African Journal of Business Management Vol. 5(22), pp. 8891-8901, 30 September, 2011
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM11.313
ISSN 1993-8233 ©2011 Academic Journals

Full Length Research Paper

Measuring Dhaka stock exchange market efficiency: A stochastic frontier analysis

Md. Zobaer Hasan[1], Anton Abdulbasah Kamil[1] and Azizul Baten[2]*

[1]School of Distance Education, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia.
[2]Department of Statistics, School of Physical Sciences, Shahjalal University of Science and Technology Sylhet-3114, Bangladesh.

Accepted 26 May, 2011

This study measures the status of technical efficiency of companies in Dhaka stock exchange (DSE) for panel data using the stochastic frontier production function, incorporating technical inefficiency effect model. For this study, we used the data collected from DSE market consisting 94 companies in Bangladesh for the period of 2000 to 2008. It was observed that the inefficiency increased over the reference period and translog production function was more preferable than Cobb-Douglas production function. This study showed that the estimated year-wise average efficiency of companies in DSE market was 0.8782 while group-wise average efficiency was 0.8571. At the company group level, Group-A companies was most efficient than the other two groups. The most efficient company was ICB and the most inefficient company was Bextex limited.

Key words: Stochastic frontier model, translog production, stock market efficiency, Dhaka stock exchange, panel data.

INTRODUCTION

Recently, Dhaka stock exchange has taken significant steps towards the development of its capital market. It is the main stock exchange of Bangladesh so we concentrated on the DSE, which is the country's oldest stock exchange, and according to Standard and Poor's Emerging Stock Markets Factbook (2000), the DSE is one of the frontier emerging markets of South Asia. By improving the technical efficiency of DSE market, it can play the desired role in the process of economic development of the country. In DSE, several studies have been conducted for market efficiency. Alam et al. (1999) studied the market efficiency of the DSE. Mobarek et al. (2000) sought evidence supporting existence of at least weak-form efficiency of DSE. Chowdhury et al. (2001) investigated the mean daily returns of DSE around the turn of the week, turn of the month, turn of the year, and around the holidays. A study by Ahmed (2002) revealed that the behavior of stock prices could not be described as obeying the random walk theory rather they follow some dependencies. Hassan and Maroney (2004) examined the issue of nonlinearity and thin trading as a test for market efficiency in the context of Bangladesh.

Stock market economy is currently progressing rapidly due to the economical boost on South Asian region (Mursalin et al., 2006). Uddin and Alam (2007) examined the linear relationship between share price and interest rate, share price and growth of interest rate, growth of share price and interest rate, and growth of share price and growth of interest rate were determined through ordinary least square (OLS) regression.

Uddin and Yasmin (2008) sought evidence supporting the existence of market efficiency in the DSE market. Researchers investigated technical efficiency of financial institutions used either methods, parametric Stochastic frontier approach (SFA) or non-parametric Data envelopment analysis (DEA) in abroad (Berger and Humphrey, 1997).

There have been a number of studies, which have compared parametric and non-parametric techniques to examine efficiency of financial institutions, for example, for banking industry (Ferrier and Lovell, 1990; Pastor et al., 1997; Resti, 1997; Bauer et al., 1998; Berger et al., 2000; Altunbas et al., 2001; Maudos et al., 2002; Weill,

*Corresponding author. E-mail: baten_math@yahoo.com

2004); for the insurance industry (Fecher et al., 1993; Cummins and Zi, 1998). There seems to be no literature on the topics of measuring stock market efficiency of the 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. In this study we considered the Stochastic frontier approach to measure the technical efficiencies of selected companies in DSE market instead of DEA approach; because of the advantage of SFA which allows a firm to be off the frontier because of random noise and for the main disadvantage of DEA which does not impose any assumptions about production functional form and does not take into account random error, hence the efficiency estimates may be bias if the production process is largely characterized by stochastic elements (Kasman and Turgutlu, 2007).

The stochastic frontier production function was independently proposed in Aigner et al. (1977) and Meeusen and van den Broeck (1977), there has been considerable research to extend and apply the model. Reviews of much of this research are provided in Forsund et al. (1980), Schmidt (1986), Bauer (1990), Battese (1992), and Krikley et al. (1995). In this paper, we used the stochastic frontier production function model specified by Battese and Coelli (1995) for the panel data. The objective of this study is to apply the stochastic frontier production function to investigate the technical efficiencies of companies listed in the Dhaka stock exchange market of Bangladesh. The main focus of our study is to measure the company's technical efficiency in accordance with three groups: Groups A, B and Z and to identify the factors causing technical inefficiency of the stock market.

DHAKA STOCK EXCHANGE (DSE): A BRIEF DESCRIPTION

The Dhaka stock exchange (DSE) was first incorporated as the East Pakistan stock exchange association limited on April 28, 1954. It was renamed as Dhaka stock exchange limited on June 23, 1962.

After the liberation of the country, until 1976, the trading activities of the stock exchange remained closed due to the liberation war and the economic policy pursued by the government. The Securities and Exchange Commission (SEC) which is the regulator of the capital market of Bangladesh was established on 8 June, 1993 under the Securities and Exchange Commission Act, 1993. On August 10, 1998, DSE introduced screen-based state-of-the-art automated online real-time trading through Local area network (LAN) and Wide area network (WAN) on January 24, 2004. Later, the DSE upgraded its automated trading system on August 21, 2005 (Report on Dhaka Stock Exchange" School of Business, University of Information Technology and Sciences, Dhaka, Bangladesh).

There are four markets in the system: (1) public market: Only for market lot share; (2) spot market: Only for spot transactions which must be settled within 24 h; (3) block market: Only for bulk quantities of shares; (4) odd lot market: Only for odd lot scripts. In the public and spot market, securities are traded through automatic matching and block market and odd lot market is traded through pick and fill basis. All transactions are done by the software called TESA. There are three indices in the DSE as follows: (1) DSI index (comprises all listed securities of the exchange), (2) DSE general index (comprises all companies excluding the Z-category companies) and (3) DSE20 index (comprises leading 20 shares with a base index of 1000).

DSE classified the shares in four groups, such as A, B, Z, and N. Group A companies do regular annual general meeting (AGM) and provide dividend minimum which is 10% of EPS. On the other hand, group B companies do regular AGM but provide dividend less than 10% of EPS. Z group companies are irregular in terms of dividend paying and AGM and N (new) groups companies are newly listed companies placed in this category and their settlement system is like B-category companies. The number of listed securities including debentures and bonds in the DSE market is 444 as of 10 December, 2010. In 444 listed securities, there are 217-A category, 11-B category, 7- N category, 15-Z category companies and 8-Debentures, 186-Bonds in the stock exchange market (DSE website: www.dsebd.org; and SEC website: www.secbd.org).

MATERIALS AND METHODS

Stochastic frontier model

Technical efficiency measurement by frontier method is based on the assumption that a gap normally exists between a firm's actual and potential levels of technical performance. Thus, the technical efficiency is measured as the ratio between actual output and the potential output. In stochastic frontier analysis, the assumption is that the production function of the fully efficient firm is known. Lovell et al. (1993) have shown that econometric approaches like the stochastic frontier analysis can distinguish the effects of noise from the effects of inefficiency.

Since one of the objectives of this research is to examine the production efficiency (scores) of listed companies in DSE market, the stochastic frontier analysis was selected as the tool to measure efficiency in this study. So, we considered the stochastic frontier model introduced by Battese and Coelli (1995) for panel data which can be written as:

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

Where, Y_{it} denotes the logarithm of output for the i-th company 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, 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.

The Technical inefficiency effect U_{it} in the stochastic frontier model is specified as follows:

$$U_{it} = Z_{it}\delta + W_{it} \quad \text{..... .(2),}$$

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 using maximum likelihood estimation. After obtaining the estimates of U_{it} the efficiency of i-th company at t-th time period is given by:

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

Data sources and variables construction

Data set

The data collected from Dhaka stock exchange (DSE) market consists of 94 companies in Bangladesh for the period of 2000 to 2008. In DSE market, 22 types of category of company exist and this study covered 14 types of category of company as: Banks, Financial Institutions, Mutual Funds, Engineering, Food and Allied Products, Fuel and Power, Textile, Pharmaceuticals and Chemicals, Service and Real Estate, Cement, Tannery Industries, Ceramic Industry, Insurance and Miscellaneous. 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 data also covered 3 out of 4 groups in DSE market. There are 76 companies belonging to Group-A, 15 companies to Group-B and 3 companies to Group-Z. In short, we can say that, the data represents the overall market.

Dependent variable

i. Individual return (Y): In this study, we took individual company's return as a dependent variable. DSE prepares individual company's daily closing price. Using the closing price of individual company, we calculate the return of individual company 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.

In order to obtain the individual company's return, we do not adjust company's dividend, bonus and right issues 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 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

i. 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.

ii. 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 given thus:

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

iii. Book to market ratio (X_3): The book value of a company is total assets minus intangible assets and liabilities. Here we took the company's net asset value per share 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, simply dividing the book value by the market value, we got the book to market ratio as:

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

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

Market value = (Share price * number of securities traded).

Explanatory variables

i. Time (Z_1): Time is used in this study as influencing variable. A, B and Z are company group specific dummies for Group-A, Group-B and Group-Z respectively. The dummy variables can take either 1 or 0, depending on data availability or not respectively.

Specification of the stochastic frontier translog model and technical inefficiency effects model

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:

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

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 values of the log likelihood for the Cobb-Douglas and Translog production frontiers are -132.9089 and -74.7714, respectively. By employing Equation (4), we estimated the values of Likelihood ratio (LR) statistic $\lambda = 116.2750 (Table 7)$. 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. Thus we can write the model as:

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

where, the subscripts i and t represent the i-th company and the t-th year of observation, respectively; *i*=1,2,…,94; *t*=1,2,….,9; Y_{it} represents the individual return of the i-th company in the t-th period; MR_{it} represents the market return of the i-th company in the t-th period; MC_{it} represents market capitalization of the i-th company in the t-th period; BM_{it} represents book to market ratio of the i-th company in the t-th period; MV_{it} represents market value of the i-th company 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.

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

$$U_{it} = \delta_0 + \delta_1 T + \delta_2 A + \delta_3 B + \delta_4 Z + W_{it} \quad \ldots\ldots\ldots\ldots\ldots (6)$$

where δ_0 is the intercept term and $\delta_j (j = 1,2,3,4)$ is the parameter for the j-th explanatory variable, T =Year of observation, A is the dummy variable for Group-A companies; A=1 if an observation involves the Group-A, zero otherwise; B is the dummy variable for Group-B companies: B =1 if an observation involves the Group-B, zero otherwise; Z is the dummy variable for Group-Z companies: Z =1 if an observation involves the Group-Z, zero otherwise.

Tests of hypothesis

The hypothesis tests are obtained using the generalized likelihood-ratio test statistic (4). This test statistic is assumed to be asymptotically distributed as mixture of chi-square distribution with degree of freedom equal to the number of restrictions involved. The restrictions imposed by the null hypothesis are rejected when λ exceeds the critical value (Taymaz and Saatci, 1997). These are obtained by using the values of the log–likelihood functions for the companies and the stochastic frontier production function.

$H_0 : \gamma = 0,$ the null hypothesis specifies that the technical inefficiency effects in companies 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 developed by Coelli (1996). If the null hypothesis is accepted, this would indicate that $\sigma_u^{\ 2}$ 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). Further, $H_0 : \eta = 0,$ 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.

RESULTS AND DISCUSSION

Here, maximum likelihood estimates (MLE) of the parameters were reported in the context of company specific efficiency of Dhaka stock exchange followed by translog stochastic frontier model. The MLE of parameters in the model are shown in Table 1. The results showed that the maximum-likelihood estimates of the coefficients of market return, market capitalization, book to market ratio and market value were found significant at 1% level of significance. The square effects and interaction effects of the input variables-market return, market capitalization, book to market ratio and market value were also statistically significant at different level of significance. The estimates of the parameters of the inefficiency effects model were reported in the Table 2. In the inefficiency effects model, a positive coefficient value increased the level of inefficiency and vice-versa. Hence from the result, it was reported that Groups -A and -B companies were found decreasing the level of inefficiency. These indicated that the Groups -A and -B companies were inversely related with inefficiency. There

Table 1. Maximum-likelihood estimates of translog stochastic frontier production model.

Variable	Parameters	Coefficients	S.E	t-value
Constant	β_0	-36.3802**	15.1829	-2.3961
Market return	β_1	3285.9946*	1.9843	1655.9823
Market capitalization	β_2	-15086.0080*	0.9008	-16745.6390
Book to market ratio	β_3	-3092.0590*	0.9003	-3434.3754
Market value	β_4	9973.9074*	0.9044	11028.0030
Market return * Market return	β_{11}	-1675.2537*	3.6459	-459.4883
Market capitalization*Market capitalization	β_{22}	7543.3792*	0.4905	15376.3640
Book to market ratio * Book to market ratio	β_{33}	1546.3670*	0.4914	3146.2640
Market value * Market value	β_{44}	-4985.5428*	0.5962	-8361.7013
Market return * Market capitalization	β_{12}	6.1555*	0.7802	7.8890
Market return * Book to market ratio	β_{13}	-0.1939*	0.0703	-2.7561
Market return * Market value	β_{14}	-4.8864*	0.5884	-8.3039
Market capitalization * Book to market ratio	β_{23}	-0.1287*	0.0491	-2.6195
Market capitalization * Market value	β_{24}	-0.0745**	0.0314	-2.3710
Book to market ratio * Market value	β_{34}	0.1344*	0.0448	3.0019

*, **, *** Significance level at 1, 5 and 10% consecutively; @ means insignificant, S.E = Standard error.

Table 2. Maximum likelihood estimates of the parameters of inefficiency effects model.

Variable	Parameters	Coefficients	S.E	t-value
Constant	δ_0	-3.6234*	0.9906	-3.6575
Time	δ_1	0.5058*	0.0977	5.1735
Group-A Dummy	δ_2	-1.5847*	0.6037	-2.6246
Group-B Dummy	δ_3	-1.2596**	0.5856	-2.1509
Group-Z Dummy	δ_4	-0.7790@	0.5701	-1.3663
Sigma-squared	σ^2	0.3784*	0.0706	5.3578
Gamma	γ	0.8643*	0.0296	29.1480
Loglikelihood function		-74.7714		

*, **, *** Significance level at 1, 5 and 10% consecutively; @ means insignificant, S.E = Standard error.

was no significant effect of Group-Z companies though it was negative. Other explanatory variable in the inefficiency model was “Time”. The positive coefficient of time indicated that the technical efficiency level tended to decrease by 50.58% per year over the time period 2000 to 2008. The value of γ was estimated at 0.8643 which was positive and significant at 1% level of significance. It could be interpreted as follows: 86% of random variation around in stock market returns due to inefficiency and 14% due to stochastic random error. This could be interpreted that 86% variations in output among the companies were due to the differences in technical efficiency. It is evident from Table 2 that, the estimate of σ was 0.3784 which was significantly different from zero, indicated a good fit. The year wise mean efficiency of 94 companies in DSE market is displayed in Table 3. From this investigation, we observed that the highest mean efficiency was in 2000 and the score was 93.60% and the lowest mean efficiency was in 2008 and the score was 75.68%. In 2008, the mean efficiency decreased by 19.15 from 2000. Time was observed as an important affect in increasing inefficiency. It was also revealed from Table 3 that the mean technical efficiency of the companies of DSE market during the period 2000 to 2008 was found to be 0.8782. This implied that 87% of potential output was being realized by the companies of DSE market. The group wise mean efficiency of 94 companies in DSE market is displayed in Table 4. It was observed that in case of higher efficiency, the Group-A companies were most efficient (88.29%). These findings are in line with

Table 3. Year wise mean efficiency of companies in Dhaka stock exchange.

Year	Mean
2000	0.9360
2001	0.9275
2002	0.9167
2003	0.9140
2004	0.8942
2005	0.8836
2006	0.8588
2007	0.8162
2008	0.7568
Mean	0.8782

Table 4. Group wise mean efficiency of companies in Dhaka stock exchange.

Year	Group-A	Group-B	Group-Z
2000	0.9396	0.9223	0.9117
2001	0.9326	0.9212	0.8283
2002	0.9163	0.9239	0.8894
2003	0.9176	0.9064	0.8594
2004	0.9063	0.8661	0.7282
2005	0.8894	0.8767	0.7706
2006	0.8537	0.8808	0.8771
2007	0.8261	0.7709	0.7903
2008	0.7647	0.7174	0.7536
Mean	0.8829	0.8651	0.8232

the argument that the companies included in Group-A were found to be superior as they were regular in holding the annual general meetings and declared dividend at the rate of 10% or more in a calendar year.

The Group-B (86.51%) and the Group-Z (82.32%) companies were relatively less efficient than Group-A companies because the companies included in Group-B were regular in holding the annual general meetings (AGM) but failed to declare dividend at least at the rate of 10% in a calendar year and the companies included in Group-Z were also 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 companies (91.63%) was lower than Group-B companies (92.39%) in the year 2002 and also the efficiency of Group-A companies (85.37%) was lower than Group-B (88.08%) and Group-Z (87.71%) companies in the year 2006.The rest of the years in the study period the companies included in Group-A showed higher efficiency than the other two groups. Company's year-wise technical efficiency in DSE market showed a more clear perception about the performance of an individual company was displayed in Table 5. There was a variation in the technical efficiencies among the different companies in DSE market: it ranged from a low of 0.7650 for company Bextex Limited, to a high of 0.9219 for company ICB.

The actual range in this case was found to be 0.1569. The most efficient companies during the study period were found to be ICB (with 92.19%), Apex Adelchy Footwear (92.01%), ACI Limited (91.67 %), 7th ICB M.F. (91.28 %), and 1st BSRS (91.14%). On the contrary, the most inefficient companies during the data period were Bextex Limited (76.05%), Al-Arafah Islami Bank (78.90%), Aramit Cement (81.39%), Anwar Galvanizing (82.70%) and BD.Autocars (with 82.87%). From the investigation, it was observed that the top five companies are Group-A companies and among the bottom five companies there were three Group-Z companies.

Hypothesis testing

The results of various hypothesis tests for the model are presented in Table 6. The all hypothesis tests were obtained using the generalized likelihood-ratio statistic (4). The second null hypothesis is $H_0 : \gamma = 0$, which Specified that there was no technical inefficiency effect in

Table 5. Company's year-wise efficiency in Dhaka stock exchange market.

Firm's name	2000	2001	2002	2003	2004	2005	2006	2007	2008	Mean efficiency
AB Bank	0.9464	0.9605	0.9422	0.8922	0.8970	0.9218	0.9506	0.9425	0.6059	0.8955
City Bank	0.9396	0.9573	0.9476	0.9008	0.9488	0.9028	0.8719	0.7557	0.4763	0.8557
IFIC Bank	0.9491	0.9649	0.8989	0.9207	0.9062	0.9349	0.9487	0.9285	0.5121	0.8849
Islami Bank	0.9476	0.9317	0.9403	0.9106	0.9013	0.9211	0.8823	0.7093	0.6473	0.8657
NBL	0.9662	0.9607	0.9288	0.9041	0.9196	0.9474	0.9300	0.8334	0.5759	0.8851
Uttara Bank	0.9479	0.9724	0.9519	0.9374	0.9517	0.9442	0.8876	0.8354	0.6125	0.8934
Eastern Bank	0.9510	0.9604	0.9423	0.9240	0.9137	0.9391	0.8973	0.7318	0.5260	0.8651
Al-Arafah IB	0.9431	0.9376	0.9248	0.9288	0.9221	0.9161	0.8800	0.4787	0.1697	0.7890
ICB	0.9137	0.9145	0.9431	0.8919	0.9181	0.9265	0.8848	0.9607	0.9441	0.9219
IDLC	0.9433	0.9260	0.9390	0.9176	0.9130	0.9047	0.8776	0.7966	0.8482	0.8962
United Leas.	0.9391	0.9234	0.9400	0.9345	0.9151	0.8605	0.7321	0.6908	0.6856	0.8468
Uttara Finan.	0.9454	0.9424	0.9451	0.9348	0.9217	0.9204	0.7893	0.7866	0.6559	0.8713
1stICB M.F.	0.9448	0.9384	0.9206	0.9176	0.8848	0.8982	0.9069	0.8607	0.7688	0.8934
2nd ICB M.F	0.9260	0.9331	0.9267	0.9229	0.8947	0.9174	0.9006	0.8827	0.8435	0.9053
3rd ICB M.F.	0.9370	0.9372	0.9298	0.9207	0.8831	0.8900	0.8555	0.8569	0.8038	0.8905
4th ICB M.F.	0.9450	0.9322	0.9230	0.9125	0.8870	0.9056	0.8913	0.8685	0.8215	0.8985
5th ICB M.F.	0.9398	0.9307	0.9247	0.9173	0.8886	0.8990	0.8823	0.9147	0.8957	0.9103
6th ICB M.F.	0.9334	0.9351	0.9272	0.9110	0.8839	0.8998	0.8886	0.9013	0.8384	0.9021
7th ICB M.F.	0.9434	0.9355	0.9234	0.9097	0.8949	0.9127	0.8799	0.9146	0.9008	0.9128
8th ICB M.F.	0.9412	0.9377	0.9289	0.9112	0.8944	0.9094	0.8864	0.8977	0.8474	0.9060
1st BSRS	0.9359	0.9465	0.9416	0.9055	0.8818	0.8990	0.8807	0.9649	0.8466	0.9114
Aftab Aoto.	0.9492	0.9283	0.9388	0.9319	0.9351	0.8747	0.7958	0.8002	0.6134	0.8631
Olympic Ind.	0.9321	0.9353	0.9116	0.9353	0.9201	0.8867	0.8426	0.8900	0.7830	0.8930
BD. Lamps	0.9392	0.8999	0.9100	0.9216	0.8946	0.9117	0.8671	0.8087	0.7242	0.8752
Eastern Cable	0.9415	0.9403	0.9466	0.9200	0.8812	0.8811	0.9121	0.9348	0.6213	0.8866
Monno Jutex	0.8901	0.9070	0.9217	0.8873	0.9256	0.8941	0.8942	0.6897	0.7085	0.8576
Monno Stafl.	0.9359	0.9293	0.9278	0.8939	0.8814	0.8894	0.9073	0.6993	0.6383	0.8558
Singer BD.	0.9401	0.9215	0.9259	0.9087	0.7642	0.7977	0.7957	0.8816	0.7087	0.8493
Atlas BD.	0.9375	0.9239	0.9433	0.9297	0.9038	0.8914	0.7999	0.8640	0.5648	0.8620
BD.Autocars	0.8517	0.6319	0.9450	0.9422	0.7754	0.7811	0.9144	0.7951	0.8212	0.8287
Quasem Dry.	0.9301	0.9393	0.9247	0.8946	0.8955	0.8937	0.8526	0.8502	0.8904	0.8968
National Tub.	0.9444	0.9203	0.9205	0.9155	0.9590	0.9003	0.7227	0.8560	0.7040	0.8714
Bd.Thai Alum.	0.9439	0.8624	0.9233	0.9035	0.8475	0.8512	0.7371	0.7297	0.9372	0.8595
Anwar Gal.	0.9227	0.9183	0.9167	0.8772	0.8022	0.7885	0.8155	0.7371	0.6651	0.8270
Kay and Que	0.8976	0.9411	0.9447	0.9155	0.8228	0.8085	0.8095	0.7088	0.9051	0.8615
National Poly.	0.9483	0.9314	0.9165	0.9053	0.9068	0.9256	0.9469	0.7986	0.8910	0.9078
Apex Foods	0.9383	0.9207	0.9089	0.9327	0.9302	0.9013	0.8714	0.9036	0.7120	0.8910
Bangas	0.9437	0.9402	0.9335	0.9197	0.8808	0.8948	0.8605	0.8026	0.7599	0.8818
BATBC	0.9308	0.9251	0.9096	0.9238	0.8907	0.8264	0.8197	0.8246	0.7962	0.8719
National Tea	0.9393	0.9204	0.9167	0.9075	0.8483	0.8956	0.8211	0.7850	0.8110	0.8716
AMCL (Pran)	0.9519	0.9192	0.9319	0.9190	0.9030	0.8792	0.8742	0.8322	0.8233	0.8926
Rahima Food	0.9220	0.9001	0.9271	0.8906	0.7493	0.8359	0.9550	0.7958	0.6239	0.8444
BOC	0.9430	0.9176	0.9295	0.9309	0.8876	0.8481	0.8819	0.8820	0.7262	0.8830
Padma Oil Co.	0.9259	0.9379	0.9381	0.9489	0.8476	0.9212	0.9378	0.8564	0.7651	0.8977
Saiham Textile	0.9245	0.9159	0.9139	0.9147	0.8976	0.9008	0.8848	0.8455	0.7132	0.8790
Desh Garman.	0.9360	0.8925	0.9357	0.9162	0.8113	0.9018	0.9003	0.7715	0.5094	0.8416
Bextex Ltd.	0.9440	0.8760	0.2759	0.8858	0.9391	0.9268	0.8439	0.6477	0.5048	0.7605
Apex Spinning	0.9399	0.9447	0.9340	0.9281	0.9284	0.9034	0.8707	0.8154	0.8023	0.8963
Delta Spinners	0.9023	0.9372	0.9284	0.9255	0.9385	0.8932	0.9012	0.8202	0.7438	0.8878
Sonargaon Te.	0.9228	0.9279	0.9327	0.9194	0.8684	0.8981	0.8909	0.7094	0.8285	0.8776
Prime Textile	0.9422	0.9527	0.9112	0.8778	0.9151	0.8917	0.8928	0.8573	0.7386	0.8866

Table 5. Contd.

H.R.Textile	0.9381	0.9299	0.8909	0.9032	0.9032	0.8858	0.8994	0.7899	0.7348	0.8750
Ambee Phar.	0.9467	0.9377	0.9166	0.9133	0.8893	0.8967	0.8672	0.7649	0.8795	0.8902
Beximco Phar.	0.9491	0.9359	0.9106	0.8956	0.9354	0.9300	0.8279	0.7733	0.8107	0.8854
Glaxo SmithK.	0.9334	0.9116	0.9359	0.9110	0.9115	0.9003	0.8602	0.7621	0.7755	0.8779
ACI Limited	0.9562	0.9420	0.9280	0.9184	0.9049	0.8951	0.8871	0.8958	0.9229	0.9167
Renata Ltd	0.9374	0.9418	0.9420	0.9393	0.9538	0.9239	0.8886	0.8663	0.7920	0.9094
Reckitt Benc.	0.9259	0.9336	0.9380	0.8888	0.8899	0.8963	0.9365	0.8613	0.7766	0.8941
The Ibn Sina	0.9473	0.9386	0.9414	0.9328	0.9199	0.8921	0.8534	0.7742	0.7718	0.8857
Beximco Syn.	0.9355	0.9319	0.8965	0.8727	0.9248	0.8803	0.8747	0.8347	0.6752	0.8696
Libra Infus.	0.9203	0.9180	0.9415	0.9236	0.9300	0.9076	0.8700	0.7984	0.8238	0.8926
Square Pharma	0.9580	0.9464	0.9212	0.9130	0.9431	0.8827	0.8387	0.8455	0.5968	0.8717
Imam Button	0.9258	0.9300	0.9125	0.8950	0.8617	0.8094	0.8838	0.8241	0.8223	0.8738
Samorita Hos.	0.9367	0.9280	0.9348	0.9190	0.8029	0.8942	0.8961	0.7033	0.6783	0.8548
Eastern Hous.	0.9342	0.9255	0.9022	0.9162	0.9148	0.8801	0.8932	0.8781	0.7707	0.8906
Heidelberg C.	0.9634	0.9120	0.8567	0.8730	0.8967	0.8820	0.8593	0.8937	0.6417	0.8643
Confidence C.	0.9633	0.9325	0.8558	0.8086	0.8680	0.8939	0.9104	0.9349	0.5854	0.8614
Meghna C.	0.9664	0.9473	0.9017	0.8882	0.8891	0.8881	0.8994	0.8042	0.6872	0.8746
Aramit C.	0.9608	0.9346	0.8065	0.7588	0.6070	0.7424	0.9014	0.8389	0.7744	0.8139
Apex Tannery	0.9118	0.9445	0.9303	0.9267	0.9111	0.8986	0.9014	0.9021	0.8547	0.9090
Bata Shoe	0.9405	0.9328	0.9244	0.9244	0.8782	0.8702	0.8461	0.8314	0.8125	0.8845
Apex Adelch.	0.9416	0.9348	0.9196	0.9193	0.9397	0.9238	0.8736	0.9428	0.8854	0.9201
Monno Cer.	0.9255	0.9133	0.9081	0.9144	0.8428	0.8752	0.8408	0.7801	0.6565	0.8507
Standard Cer.	0.9320	0.9249	0.9277	0.9388	0.8857	0.8525	0.8401	0.8110	0.6398	0.8614
BGIC	0.9301	0.9115	0.9200	0.9386	0.9409	0.7891	0.7784	0.8145	0.8789	0.8780
Green D.Ins.	0.9449	0.9234	0.9345	0.9279	0.9298	0.8436	0.7646	0.8384	0.9238	0.8923
United Ins.	0.9371	0.9328	0.9360	0.9397	0.9253	0.8952	0.8974	0.7525	0.8308	0.8941
Peoples Ins.	0.9165	0.9429	0.9187	0.9230	0.9222	0.8721	0.6923	0.5058	0.8689	0.8403
Eastern Ins.	0.9311	0.9300	0.9283	0.9369	0.9287	0.8822	0.8298	0.8123	0.8048	0.8871
Janata Ins	0.9356	0.9099	0.9100	0.9363	0.9178	0.8391	0.7733	0.8058	0.9118	0.8822
Phoenix Ins	0.9350	0.9293	0.9382	0.9309	0.9044	0.8681	0.8076	0.8160	0.7614	0.8768
Eastland Ins	0.9331	0.9303	0.9293	0.9345	0.9397	0.8594	0.8325	0.8571	0.9107	0.9030
Central Ins	0.9334	0.9315	0.9229	0.9236	0.9281	0.8530	0.8059	0.8213	0.8471	0.8852
Karnaphuli Ins	0.9351	0.9374	0.9242	0.9310	0.9187	0.8205	0.8275	0.8370	0.8884	0.8911
Rupali Ins	0.9275	0.9289	0.9145	0.9309	0.9370	0.8816	0.8000	0.8866	0.8793	0.8985
Federal Ins	0.9272	0.9443	0.9113	0.9241	0.9069	0.8666	0.8099	0.8547	0.8789	0.8915
Reliance Ins	0.9443	0.9205	0.9347	0.9404	0.9257	0.8158	0.7439	0.7968	0.8767	0.8776
Purabi G.Ins	0.9399	0.9517	0.8991	0.9260	0.8991	0.8691	0.8029	0.7958	0.8594	0.8826
Pragati Ins.	0.9354	0.9197	0.9412	0.9343	0.8966	0.8388	0.8594	0.7744	0.8814	0.8868
Aramit	0.9404	0.9336	0.9196	0.9234	0.8912	0.9013	0.8814	0.8193	0.9114	0.9024
GQ Ball Pen	0.9261	0.9447	0.9176	0.9274	0.8962	0.8555	0.8394	0.8683	0.7114	0.8763
Usmania Glass	0.9518	0.9535	0.9491	0.9383	0.9373	0.8887	0.7615	0.8842	0.7569	0.8913
Savar Ref.	0.8828	0.9147	0.9467	0.8985	0.8476	0.9035	0.9227	0.6975	0.6069	0.8468
BEXIMCO	0.9343	0.9291	0.8970	0.9029	0.8865	0.9495	0.8191	0.6665	0.9215	0.8785

in the model. The hypothesis was rejected, so we concluded 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 companies listed in the DSE market applying the stochastic frontier approach. We observed that the variables market return, market capitalization, book to market ratio and market value show significant

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

Null hypothesis	Log-likelihood function	Test statistic λ	Critical value*	Decision
$H_0 : \beta_{ij} = 0$	-132.9089	116.2750	11.911	Reject H_0
$H_0 : \gamma = 0$	-101.9755	54.4082	11.911	Reject H_0
$H_0 : \eta = 0$	-157.1236	16.0668	5.138	Reject H_0

All critical values are at 5% level of significance. *The critical values are obtained from table of Kodde and Palm (1986). The null hypothesis which includes the restriction that γ is zero does not have a chi-square distribution, because the restriction defines a point on the boundary of parameter space.

affects for MLE estimation of the translog production function. These results indicated that these input variables significantly affect the return of individual company of the share market in Bangladesh. From the inefficiency effects model, we found that the variable Groups -A and -B significantly contributed to improve technical efficiency of return in DSE market. The result showed that the explanatory variable “time” has significant impact. It indicated that technical inefficiency increased over the reference period. This means that, the technical efficiency rate was found gradually decreasing over time in the stock market in Bangladesh. According to the results obtained from the stochastic frontier estimation, the mean technical efficiency of DSE market during the period 2000 to 2008 given by the translog model was 0.8782. This implies that 87% of 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. In this study we also found that the companies which are listed in Group-A were the most efficient companies among the three groups. As a result, this study examined the efficiency and other characteristics of DSE markets which would be of great benefit to investors at home and abroad, policy makers and local and foreign listed and unlisted companies and has important practical implications to different capital market participants. Finally, it may also be useful for international organizations and governments of development partners who are interested in the development of capital markets in the emerging countries.

REFERENCES

Ahmed F (2002). Market Efficiency in Emerging Stock Markets: The Case of Dhaka Stock Exchange. (Available at http://www.fgda.org/html/savings_2002-1.htm)

Aigner D, Lovell CAK, Schmidt P (1977). Formulation and Estimation of Stochastic Frontier Production Function Models. J. Econ., 6: 21-37.

Alam MI, Hasan T, Kadapakkam P (1999). An Application of Variance Ratio Test to Five Asian Stock Markets. Rev. Pac. Basin Financ. Mark. Pol., 2: 301-315.

Altunbas Y, Evans L, Molyneux P (2001). Bank ownership and efficiency. J. Money Credit Bank., 33: 926-954.

Battese GE (1992). Frontier Production Function and Technical Efficiency: A Survey of Empirical Applications in Agricultural Economics. Agric. Econ., 7: 185-208.

Battese GE, Coelli TJ (1995). A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. Empirical Econ., 20(2): 325-332.

Battese GE, Corra G (1977) Estimation of a Production Frontier Model with Application to the Pastoral Zone of Easter Australia. Austr. J. Agric. Econ., 21(3): 167- 179.

Bauer P, Berger AN, Ferrier G, Humphrey DB (1998). Consistency conditions for Regulatory analysis of financial institutions: A comparison of frontier efficiency methods. J. Econ. Bus., 50: 85-114.

Bauer PW (1990). Recent Developments in the Econometric Estimation of Frontiers. J. Econ., 46: 39-56.

Berger AN, DeYoung R, Genay H, Udell GF (2000). The globalization of financial institutions: Evidence from cross-border banking performance. Brookings-Wharton Paper. Finan. Serv., 3: 23-158.

Berger AN, Humprey DB (1997). Efficiency of Financial Institutions: International Survey and Directions for Future Research. Eur. J. Oper. Res., 98: 175-212.

Chowdhury SSH, Sadique MS, Rahman MA (2001). Capital Market Seasonality: The Case of Dhaka Stock Exchange (DSE) Returns. South. Asian. J. Manage., 8(3/4): 1-7.

Coelli TJ (1996). A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation. CEPA Working Papers, No. 7/96, School of Economics, University of New England, Armidale, NSW 2351, Australia.

Cummins JD, Zi H (1998). Comparison of frontier efficiency methods: An application to the U.S. life insurance industry. J. Prod. Anal., 10: 131- 152.

Fecher F, Kesler D, Perelman S, Pestieau P (1993). Productive performance of the French insurance industry. J. Prod. Anal., 4: 77-93.

Ferrier GD, Lovell CAK (1990). Measuring cost efficiency in banking: Econometric and linear programming evidence. J. Econ., 46: 229-245.

Fishe R, Gosnell T, Lasser D (1993). Good news, bad news, volume and the Monday effect. J. Bus. Financ. Account., 20: 881-892.

Forsoud FR, Lovell CAK, Schmidt P (1980). A Survey of Frontier Production Functions and their Relationship to Efficiency Measurement. J. Econ., 13: 5-25.

Hassan MK, Maroney NC (2004). Thin trading, nonlinearity and market efficiency of a small emerging stock market: evidence from Bangladesh. Int. J. Appl. Bus. Econ. Res., 2(2).

Kasman A, Turgutlu E (2007). A Comparison of Chance-constrained DEA and Stochastic Frontier Analysis: An Application to the Turkish Life Insurance Industry. Working Papers.

Kirkley JE, Squires D, Strand IE (1995). Assessing Technical Efficiency in Commercial Fisheries: The Mid-Atlantic Sea Scallop Industry. Am. J. Agric. Econ. 77(3): 686-697.

Kodde DA, Palm AC (1986). Wald criteria for jointly Testing Equality and Inequality Restrictions. Econometrica, 54: 1243-1248.

Lakonishok J, Smidt S (1988). Are Seasonal Anomalies Real? A Ninety Year Perspective. Rev. Financ. Stud., 1: 402-425.

Lovell CAK, Fried HO, Schmidt SS (1993). The Measurement of Productive Efficiency: Techniques and Applications. Oxford University Press, New York.

Maudos J, Pastor M, Perez F, Queseda J (2002). Cost and profit efficiency in European banks. J. Int. Financ. Mark. Inst. Money. 12: 33-58.

Meeusen W, Van Den Broeck J (1977). Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. Int. Econ. Rev., 18: 435-444.
Mobarek A, Keasey K (2000). Weak-Form Market Efficiency of an Emerging Market: Evidence from Dhaka Stock Market of Bangladesh. Presented at the ENBS Conference, Oslo. (Available at http://www.bath.ac.uk/Centres/CDS/enbs-papers/mobarek_new.htm)
Mursalin TE, Tanvir A, Alam MJ (2006). Share Market Analysis Using Various Economical and Social Determinants to Predict Decision for Investors. The 3rd China's financial year will - Shanghai, China.
Pastor M, Perez F, Queseda J (1997). Efficiency analysis in banking firms: An international comparison. Eur. J. Oper. Res., 98: 395-407.
Resti A (1997). Evaluating the cost-efficiency of the Italian banking system: What can be learned from the joint application of parametric and non-parametric techniques. J. Bank. Financ., 21: 221-250.
Schmidt P (1986). Frontier Production Functions. Econ. Rev., 32: 715-723.
Strong N (1992). Modeling Abnormal Returns: A Review Article. J. Bus. Financ. Account., 19(4): 533-553.
Taymaz E, Saatci (1997). Technical Change and Efficiency in Turkish Manufacturing Industries. J. Prod. Anal., 8: 474.
Uddin MGS, Alam MM (2007). The Impacts of Interest Rate on Stock Market: Empirical Evidence from Dhaka Stock Exchange. South Asian J. Manage. Sci., 1(2): 123-132.
Uddin MGS, Yasmin S (2008). Random Walk Model in the Dhaka Stock Exchange: An Empirical Evidence of Daily Return. Accepted for publication J. Bus. Admin. IBA, Dhaka University. Bangladesh.
Weill L (2004). Measuring cost efficiency in European banking: A comparison of frontier techniques. J. Prod. Anal., 21: 133-152.

APPENDIX

List of companies considered in this study

List of company's name	Serial number	List of company's name	Serial number
AB Bank	1	Apex Spinning	48
City Bank	2	Delta Spinners	49
IFIC Bank	3	Sonargaon Textiles	50
Islami Bank	4	Prime Textile	51
NBL	5	H.R. Textile	52
Uttara Bank	6	Ambee Pharma	53
Eastern Bank	7	Beximco Pharma	54
Al-Arafah IB	8	Glaxo SmithKline	55
ICB	9	ACI Limited	56
IDLC	10	Renata Ltd	57
United Leasing	11	Reckitt Benckiser	58
Uttara Finance	12	The Ibn Sina	59
1stICB M.F.	13	Beximco Synthetics	60
2nd ICB M.F	14	Libra Infusions	61
3rd ICB M.F.	15	Square Pharma	62
4th ICB M.F.	16	Imam Button	63
5th ICB M.F.	17	Samorita Hospital	64
6th ICB M.F.	18	Eastern Housing	65
7th ICB M.F.	19	Heidelberg Cement	66
8th ICB M.F.	20	Confidence Cement	67
1st BSRS	21	Meghna Cement	68
Aftab Automobiles	22	Aramit Cement	69
Olympic Industries	23	Apex Tannery	70
Bangladesh Lamps	24	Bata Shoe	71
Eastern Cables	25	Apex Adelchy Footwear	72
Monno Jutex	26	Monno Ceramic	73
Monno Stafllers	27	Standard Ceramic	74
Singer Bangladesh	28	BGIC	75
Atlas Bangladesh	29	Green D. Ins.	76
BD.Autocars	30	United Ins.	77
Quasem Drycells	31	Peoples Ins.	78
National Tubes	32	Eastern Ins.	79
Bd. Thai Aluminium	33	Janata Ins	80
Anwar Galvanizing	34	Phoenix Ins	81
Kay & Que	35	Eastland Ins	82
National Polymer	36	Central Ins	83
Apex Foods	37	Karnaphuli Ins	84
Bangas	38	Rupali Ins	85
BATBC	39	Federal Ins	86
National Tea	40	Reliance Ins	87
AMCL (Pran)	41	Purabi G.Ins	88
Rahima Food	42	Pragati Ins.	89
BOC	43	Aramit	90
Padma Oil Co.	44	GQ Ball Pen	91
Saiham Textile	45	Usmania Glass	92
Desh Garmants	46	Savar Ref.	93
Bextex Limited	47	BEXIMCO	94