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EFFICIENCY OF COMMERCIAL BANKS IN BANGLADESH

This paper investigates the technical efficiency of Bangladeshi commercial banks using the multiplier model of bootstrap data envelopment analysis. The results from the input oriented radial model estimate an upward-bias. This is explained by the corrections in the confidence intervals. The assessments lie for every observation inside but close to lower bound. Out of 39 selected banks, 18 banks are found as unit efficient. Only two banks have found to be significantly inefficient. The average efficiency of commercial banks in Bangladesh has scored 95.05%. Brief limitations and policy implications are also addressed at the end of the paper.

Keywords: *data envelopment analysis; bootstrap; commercial banks; Bangladesh.*
JEL codes: G21, G28.

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ЕФЕКТИВНІСТЬ РОБОТИ КОМЕРЦІЙНИХ БАНКІВ БАНГЛАДЕШ

У статті досліджено технічну ефективність роботи комерційних банків Бангладеш з використанням методу аналізу середовища функціонування. Результати радіальної моделі демонструють завищення оцінок, що пояснюється корегуванням в довірчих інтервалах. Оцінювання проведено для кожного інтервалу окремо, але вже ближче до нижчого показнику. З 36 досліджуваних банків 18 можна вважати ефективними. Тільки два банки можна вважати такими, що працюють абсолютно неефективно. Середня ефективність роботи комерційних банків Бангладеш – на рівні 95,05%. Математичні обмеження даного дослідження та рекомендації відносно змін в економічній політиці надано в кінці статті.

Ключові слова: *аналіз середовища функціонування; бутстреп; комерційні банки; Бангладеш.*
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ЭФФЕКТИВНОСТЬ РАБОТЫ КОММЕРЧЕСКИХ БАНКОВ БАНГЛАДЕШ

В статье исследована техническая эффективность работы коммерческих банков Бангладеш с использованием метода анализа среды функционирования. Результаты радиальной модели демонстрируют завышение оценок, что объясняется корректировкой в доверительных интервалах. Оценивание проведено для каждого интервала отдельно, но теперь уже ближе к нижнему показателю. Из 39 исследуемых банков 18 могут считаться работающими эффективно. Только два банка можно считать существенно неэффективными. Средняя эффективность работы коммерческих банков в Бангладеш – на уровне 95,05%. Математические ограничения данного исследования и рекомендации относительно изменений экономической политики представлены в конце статьи.

Ключевые слова: *анализ среды функционирования; бутстреп; коммерческие банки; Бангладеш.*

1. Introduction. Banking sector of Bangladesh has gone through noteworthy improvements in the last decades. Taking the advantage from favorable government regulations, restricted national market and foreign aid to national development, the sector has ensured an outstanding growth in scale of economics and assets diversification (Akther, Fukuyama and Weber, 2013; Masum, Azad and Loo-See, 2015; Uddin and Suzuki, 2014).

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This paper examines the technical efficiency of 39 commercial banks in Bangladesh. Bank efficiency has been the focal point since the first inception DEA by Charnes, Cooper and Rhodes (1978). After that, a large numbers of research papers have contributed to banks efficiency investigations (Sherman and Gold, 1985; Wanke, Barros and Faria, 2015). However, Paradi, Yang and Zhu (2011) surveyed the existing literature on bank efficiency and recommended further studies to be focused only on developed economies. Likewise, a profound exploration of developing economies (including Bangladesh) is of greater significance because of its regional and economic importance.

The next section refers to the progress in the banking sector of Bangladesh. Section 3 demonstrates a brief overview of previous studies. Sections 4 and 5 present the data and the methodology respectively. Section 6 offers the empirical results, discussions and findings. Finally, limitations and conclusions are presented in Sections 7 and 8.

2. Contextual setting of Bangladeshi banks. There are 3 main phases in the development of Bangladeshi banking system (Akther et al., 2013; Suzuki and Adhikary, 2010). The first stage (1972 to 1982) combines the banks which were nationalized and credit was targeted to agriculture and public investment. Table 1 summarizes the development of banking sector in Bangladesh.

Table 1. **Phase-wise development of the banking sector in Bangladesh**

	Total deposits		Number of branches	
Year	Tk (bln)	Growth (%)	Total	Growth (%)
1972–1981	5.236	-	1196	-
1982–1989	36.712	21.85	4470	14.38
1989–2007	164.625	24.26	5451	2.88
2008 – till dates	2171.142	17.24	7049	1.33

Source: http://www.bb.org.bd, schedule bank statistics (1972–2012).

Today, the banking system of Bangladesh contains 56 scheduled banks. Among them: 4 banks are nationalized commercial banks, 39 private commercial banks, 4 specialized government owned banks, 9 foreign banks, and 31 non-bank financial institutions. 5 specialized non-scheduled government banks are also operating in the sector. Details on these are available at http://www.bb.org.bd/fnansys/bankfi.php.

3. Literature review. Banks facilitate the payments mechanism, which is a perquisite for economy expansion. Efficiency analysis on Bangladeshi banks is still rather limited even though the research on bank efficiency has widely used DEA. Several studies, such as Chowdhury and Ahmed (2009), Sarker (1999), have used ratio analysis to evaluate the performance of Bangladesh banks. For instance, Chowdhury and Ahmed (2009) examined only 5 commercial banks and used the ratio analysis to examine branches, number of staffs and net income. Sarker (1999) considered only Islamic banks. In his study the ratio analysis was deployed to examine few administrative and financial ratios. Adhikary (2006) analyzed bank performance only on the basis of nonperforming loans. His comparative study was based on parametric test.

The first ever nonparametric study on financial performance of Bangladeshi banks has been carried out by Akther et al. (2013). However, this paper suffered from the shortage of banks information. Only 19 banks have been analyzed while 48 banks

were already operating during his study period (2005–2008). He used slacks-based DEA analysis at two stages. However, his study successfully used network DEA to explore the gap of maximize desirable loans and minimize bad loans. However, financial performance of the banks remained untouched.

4. Data and variables. In this paper, the variable selection is done through literature survey based on the work by Assaf, Barros and Matousek (2011). The number of total input-output variables and the number of the total decision making units (DMUs) (i.e., 39 banks) are justified. Table 2 summarizes the descriptive statistics on inputs and outputs of this paper. The details of the bank list and their operational information is available in Table 3.

Table 2. **Descriptive summary of inputs and outputs**

Items	Minimum	Maximum	Mean	Std. Deviation
Inputs (X_i)				
Total interest expense (TIE)	42.900	38838.600	10635.454	7568.641
Personnel expenses (PE)	49.700	8094.400	2161.841	1842.748
Operating expenses (OE)	82.100	5457.100	1769.615	1402.113
Non-interest expenses (NiE)	140.000	12422.600	3931.456	3054.173
Total earning assets (TEA)	5353.900	565525.200	141889.892	111926.835
Cash and due from banks (CaD)	2.100	49491.500	12081.044	10542.031
Outputs (Y_i)				
Interest and dividend income (IDI)	228.800	48145.500	15721.833	10190.917
Net fees and commissions (NFC)	0.200	6912.400	1469.190	1435.789
Total operating income (TOI)	0.300	10599.400	2881.287	2417.373
Operating profit (OP)	27.300	11203.800	2808.772	2166.628
Total deposits (TD)	1867.900	677325.200	137871.654	124126.014

Source: Bankscope database.

5. The bootstrap DEA technology. The motivation of the bootstrap DEA method has appeared in several previous studies. For a detailed review refer to Coelli, Rao, O'Donnell, and Battese (2005). The model used in this study follows an input oriented assumption and can be derived for the i^{th} bank by solving the following linear programming:

$$\hat{\delta}_i = \max_{\hat{\delta}_i,\lambda}\{\delta > 0 \mid \hat{\delta}_i y_i \le \sum_{i=1}^{n} Y\lambda; x_i \ge \sum_{i=1}^{n} X\lambda; \sum_{i=1}^{n}\lambda = 1; \lambda \ge 0\} \; i = 1 \ldots n, \quad (1)$$

where Y is the vector of bank outputs; X is the vector of bank inputs; λ is the I x 1 vector of constants. The value of $\hat{\delta}_i$ obtained is the technical efficiency score for the i^{th} bank. A measure of $\hat{\delta}_i = 1$ indicates that the bank l is technically efficient, and inefficient if $\hat{\delta}_i > 1$. Technological advances and regulatory changes might vary across banks in various size groups, so allowing for variable returns to scale would permit modelling the entire range of technologies.

5.1. The bootstrap DEA. The recent studies have raised justifications regarding the statistical limitations of DEA in discrediting the efficiency scores. Simar and Wilson (2007) emphasize that efficiency scores generated by DEA are strongly dependent on each other in the statistical sense. Simar and Wilson (1998) were the first to introduce the bootstrap method to obtain statistical properties of DEA efficiency scores.

Table 3. **Results of 1 stage bootstrap multiplier model, input orientation**

Bank	Total Assets[a)]	Net Income[a)]	Normal VRS[b)]	Bootstrap[b)]	Bias[b)]	Lower Bound[b)]	Upper Bound[b)]
Agrani Bank	425278.6	9,216.0	1.000	1.000	0.045	1.009	1.085
Janata Bank	286054.3	2784.8	1.000	0.991	0.043	1.016	1.066
Sonali Bank	779106.5	3446.8	1.000	1.000	0.062	1.016	1.124
AB Bank	205768.4	1098.4	0.980	1.000	0.051	1.039	1.065
Bd. Commerce Bank	24,097.1	20.0	1.000	0.735	0.025	0.746	0.781
Bd. Development Bank	43,643.4	1,037.2	1.000	0.881	0.028	0.893	0.943
Bank Asia	160954.7	1330.5	1.000	1.000	0.053	1.015	1.114
BASIC Bank	152,751.3	-531.5	1.000	0.968	0.032	0.983	1.021
BRAC Bank	178588	1339.4	1.000	1.000	0.099	1.017	1.298
City Bank	125734.2	794.5	1.000	0.952	0.025	0.963	0.991
Dhaka Bank	142258.3	1,981.5	1.000	1.000	0.042	1.009	1.078
Dutch-Bangla Bank	181,656.9	1,985.9	1.000	0.982	0.028	0.997	1.026
Eastern Bank	154589.8	2535.1	1.000	1.000	0.053	1.020	1.127
Grameen Bank	178,936.6	1,332.9	1.000	1.000	0.051	1.012	1.115
IFIC Bank	112543.4	1,133.8	1.000	0.893	0.028	0.901	0.949
Jamuna Bank	112738.4	1,144.5	1.000	1.000	0.051	1.016	1.091
Meghna Bank	7,193.7	32.0	0.979	0.722	0.019	0.734	0.753
Mercantile Bank	141682.3	1977.8	1.000	0.975	0.037	0.997	1.041
Mutual Trust Bank	51723.1	820.6	1.000	0.943	0.036	0.956	1.009
National Bank	231901.6	2,086.4	1.000	0.969	0.038	0.984	1.032
NCC Bank	121281.8	1,141.6	1.000	0.973	0.025	0.983	1.008
NRB Bank	5,962.5	10.5	1.000	1.000	0.079	1.013	1.189
One Bank	100073.9	1,348.6	1.000	0.941	0.025	0.950	0.975
Premier Bank	88756.8	785.8	1.000	1.000	0.070	1.008	1.209
Prime Bank	240521.4	2,038.3	1.000	0.879	0.028	0.887	0.936
Pubali Bank	222621.5	2,431.6	1.000	1.000	0.061	1.024	1.105
Rupali Bank	209567.3	452.0	1.000	1.000	0.047	1.014	1.087
Southeast Bank	128949.4	2763.9	1.000	1.000	0.058	1.019	1.103
Standard Bank	106855.2	1,011.0	1.000	0.888	0.032	0.898	0.947
The Farmers Bank	6,059.0	38.2	1.000	1.000	0.045	1.014	1.113
Trust Bank	94830.6	182.7	1.000	0.869	0.026	0.881	0.904
United Commercial Bank	128337.9	2179.8	1.000	1.000	0.087	1.016	1.134
Uttara Bank	130690.5	1,319.5	1.000	0.972	0.028	0.984	1.016
Al-Arafah Islami Bank	171284	2276.7	0.896	0.796	0.022	0.805	0.832
EXIM Bank	166997.9	2,083.1	1.000	1.000	0.096	1.019	1.302
First Security Islami Bank	159704.7	776.5	1.000	0.996	0.029	1.012	1.041
Islami Bank Bangladesh	537569.7	5,055.4	1.000	0.861	0.037	0.873	0.926
Shahjalal Islami Bank	122087.3	1305.9	1.000	1.000	0.063	1.017	1.158
Social Islami Bank	112889.4	1465.2	1.000	0.887	0.034	0.901	0.947

[a)] Bankscope database, as of 03.01.2015.
[ь)] author's own calculation.

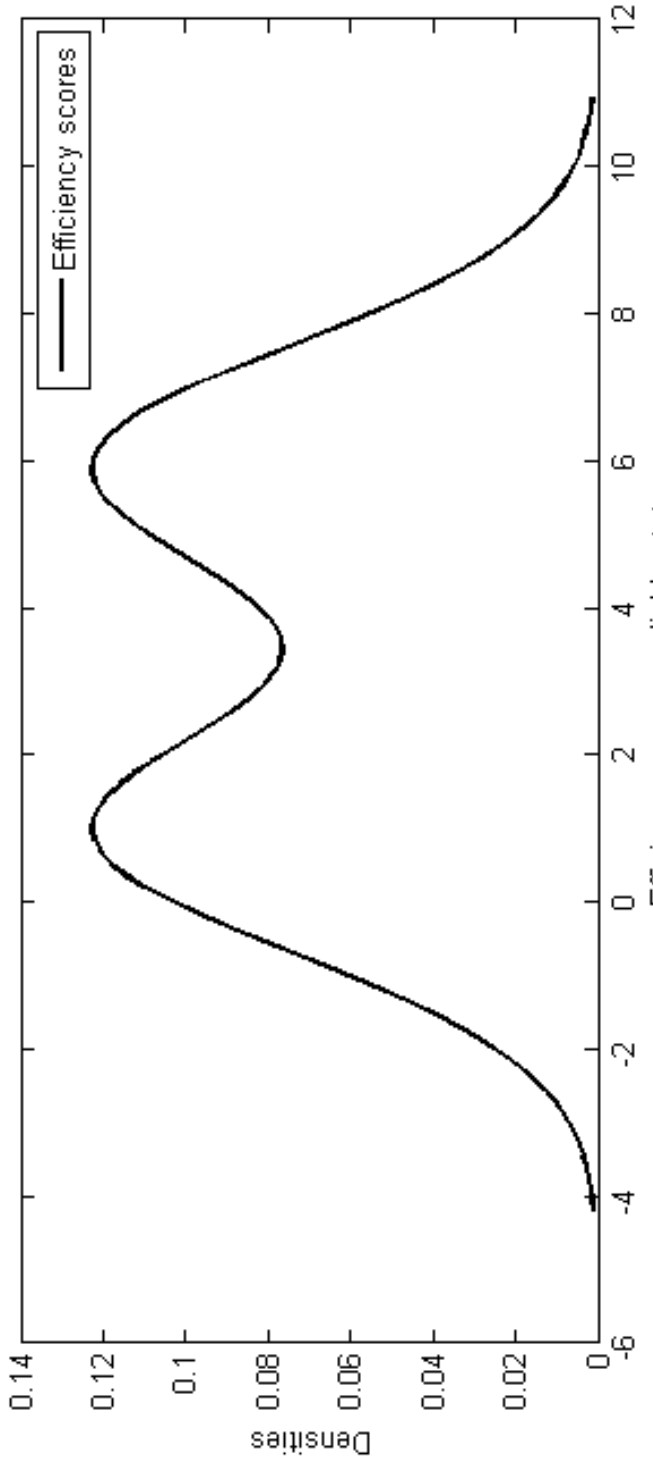

Figure 1. **Kernel density estimation,** *author's*

6. Results and analysis. The variable returns to scale estimates of different Bangladeshi banks, are reported in Table 3. To compare the bootstrap method with the old-fashioned DEA model, a comparative discussions are reported in Table 3. Due to the upward-bias in the original estimates and due to the bootstrap correction in the confidence intervals, the original estimates lie for every observation inside but close to lower bound of the confidence interval.

The results clearly indicate that the average efficiency score of Bangladeshi banks' efficiency level of 73.49% to 100%. In the study year 18 banks out of the 39 selected banks operated at the unit efficiency level. The lowest performing banks include BACOIFRS and SMALLINI. On average, Bangladeshi banks are nearly 4.79% away from their frontier (maximum) efficiency.

The investigation of each individual from upper and lower boundaries of efficiency scope provides clear cut operational directions. Target banks and their resource target is the best alternative to enhance banks future operations. The major findings of this paper are as follows:

1) The results from VRS DEA and bootstrap DEA vary at a significant rate. Such discrimination allows banks examine their performances with special reference to upper and lower boundaries given in the result section.

2) Majority of the banks (18 out of 39) are found unit efficient. Moreover, all the sectors have representative in efficient frontier. As a result, banks can easily benchmark their performance with their peers and do long-term planning.

3) Last but not the least, Islamic commercial banks are outperformed in sector-wise discussions and efficiency estimation. Such results appeal for further investigation on Islamic banks operational process as compared with conventional banks.

Finally, the Kernel densities estimation in Figure 1 depicts the efficiency scores of Bangladeshi banks calculated from one-stage bootstrap model. Nevertheless, the bimodal shape of such distribution may have link with the existing government regulation towards controlled monetary policy.

7. Limitations and future work. The author assumes that a slack based efficiency measurement tool used along with remaining banks panel data can easily show the periodic change in banking efficiency. Moreover, the heterogeneity of the banking system (i.e., local vs. foreign, conventional vs. Islamic, public vs. private etc.) are overlooked in this study. In future studies, panel data with second stage data envelopment analysis can be useful to detect the major sources of macroeconomic variables in banking inefficiency.

8. Conclusions. This paper examines the efficiency of banking sector among the major banks in Bangladesh. The author uses 39 banks' data from the Bankscope database and run one stage multiplier model. More specifically, a radial input-oriented bootstrap is run to get maximum discrimination among the selected banks. Finally, Kernel density function is run to examine the pattern of densities of efficiency scores among the banks.

Out of selected 39 banks, 18 banks are found to be unit efficient. The average efficiency of Bangladeshi banks is 95.05%. Only 2 banks are found to be significantly inefficient. The upward bias from the frontier analysis signifies that banks could achieve the target with reference to upper and lower boundaries.

Even though the banks have been operating in sound financial conditions for the last 3 decades, the banks in Bangladesh have been unsuccessful to operate at their maximum. A number of reasons behind such failure have been identified. Among them, poor human resource management deems the major concern (Masum et al., 2015). Political favoritism in the establishment and development of national banking system caused long term crisis for the actual development of this industry (Akther et al., 2013; Uddin and Suzuki, 2014).

The contributions of this paper are of 3 phases. Firstly, to the best of the author's knowledge, for the first time the bootstrap multiplier model is used to examine banking efficiency in a Bangladesh context. Secondly, the upper and lower boundaries of efficiency can help managers set progress plan for future years. Nevertheless, additional discriminations among the efficiency scores will be helpful in determining the target points (both input and output) for the banks. Likewise, managers can benchmark their actions and long-term policies basing on the achieved results.

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