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Evaluation of stock market technical efficiency with a comparison of groups of companies in Dhaka stock exchange

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The objective of this study was to measure stock market efficiency of the groups of companies, such as Group-A (financial), Group-A (non-financial), Group-B and Group-Z of Dhaka stock exchange (DSE) market in Bangladesh applying the Stochastic Frontier approach, incorporating technical inefficiency effect model. Among the four groups, most efficient group was Group-A (financial) and most inefficient group was Group-Z. This study showed that the mean technical efficiency of the companies of DSE market during the period 2000 to 2008 was 0.8782. This implied that 87% of potential output was being realized by the companies of DSE market. In case of using production function model; it was found that the Translog production function was more preferable than the Cobb-Douglas production function. The technical efficiency rate was found gradually increasing over time in the stock market in Bangladesh.

Key words: Dhaka stock exchange, technical efficiency, stochastic frontier model, inefficiency effects.

INTRODUCTION

Financial markets constitute an important part of the total infrastructure for every society that has passed the stage of largely domestic economics. Stock market which is part of the financial markets is concerned as the means of support in a country's economic growth and is a volatile financial market, in which various factors can affect the return that investors can gain from investing in stocks. In Bangladesh, the stock market plays a crucial role to mobilize capital for the development of a capital market. Dhaka stock exchange (DSE), the frontline organization for the securities market was established as "East Pakistan Stock Exchange Association Limited" on 28th April, 1954, even formal trading of the market began in 1956. The name of the stock exchange was changed to "Dacca Stock Exchange Ltd" on 13th May, 1964. The Securities and Exchange Commission (SEC) which is the regulator of the capital market of Bangladesh was

established on 8th June, 1993 under the Securities and Exchange Commission Act, 1993. Later the DSE upgraded its automated trading system on 21 August, 2005 (Report on Dhaka Stock Exchange" School of Business, University of Information Technology and Sciences, Dhaka, Bangladesh, DSE website: www.dsebd.org; and SEC website: www.secbd.org).

The way by which stochastic frontier analysis (SFA) is being applied in measuring the technical efficiency of DSE market, is appropriate as it deals with stochastic noise and also allows statistical tests of hypotheses concerning production structure and degree of inefficiency. On the other hand, data envelopment analysis (DEA) cannot take account of such statistical noise, the efficiency estimates may be biased if the production process is largely characterized by stochastic elements (Herrero and Pascoe, 2002). The main disadvantage of DEA is that it does not allow firms to deviate from the frontier due to random errors (Kasman and Turgutlu, 2007).

In this study, Stochastic Frontier Approach has been considered to measure the technical efficiencies of

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selected groups of companies, such as Group-A (financial), Group-A (non-financial), Group-B and Group-Z in DSE market in Bangladesh. Thus, this study is expected to provide meaningful insights into the level of company's group-specific technical efficiency. In this paper, we tried to find out if the factors, such as: market return, market capitalization, book-to-market ratio and market value are significantly related to stock returns or not. The novelty of this study is to examine not only the capital market behavior of Bangladesh over the period 2000 to 2008, but also to predict the technical efficiencies for the selected groups of companies and will draw policy conclusions conductive to economic growth of Bangladesh.

LITERATURE REVIEW

A number of studies have been done by many researchers using parametric and non-parametric techniques to evaluate efficiency of financial institutions (for example, Altunbas et al., 2001; Maudos et al., 2002; Weill, 2004; Hassan et al., 2004; Sturm and Williams, 2004; Mohan and Ray, 2004; Das et al., 2005; Sensarma, 2005; Samad, 2009; Baten and Kamil, 2010 for banking industry) and (Fecher et al., 1993; Cummins and Zi, 1998) for the insurance industry). Recently, some studies from the banking literature have investigated the relationship between bank efficiency and stock returns (Chu and Lim, 1998; Kirkwood and Nahm, 2006; Sufian and Majid, 2006; 2007; Pasiouras, 2008).

In the case of stock market literature, few researches were done in the emerging and less developed stock markets. Most of the research is concentrated in the developed stock markets, particularly the US market. But the need for more research in the emerging and less developed markets is well recognized. The Dhaka Stock Exchange (DSE) is one of the representatives of an emerging market during the period with rapid growth in terms of market capitalization, trade volume and the number of listed companies. Few studies have already been conducted on DSE. Hassan et al., (1999) studied on time-varying risk-return relationship by using a data set of daily stock prices and returns, and found that DSE equity returns had positive skewness, excess kurtosis and deviation from normality and the returns displayed significant serial correlation, implying that the stock market is inefficient. Mobarek and Keasey (2000) concluded that DSE does not follow random walk model and there are significant autocorrelation at different lag causes of DSE in that their forms are not weak in efficiency. Haque et al., (2001) described the experience of DSE after the scam of November 1996 by applying capital Asset pricing model (CAPM) and efficient market hypothesis (EMH). Kader and Rahman (2005) has no evidence that DSE is weak form efficient. Islam and Khaled (2005) analyzed on the predictability of the share

price in DSE prior to the boom in 1996 and found evidence in favor of short-term predictability of share prices. Mobarek and Mollah (2005) suggested that there are some factors (beta, size, the ratio of price-to-book value, volume of shares traded, earnings yield, cash flow yield, dividend yield and leverage) that influence share returns on the DSE. Akhter et al. (2005) identified a number of problems being encouraged by the market. They recommended that the SEC, as a watchdog of the market, should play prominent role in reactivating markets, which is essential for accelerating the speed of country's industrialization. Rahman et al. (2006) considered Fama-French (1992) methodology to test whether CAPM is a good indicator of asset pricing in Bangladesh. Uddin and Alam (2007) examined the linear relationship between share price and interest rate on DSE through ordinary least square (OLS) regression and found that interest rate has significant negative relation-ship with share price and growth of interest rate also has significant negative relationship with growth of share price. They commented that if the interest rate is considerably controlled in Bangladesh, then it will be the great benefit of DSE. Uddin and Khoda (2009) investi-gated whether stock-price indexes of Dhaka stock markets can be characterized as random walk (unit root) processes by using the unit root test and the ADF test. They provided evidence that the DSE is not efficient even in weak form and DSE does not follow the random walk model.

There seems to be no literature on the topics of measuring stock market efficiency of the groups of companies listed in the DSE market in Bangladesh using DEA or SFA approach. It encouraged us to conduct the study to contribute to finance literature and motivates us to undertake this study to fill the gap and add to the existing literature.

MATERIALS AND METHODS

Inefficiency stochastic frontier model

Following Battese and Coelli (1995), we applied the stochastic frontier model to panel data which can be expressed as:

$$Y_{it} = \beta X_{it} + (V_{it} - U_{it}), \quad i = 1,2,........,N \quad t = 1,2,.......,T \tag{1}$$

where Y_{it} denotes the logarithm of output for the i-th company group in the t-th time period; X_{it} denotes the vector of input quantities; β is a vector of unknown parameters to be estimated; V_{it}'s are the error components of random disturbances, independent and identically distributed (i.i.d.) $N(0, \sigma_v^2)$ and independent from U_{it}. U_{it}'s are non-negative random variables associated with the technical inefficiency of production and to be independently distributed as truncations at zero of the $N(\mu, \sigma_u^2)$

distribution; where $U_{it} = Z_{it}\delta,$ where z_{it} is a (1 × p) vector of variables which may influence the inefficiency of companies and δ is a (p × 1) vector of parameters to be estimated. The parameterization from Battese and Corra (1977) are used replacing σ_u^2 and σ_v^2 with $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and the parameters are estimated by maximum likelihood approach.

In the context of stochastic frontier model, the technical inefficiency effect U_{it} is specified as follows:

$$U_{it} = Z_{it}\delta + W_{it}$$
(2)

where the random variable W_{it} follows truncated normal distribution with mean zero and variance σ^2, such that the point of truncation is $-Z_{it}\delta$. Parameters of the stochastic frontier given by Equation 1 and inefficiency model given by Equation 2 are simultaneously estimated by using maximum likelihood estimation. After obtaining the estimates of U_{it}, the technical efficiency of i-th company group at t-th time period is given by:

$$TE_{it} = \exp(-U_{it}) = \exp(-Z_{it}\delta - W_{it})$$
(3)

Research hypothesis

In order to select the best specification for the production function (Cobb-Douglas or Translog) for the given data set, we conducted hypothesis tests for the parameters of the stochastic frontier production model using the generalized likelihood-ratio (LR) statistic defined by:

$$\lambda = -2\{\ln[L(H_0)] - \ln[L(H_1)]\}$$
(4)

where $\{\ln[L(H_0)]\}$ and $\{\ln[L(H_1)]\}$ are the values of the log-likelihood function for the frontier model under the null and alternative hypotheses. The following null hypotheses will be tested:

$H_0 : \beta_{ij} = 0$ Translog production function is not more preferable than Cobb-Douglas production function or mathematically.

$H_0 : \gamma = 0,$ the null hypothesis specifies that the technical inefficiency effects in company groups are zero. This is rejected in favor of the presence of inefficiency effects. Here γ is the variance ratio, explaining the total variation in output from the frontier level of output attributed to technical efficiency and defined by $\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$. This is done with the calculation of the maximum likelihood estimates for the parameters of the stochastic frontier models by using the computer program frontier version 4.1 (Coelli, 1996). If the null hypothesis is accepted this would indicate that σ_u^2 is zero and hence, that the U_{it} term should be removed

from the model, leaving a specification with parameters that can be consistently estimated using ordinary least square (OLS).

$H_0 : \eta = 0,$ the null hypothesis that the technical inefficiency effects are time invariant , that is, there is no change in the technical inefficiency effects over time. If the null hypothesis is true, the generalized likelihood ratio statistic λ is asymptotically distributed as a chi-square (or mixed chi-square) random variable.

Specification of the stochastic frontier Translog production model

The functional form of the stochastic frontier Translog production model is defined as:

$$\ln(Y_{it}) = \beta_0 + \beta_1 \ln MR_{it} + \beta_2 \ln MC_{it} + \beta_3 \ln BM_{it} + \beta_4 \ln MV_{it} + 1/2(\beta_{11} \ln MR_{it}^2 + \beta_{22} \ln MC_{it}^2 + \beta_{33} \ln BM_{it}^2 + \beta_{44} \ln MV_{it}^2) + \beta_{12} \ln MR_{it} * \ln MC_{it} + \beta_{13} \ln MR_{it} * \ln BM_{it} + \beta_{14} \ln MR_{it} * \ln MV_{it} + \beta_{23} \ln MC_{it} * \ln BM_{it} + \beta_{24} \ln MC_{it} * \ln MV_{it} + \beta_{34} \ln BM_{it} * \ln MV_{it} + V_{it} - U_{it}$$
(5)

where, the subscripts i and t represent the i-th company group and the t-th year of observation, respectively; $i=1,2,3,4$; $t=1,2,....,9$; Y_{it} represents the individual return of the i-th company group in the t-th period; MR_{it} represents the market return of the i-th company group in the t-th period; MC_{it} represents market capitalization of the i-th company group in the t-th period; BM_{it} represents book to market ratio of the i-th company group in the t-th period; MV_{it} represents market value of the i-th company group in the t-th period. "ln" refers to the natural logarithm; the β_i's are unknown parameters to be estimated; V_{it} follows $N(0, \sigma_v^2)$ and U_{it} follows a truncations at zero of the $N(\mu, \sigma_u^2)$ distribution.

Identifying sources of technical inefficiency and hypothesis tests

The company group specific inefficiency is considered as a function of some explanatory variables and the inefficiency effects model is defined as:

$$U_{it} = \delta_0 + \delta_1 T + \delta_2 MVL + W_{it}$$
(6)

where δ_0 is the intercept term and $\delta_j (j=1,2)$ is the parameter for the j-th explanatory variable, T =Year of observation, MVL=Market volume.

Data description and variables construction

Data set

The data collected from DSE market consist of 94 companies in Bangladesh for the period of 2000 to 2008. Out of 94 companies, the data represents both financial and non-financial company. In this study, 58 companies are from non-financial sector and 36 companies are from financial sector. The 94 companies are divided into 4 groups. 36 companies belong to Group-A (financial), 40 companies belong to Group-A (non-financial), 15 companies belong to Group-B and 3 companies belong to Group-Z.

Dependent variable

Individual return (Y): In this study, individual return of four groups are taken (that is, Group-A (financial), Group-A (non-financial), Group-B and Group-Z) as a dependent variables. DSE prepares individual company's daily closing price. Using the closing price of individual company, the return of individual company is calculated as follows:

Individual company's return = ln (P_t) −ln (P_{t-1})

where P_t = closing price at period t; P_{t-1}= closing price at period t-1 and ln = natural log. By using the value of individual company's return, the values of individual return of four groups are obtained.

In order to obtain the individual company's return, company's dividend, bonus and right issues are not adjusted since many researchers confirmed that their conclusions remained unchanged whether they adjusted their data for dividend, bonus and right issues or not (Lakonishok and Smidt, 1988; Fishe et al., 1993). The reasons to take logarithm returns are justified by both theoretically and empirically. Theoretically, logarithmic returns are analytically more tractable when linking returns over longer intervals. Empirically, logarithmic returns are more likely to be normally distributed which is a prior condition of standard statistical techniques (Strong, 1992).

Independent variables

Market return (X_1): DSE prepares daily price index from daily weighted-average price of daily transaction of each stock. The name of the index is "All Share Price Index". Market return is calculated as follows:

Market return = ln (P_t) −ln (P_{t-1}),

where, P_t = price index at period t; P_{t-1}= price index at period t-1 and ln = natural log.

Market capitalization (X_2): Market capitalization is the total value of a company's issued share capital as determined by its share price in the stock market. It is calculated as the number of ordinary shares in issue multiplied by the previous day's closing share price and is expressed in millions. The formula is as follows:

Market capitalization = (Previous day's closing share price × Shares in issue).

Book to market ratio (X_3): The book value of a company is total assets minus intangible assets and liabilities. Here, the company's net asset value per share is taken as a book value of that company. The market value is the share value in the current market price. After establishing the book value and the market value of a company by simply dividing the book value by the market value, the book to market ratio is as follows:

Book to market ratio = (Book value/Market value) is obtained.

Market value (X_4): The total money value of securities traded in a specific period is called the market value of that period. The market value is calculated by multiplying share price by the number of securities traded as follows:

Market Value = (Share price × number of securities traded).

By using the value of market return, market capitalization, book to market ratio and market value, the value of four groups for the mentioned independent variables is obtained.

Explanatory variables

Time (Z_1): Time is used in this study as influencing variable.

Market volume (Z_2): Market volume is used as the influencing variable and is defined as the total number of shares traded during a given period in the stock market.

RESULTS AND DISCUSSION

Selection of the Translog production function

The hypothesis of whether the Translog production function as an adequate representation of the data or not using Equation 4 is tested. The values of the log likelihood for the Cobb-Douglas and Translog production frontiers were found as 25.0456 and 33.1727, respectively. By employing Equation 4, we estimated the values of likelihood ratio (LR) statistic $\lambda = 16.2542$ TA. This value was compared with the critical value of Kodde and Palm (1986) table. Finally it concluded that the null hypothesis $H_0 : \beta_{ij} = 0$, was strongly rejected and it indicated that Translog production function was found more preferable than Cobb-Douglas production function.

Estimating the Translog stochastic frontier model

Here, ordinary least square estimates (OLS) and maximum likelihood estimates (MLE) of the parameters were reported in the context of company's group specific efficiency of DSE, followed by Translog stochastic frontier model. The ordinary least square estimates of parameters were obtained by grid search in the first step and then, these estimates were used to estimate the maximum likelihood estimates of the parameters of Translog stochastic frontier model.

The ordinary least squared estimates of parameters in the model were presented in the Table 1. The direct effects, interaction effects and the square terms or second order parameters of market return, market capitalization, book to market ratio and market value were found statistically insignificant in case of OLS estimation.

The MLE of parameters in the model were shown in Table 2. The results showed that the maximum-likelihood estimate of the parameter market return input was 3455.6860; market capitalization input was -17135.954; book to market ratio input was 7134.8013 and market

Table 1. OLS estimates of Translog stochastic frontier production model.

Variable	Parameter	Coefficient	S.E	t-value
Constant	β_0	0.2460@	0.2095	1.1740
Market Return	β_1	3455.6190@	9261.4529	0.3731
Market capitalization	β_2	-17135.9500@	21065.0750	-0.8134
Book to market ratio	β_3	7134.0695@	8045.9940	0.8866
Market value	β_4	5527.0687@	7881.4250	0.7012
Market return × Market return	β_{11}	-1738.5246@	4631.2091	-0.3753
Market capitalization × Market capitalization	β_{22}	8567.8511@	10532.5590	0.8134
Book to market ratio × Book to market ratio	β_{33}	-3567.2127@	4022.9059	-0.8867
Market value × Market value	β_{44}	-2763.4046@	3940.7051	-0.7012
Market return × Market capitalization	β_{12}	2.2752@	1.7266	1.3177
Market return × Book to market ratio	β_{13}	-0.1527@	0.3393	-0.4500
Market return × Market value	β_{14}	-1.9177@	1.2761	-1.5028
Market capitalization × Book to market ratio	β_{23}	0.1243@	0.2518	0.4938
Market capitalization × Market value	β_{24}	0.0022@	0.0043	0.5179
Book to market ratio × Market value	β_{34}	-0.1462@	0.2131	-0.6860
Sigma-squared	σ^2	0.0201		
Log likelihood function		27.8908		

*,**,* * * Significance level at 1, 5 and 10%, consecutively. @Means insignificant, S.E = Standard Error.

Table 2. Maximum-likelihood estimates of Translog stochastic frontier production model.

Variable	Parameter	Coefficient	S.E	t-value
Constant	β_0	0.4608*	0.1291	3.5688
Market return	β_1	3455.6860*	0.9936	3477.9015
Market capitalization	β_2	-17135.954*	0 0.8944	-19157.0950
Book to market ratio	β_3	7134.8013*	1.0845	6578.5468
Market value	β_4	5527.0824*	0.8945	6178.2961
Market return × Market return	β_{11}	-1738.3913*	0.9742	-1784.3871
Market capitalization × Market capitalization	β_{22}	8567.8426*	0.4477	19134.7820
Book to market ratio × Book to market ratio	β_{33}	-3565.7486*	1.3062	-2729.7493
Market value × Market value	β_{44}	-2763.3774*	0.4485	-6160.4955
Market return × Market capitalization	β_{12}	2.2988*	0.2619	8.7770
Market return × Book to market ratio	β_{13}	-0.3433@	0.3167	-1.0840
Market return × Market value	β_{14}	-1.9669*	0.2844	-6.9141
Market capitalization × Book to market ratio	β_{23}	-0.2560@	0.2476	-1.0339
Market capitalization × Market value	β_{24}	0.0005@	0.0019	0.3015
Book to market ratio × Market value	β_{34}	0.1697@	0.1873	0.9059

*,**,* * * Significance level at 1, 5 and 10%, consecutively. @Means insignificant, S.E = Standard Error.

value input was 5527.0824, respectively. The maximum-likelihood estimates of the coefficients of market return, market capitalization, book to market ratio and market value were found to be significant at 1% level of signi-ficance. Also, the square effects of the input variables-market return, market capitalization, book to market ratio and market value were statistically significant at 1% level of significance. The aforementioned findings are

supportive to Rahman et al. (2006) findings. He commented in his study that beta is not only the factor to determine the stock return, but the other variables (market return, market capitalization and book to market ratio) are also significantly important. The interaction effects of the input variables except interaction between market return and market capitalization and interaction between market return and market value are statistically

Table 3. Maximum-likelihood estimates of the parameter of inefficiency effects model.

Variable	Parameter	Coefficient	S.E	t-value
Constant	δ_0	0.7584$^@$	0.4915	1.5429
Time	δ_1	-0.0289***	0.0253	-1.7388
Market volume	δ_2	-0.0373$^@$	0.0269	-1.3851
Sigma-squared	σ^2	0.0248*	0.0058	4.2351
Gamma	γ	0.9937*	0.0188	52.6277
Log likelihood function	-	33.1727	-	-

*, **, *** Significance level at 1, 5 and 10%, consecutively. $^@$Means insignificant, S.E = Standard Error.

insignificant. The value of log likelihood function for OLS and MLE allowed to test whether technical inefficiency exists or not. In case technical inefficiency does not exist, then technically there are no difference in the parameters of OLS and MLE.

Estimating the inefficiency effects model

The estimates of the parameters of the inefficiency effects model were reported in Table 3. Here, a positive coefficient value increased the level of inefficiency and vice-versa. Hence, from the result, it was reported that time and market volume were found decreasing the level of inefficiency. These indicated that the variables time and market volume are inversely related with inefficiency. The negative coefficient of time indicated that the technical efficiency level tended to increase by 2.89% per year over the time period.

The value of γ was estimated at 0.9937 which was positive and significant at 1% level of significance. It can be interpreted as follows: 99% of random variation around stock market returns is due to inefficiency and 1% is due to stochastic random error. This could be interpreted that 99% variation in output among the companies are due to the differences in technical efficiency. It was evident from Table 3 that the estimate of σ is 0.0248 and was significantly different from zero, which indicates a good fit.

Year-wise mean efficiency of four groups of companies in DSE market

The year wise mean efficiency of four groups of 94 companies (Group-A-financial = 36, Group-A-non-financial = 40, Group-B = 15 and Group-Z = 3) in DSE market was displayed in Table 4 and Figure 1. From this investigation the highest mean efficiency was observed in 2008 and the inefficiency score was 95.44% and the lowest mean efficiency was in 2004 and the inefficiency score was 84.09%. In 2008, the mean efficiency increased by 12.64% from 2000. Time had an important

Table 4. Year wise mean efficiency of four groups of companies in DSE.

Year	Mean
2000	0.8473
2001	0.8483
2002	0.8451
2003	0.8539
2004	0.8409
2005	0.8569
2006	0.8763
2007	0.9318
2008	0.9544
Mean	0.8727

effect in decreasing inefficiency. It was also revealed from Table 4 that the mean technical efficiency of the companies of DSE market during the period 2000 to 2008 which was found to be 0.8782%. This implied that 87% of potential output was being realized by the companies of DSE market. From Figure 1, the overall situation of companies was to be clearly understood.

Group-wise mean efficiency of companies

The group wise mean efficiency was displayed in both Table 5 and Figure 2. It was observed that in case of higher efficiency, the Group-A (financial) companies were most efficient (92.08%) and the Group-A (non-financial) companies were second most efficient (89.06%). These findings were in line with the argument that the companies included in Group-A were superior as they were regular in holding the annual general meetings and had declared dividend at the rate of 10% or more in a calendar year. The Group-B (85.86%) and the Group-Z(82.10%) companies were relatively less efficient than Group-A companies, because the companies included in Group-B were regular in holding the annual general meetings but failed to declare dividend at least at the rate of 10% in a calendar year, and the companies included in
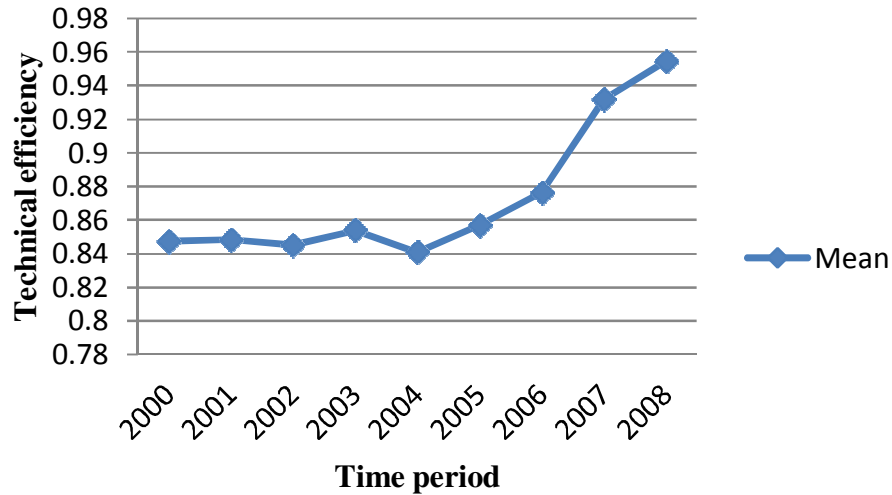
Figure 1. Year-wise mean efficiency of four groups of companies in DSE market, 2000 to 2008.

Table 5. Group wise mean efficiency of companies in DSE.

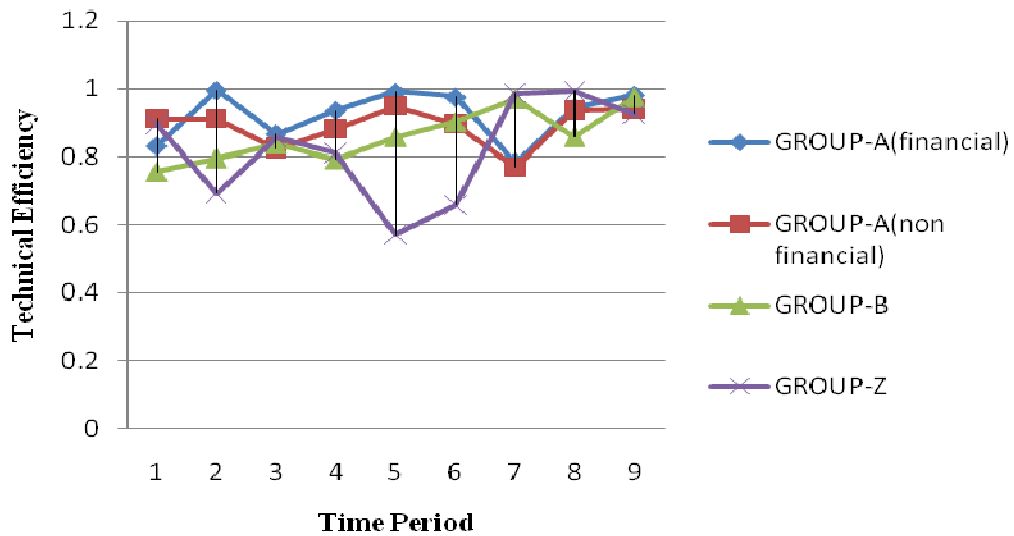| Year	GROUP-A (financial)	GROUP-A (non-financial)	GROUP-B	GROUP-Z
2000	0.8286	0.9118	0.7555	0.8932
2001	0.9942	0.9103	0.7950	0.6937
2002	0.8640	0.8244	0.8354	0.8566
2003	0.9343	0.8796	0.7916	0.8101
2004	0.9889	0.9483	0.8555	0.5708
2005	0.9742	0.8953	0.8989	0.6590
2006	0.7808	0.7699	0.9678	0.9866
2007	0.9421	0.9358	0.8556	0.9935
2008	0.9801	0.9399	0.9724	0.9252
Mean	0.9208	0.8906	0.8586	0.8210

Figure 2. Group-wise mean efficiency of four groups of companies in DSE market, 2000 to 2008.

Table 6. Likelihood-ratio test of hypothesis of the stochastic frontier Translog model.

Null hypothesis	Log-likelihood function	Test statistic λ	Critical value*	Decision
$H_0 : \beta_{ij} = 0$	25.0456	16.2542	8.761	Reject H_0
$H_0 : \gamma = 0$	27.8908	10.5638	8.761	Reject H_0
$H_0 : \eta = 0$	21.4094	5.2846	5.138	Reject H_0

All critical values are at 5% level of significance. *The critical value are obtained from table of Kodde and Palm (1986) work.

Group-Z failed to hold the annual general meetings or failed to declare any dividend. But during the period 2000 to 2008, the efficiency of Group-A (financial) companies (82.86%) was lower than Group-A (non-financial) companies (91.18%) and Group-Z companies (89.32%) in the year 2000 and the efficiency of Group-A (financial) companies (78.08%) was lower than Group-B (96.78%) and Group-Z (98.66%) companies in the year 2006 and the efficiency of Group-A (financial) companies (94.21%) was lower than Group-Z (99.35%) companies in the year 2007. The companies included in Group-A (financial) showed higher efficiency than the other two groups for rest of the years in the study period.

Results of hypothesis tests

The results of the various hypothesis tests for the model were presented in Table 6. All hypothesis tests were obtained using the generalized likelihood-ratio statistic (Equation 4).

From Table 6, the second null hypothesis is $H_0 : \gamma = 0$, which specified that there is no technical inefficiency effect in the model. The hypothesis was rejected, so we could conclude that there was a technical inefficiency effect in the model.

The third null hypothesis is $H_0: \eta = 0$, which specified that the technical inefficiency effect did not vary significantly over time. The null hypothesis was rejected indicating that the technical inefficiency effect varied significantly.

Conclusion

This study focused on the estimation of the technical efficiency of the groups of companies of DSE market in Bangladesh, applying the stochastic frontier approach to identify the factors causing inefficiency over the reference period 2000 to 2008. This study was set out to compare efficiency estimates for Group-A (financial), Group-A (non-financial), Group-B and Group-Z companies in DSE market of Bangladesh using stochastic frontier analysis.

The most efficient group was observed as Group-A (financial) and the most inefficient group was Group-Z. The technical efficiency rate was found gradually increasing over time in the stock market in Bangladesh. The mean technical efficiency of DSE market during the period 2000 to 2008 given by the Translog model was 0.8727. This implied that 87% of the potential yield was being realized by the companies in the market and also, indicated that there was a scope to further increase the output by 13% without increasing the levels of inputs.

Some of the results of this study is of great interest to academics, policy makers and local and foreign listed and unlisted companies and have important practical implications to different capital market participants, such as investors, managers and regulatory authorities. The researchers could use this study as a benchmark for future research and they would get proper guideline from this study. Future research could be recommended by including the companies of other two groups (Group-G and Group-N) of DSE market and evaluate the stock market technical efficiency with a comparison of all groups of companies listed in DSE market.

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