2011	1,668	2,711.3186	2600.5728	1734.1723	24645.377	79999.7995	94102.8329	0.777424	0.809443
MBL2012	1,981	2,898.5960	2759.9765	1381.4510	41314.195	93610.8744	118106.8837	0.981114	1
PRIB2008	834	1,374.8263	1930.9558	1231.8322	23103.098	75156.2068	88020.5914	1	1
PRIB2009	893	1,572.6189	2906.8877	2784.2190	19933.930	89252.2225	106956.2705	1	1
PRIB2010	965	1,691.6437	3602.9298	3002.8766	20484.288	111167.3889	124518.6286	1	1
PRIB2011	1117	3,975.4585	4190.3197	3662.1831	35377.798	139408.8932	159815.7210	1	1
PRIB2012	1259	4,363.3493	4941.1159	2698.9923	49670.435	160889.8486	182052.8721	1	1
BRAC2008	4192	1,472.0243	2862.2776	3173.9063	8245.375	52676.7167	58006.8870	0.588077	0.899261
BRAC2009	5907	1,637.8981	3546.5732	1303.5889	10972.204	64150.8352	75219.6152	0.328443	0.511325
BRAC2010	7151	1,748.9055	4571.3092	1664.3550	12855.985	84302.7893	88157.9083	0.319379	0.653611
BRAC2011	6619	2,349.1648	5164.8223	1702.3819	14198.828	90822.1747	103725.5292	0.305028	0.664645
BRAC2012	7403	2,591.4519	5749.6058	540.3811	25372.525	103624.4380	134646.4485	0.39856	0.824733
DB2008	898	286.5941	1353.0385	838.7646	7239.438	49697.7056	56985.9246	0.943362	1
DB2009	924	424.4627	1424.4513	959.3728	8659.566	52879.8140	60918.3740	0.908081	0.961905
DB2010	1,109	977.3854	1714.7366	1678.9762	8441.808	63591.3874	70420.3807	0.831036	0.836387
DB2011	1,240	1,702.9270	1906.6934	2165.6062	9576.139	75983.2917	85276.8887	0.85813	0.858711
DB2012	1,455	1,879.4740	2119.5062	701.4084	18403.921	90140.2846	107427.1513	0.900294	0.952348
TBL2008	979	342.3926	753.6680	463.0495	4962.660	27528.0844	32919.7647	0.684839	0.687239
TBL2009	1041	381.9191	1109.3138	610.9058	8705.609	32663.1078	48464.6397	0.781244	0.792343
TBL2010	1041	413.1243	1395.4608	1294.4383	8559.940	42760.4330	50357.9013	0.853716	0.923983
TBL2011	1128	421.2274	1595.4935	933.4366	9665.330	54552.6598	65930.0450	0.852135	0.884294
TBL2012	1299	454.9457	1843.4097	182.6993	13622.110	54616.0601	82997.3261	1	1
SIBL2008	750	443.2802	504.3423	202.0683	853.458	19951.3035	24099.8234	0.627933	0.723506
SIBL2009	950	649.6075	653.3370	431.5227	1310.659	26580.5846	31588.1604	0.620249	0.624121
SIBL2010	1252	914.7360	994.4620	643.0197	3049.725	36680.2859	44850.7684	0.602518	0.626706
SIBL2011	1375	2,134.8726	1377.4563	1083.4192	5241.358	53908.5758	66852.5511	0.650531	0.651854
SIBL2012	1625	2,249.9547	1897.2682	1441.1273	6144.015	76024.9739	93594.2925	0.74409	0.749178
STBL2008	734	115.2154	443.0735	656.5960	3217.697	27189.9431	29304.7396	1	1
STBL2009	821	172.8479	653.2187	773.0610	5359.122	38055.7531	42548.1161	1	1
STBL2010	1018	373.9377	878.5826	1377.1841	7643.463	51757.6891	58344.4413	1	1
STBL2011	1049	489.5472	1124.9038	1362.7687	9608.927	55346.8412	63830.3155	0.966007	0.968353
STBL2012	1270	583.1178	1417.0355	1251.1538	17517.672	61380.3955	76088.7804	1	1
JB2008	935	609.0230	712.2988	479.4379	4238.626	21036.8610	27307.9361	0.566976	0.57263
JB2009	1215	681.5999	1013.7415	923.2232	8503.440	32287.6612	42356.2036	0.715393	0.717067
JB2010	1511	1,822.6645	1335.6091	1066.0122	10891.022	49734.8008	60673.5647	0.654872	0.690373
JB2011	1786	2,258.3153	2056.2312	1351.7608	16541.775	56800.2434	70513.4996	0.638207	0.6728
JB2012	2006	2,082.0308	2078.2204	1042.0526	39118.933	54887.0340	79623.1345	1	1
EXIM2008	1312	293.5290	1030.9427	1096.6270	2894.021	53637.6771	57586.9918	0.887042	0.943842
EXIM2009	1440	381.9830	1258.9726	1694.0954	2189.536	68609.9075	73835.4618	0.962699	1
EXIM2010	1686	463.7433	1810.1087	3476.0080	6012.856	93296.6489	94949.4001	1	1
EXIM2011	1724	467.9812	2488.2905	2009.3728	7653.765	99699.6277	107881.2059	0.92828	0.93236
EXIM2012	1909	433.0916	2751.3499	2157.6313	11314.595	118219.9930	140369.6572	1	1

Sources: Author

Appendix -3

Sources of inefficiencies of sample banks

Banks	**CCR Efficiency Scores**	**BCC Efficiency Scores**	**Scale Efficiency**	RTS* (for efficient DMUs)	RTS* (for inefficient DMUs)
BA2008	0.800228	0.847314	0.944429		Constant
BA2009	0.733779	0.740833	0.990478		Constant
BA2010	0.786907	0.791241	0.994523		Constant
BA2011	1	1	1	Constant	
BA2012	0.758671	0.810608	0.935928		Decreasing
MBL2008	0.648778	0.664425	0.976450		Constant
MBL2009	0.607025	0.643795	0.942886		Constant
MBL2010	0.667566	0.714108	0.934825		Decreasing
MBL2011	0.777424	0.809443	0.960443		Decreasing
MBL2012	0.981114	1	0.981114	Decreasing	
PRIB2008	1	1	1	Constant	
PRIB2009	1	1	1	Constant	
PRIB2010	1	1	1	Constant	
PRIB2011	1	1	1	Constant	
PRIB2012	1	1	1	Constant	
BRAC2008	0.588077	0.899261	0.653956		Constant
BRAC2009	0.328443	0.511325	0.642337		Constant
BRAC2010	0.319379	0.653611	0.488638		Constant
BRAC2011	0.305028	0.664645	0.458934		Constant
BRAC2012	0.39856	0.824733	0.483259		Constant
DB2008	0.943362	1	0.943362	Increasing	
DB2009	0.908081	0.961905	0.944044		Increasing
DB2010	0.831036	0.836387	0.993602		Constant
DB2011	0.85813	0.858711	0.999323		Constant
DB2012	0.900294	0.952348	0.945341		Decreasing
TBL2008	0.684839	0.687239	0.996508		Constant
TBL2009	0.781244	0.792343	0.985992		Increasing
TBL2010	0.853716	0.923983	0.923952		Constant
TBL2011	0.852135	0.884294	0.963633		Increasing
TBL2012	1	1	1	Constant	
SIBL2008	0.627933	0.723506	0.867903		Constant
SIBL2009	0.620249	0.624121	0.993796		Constant
SIBL2010	0.602518	0.626706	0.961405		Constant
SIBL2011	0.650531	0.651854	0.997970		Constant
SIBL2012	0.74409	0.749178	0.993209		Constant
STBL2008	1	1	1	Constant	
STBL2009	1	1	1	Constant	
STBL2010	1	1	1	Constant	
STBL2011	0.966007	0.968353	0.997577		Constant
STBL2012	1	1	1	Constant	
JB2008	0.566976	0.57263	0.990126		Constant
JB2009	0.715393	0.717067	0.997665		Constant
JB2010	0.654872	0.690373	0.948577		Decreasing

JB2011	0.638207	0.6728	0.948584		Decreasing
JB2012	1	1	1	Constant	
EXIM2008	0.887042	0.943842	0.939820		Decreasing
EXIM2009	0.962699	1	0.962699	Decreasing	
EXIM2010	1	1	1	Constant	
EXIM2011	0.92828	0.93236	0.995624		Increasing
EXIM2012	1	1	1	Constant	
Average	**0.797572**	**0.846907**	**0.933578**		

* Return to scale
Source: Authors

REFERENCES

[1] Amer, H. M., H., Moustafa, W., and Eldomiaty, T. (2011), 'Determinants of Operating Efficiency for Lowly and Highly Competitive Banks in Egypt'; Cambridge Business & Economics Conference, pp. 4 – 5.

[2] Berger, A.N. and Humphrey, D.B. (1991), The Dominance of Inefficiencies over Scale and Product Mix Economies in Banking; Journal of Monetary Economics 28, pp. 117- 148.

[3] Berger, A.N., Hunter, W.C., and Timme, S.G. (1993), The efficiency of financial institutions: a review and preview of research past, present and future; Journal of Banking and Finance 17, pp. 221–249.

[4] Girardone, C., Molyneux, P. and Gardener, E. (2004), Analyzing the Determinants of Bank Efficiency: The Case of Italian Banks; Journal of Applied Economics 36, pp. 215-227.

[5] Sturm, J. E. and Williams B. (2004), Foreign Bank Entry, Deregulation and Bank Efficiency: Lessons from the Australian Experience; Journal of Banking and Finance 28, pp. 1775-1799.

[6] Fries, S. and Taci A. (2005), Cost Efficiency of Banks in Transition: Evidence from 289 Banks in 15 Post Communist Countries; Journal of Banking and Finance 29, pp. 55-81.

[7] Kasman, A., and Yildirim, C. (2006), Cost and profit efficiencies in transition banking: the case of new EU members; Journal of Applied Economic 38, pp. 1079–1090.

[8] Kraft, E., Hofler, R., and Payne, J. (2006), Privatization, Foreign Bank Entry and Bank Efficiency in Croatia: A Fourier-Flexible Function Stochastic Cost Frontier Analysis; Journal of Applied Economics 38, pp. 2075-2088.

[9] Park, K. and Weber, W. (2006), A Note on Efficiency and Productivity Growth in the Korean Banking Industry, 1992-2002; Journal of Banking and Finance 30, pp. 2371-2386.

[10] Sensarma, R. (2006), Are Foreign Banks Always the Best? Comparison of State owned, Private and Foreign Banks in India; Economic Modelling 23, pp. 717-735.

[11] Ikhide, S. (2000), Efficiency of Commercial Banks in Namibia; Bank of Namibia, BON occasional Paper No. 4, pp. 1 -30.

[12] Miller, M. S. and Noulas, A. G. (1996), The technical efficiency of large bank production; Journal of Banking & Finance 20, pp. 495-509.

[13] Sufian F. and Majid M. Z. (2009), Bank Efficiency and Share Prices in China: Empirical Evidence from a Three-Stage Banking Model; International Journal of Computational Economics and Econometrics 1, pp. 23-47.

[14] Kasman, S. and Kasman, A. (2011), Efficiency, Productivity and Stock Performance: Evidence from the Turkish Banking Sector; PANOECONOMICUS 3, pp. 355-372.

[15] Pasiouras, F. (2008), Estimating the technical and scale efficiency of Greek commercial banks: The impact of credit risk, off-balance sheet activities, and international operations; Research in International Business and Finance 22, pp. 301–318.

[16] Yang Z. (2005), DEA Evaluation of Bank Branch Performance; IEEE, pp.82-84.

[17] Cooper W.W., Seiford, L. M. and Tone, K. (2006), Introduction to data envelopment analysis and its uses- with DEA-solver software and references, Springer Science + Business Media Inc, New York, USA.

[18] Charnes, A., Cooper, W.W., and Rhodes, E. (1978), Measuring the Efficiency of Decision Making Units; European Journal of Operational Research 2, pp. 429-444.

[19] Cooper, W.W., Seiford, L. M., and Tone, K. (2000), Data Envelopment Analysis. A Comprehensive Text with Models, Applications, References and DEA-Solver Software. Kluwer Academic Publishers, USA.

[20] Banker, R.D., Charnes, A., and Cooper, W.W. (1984), Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis; Management. Science 30, pp. 1078-1092.

[21] Berger, A. N. and Humphery, D.B. (1997), Efficiency of financial institutions: International survey and directions for future research; European Journal of Operational Research 98, pp. 175–212.

[22] Drake, L., Hall, M.J.B., and Simper, R. (2006), The impact of macroeconomic and regulatory factors on bank efficiency: a non-parametric analysis of Hong Kong's banking system; Journal of Banking and Finance 30, pp. 1443–1466.