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Cost and Profit Efficiency of Online Banks: Do National Commercial Banks Perform better than Private Banks?

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Abstract

This study employs the parametric approach, in particular the Stochastic Frontier Approach, to examine the cost and profit efficiency of National Commercial

Banks and Private Banks in Bangladesh using stochastic frontier model. The cost inefficiency and profit efficiency are observed slightly higher for private banks than national commercial banks. The coefficient of advance (0.334) is highly significant at 1% level and the coefficient of off-balance sheet items (0.339) is significant at 5% level. Both results are positive influence to the banks for cost model. The coefficients of Advance, Other earning assets, Off-balance sheet items, Price of fixed assets and Price of labour are recorded highly significant in profit model. The average cost inefficiency and profit efficiency are observed 16.3% and 91% respectively. The lowest cost inefficiency is 5.3% for United Commercial Bank Limited while the highest cost inefficiency is 44.7% for Janata Bank. The lowest profit efficiency is 76.9% for Janata Bank while the highest profit efficiency is 94.9% for Eastern Bank Limited.

Keywords: **Cost efficiency; Profit efficiency;Translog stochastic cost and profit model; National Commercial Banks and Private Banks; Bangladesh**

INTRODUCTION

In the banking sector, econometric measurement of inefficiency has been undertaken mainly through estimating a cost function. The implementation of the profit function approach is rather difficult due to chronic data problems, as the profit function requires price data for outputs, which is hard to construct in banking. However, to measure cost and profit efficiency of national commercial banks and private banks is important for at least two reasons. First, efficiency measures are indicators of success, by which the performance of individual banks, and the industry as a whole, can be gauged. Banks have faced growing competition, from other banks and from other firms and markets outside the industry (Wheelock) and presumably banks will be more successful in maintaining their business if they operate efficiently. During 1982-83, the government of Bangladesh allowed commercial banks to operate in private sector side by side with the public sector banks to start a meaningful and constructive competition in the banking sector. Question arises how successfully the national and private commercial banks are serving the country? How far they have achieved their desired goals?

Bank cost and profit efficiency studies are available in literature [1-19]. There has been a prevalent discussion about lack of sufficient technical efficiency of banks in developing countries like in Bangladesh compared to their counterparts in the developed world [20-23]. They measured online bank deposit, advance and profit efficiency using stochastic frontier analysis but not measured for cost and profit together for the Bangladeshi banks. Again Baten and Begum [23] evaluated cost and profit efficiency of Islamic banks only. A review of the literature indicated that

only few studies examined the Bangladesh banking sector individually. Despite the wide agreement on the relevance of profit efficiency analysis, the technical difficulties with the measurement and decomposition of profit inefficiency were the main reasons for the small number of empirical studies on banking profit efficiency. Thus, the literature review shows the motivation for this study.

The two general approaches are used to assess efficiency of an entity, parametric and non-parametric methods, which employ different techniques to envelop a data set with different assumptions for random noise and for the structure of the production technology. The nonparametric methods are Data Envelopment Analysis (DEA) and Free Disposal Hull, which are based on linear programming tools. The parametric methods most widely used in empirical estimations are Stochastic Frontier Approach (SFA), Distribution Free Approach and Thick Frontier Approach. The Bangladesh's financial system is bankbased and banks play an important role in the economy. The analysis of efficiency in industry with so many important development milestones is of high interest. DEA does not have to be specified for the production function and it does not take into account random error hence the efficiency estimates may be bias if the production process is largely characterized by stochastic elements. SFA approach is a stochastic frontier and allows the effects of noise to be separated from the effects of inefficiency and generate good results only for single output and multiple inputs.

The objective of this paper is to measure cost and profit efficiency of NCBs (National Commercial Banks) and PBs (Private Banks) of Bangladesh using parametric method, especially stochastic frontier approach. Year wise technical efficiency is also an important issue to estimate for individual banks in this study. The paper is organized as follows. Section 2 presents methodology and data. Empirical analysis and discussion is reported in Section 3 and section 4 concludes this paper.

MATERIALS AND METHODS

Stochastic cost frontier model

The cost efficiency measures of banks relative to best practice banks that produce the same output under the same exogenous conditions. The cost function describes the relationship between the cost with quantities of output and input variables plus the inefficiency and random error. Following, Aigner et al. [24] and Meeusen and Broeck [25] cost efficiency model can be defined as:

$$C_{it} = f\left(y_{it}, p_{it}, \varepsilon_{it}\right), \quad i = 1,2,3,...,n \qquad (1)$$

where, C_{it} stands for the n-th bank's total operational costs at time t, y_{it} represents the vector of quantities of the bank's variable i-th outputs, p_{it} is the

vector of prices of the bank's variable i-th inputs, and ε_{it} is a composite error term, through which the cost function varies stochastically.
The term ε_{it} can be partitioned into two parts as follows:

$$\varepsilon_{it} = v_{it} + u_{it} \qquad (2)$$

Where, v_{it} refers the inefficiency term that captures the difference between the efficient level of cost for given output levels and input prices and the actual level of cost and u_{it} refers the random error. They are assumed to follow the following distributions: $v_{it} \sim N^{+}(0, \sigma_v^2)$, $u_{it} \sim N^{+}(0, \sigma_u^2)$.

The cost efficiency of the bank can be written in natural logs:

$$\ln C_{it} = \ln f(y_{it}, p_{it}) + \ln v_{it} + \ln u_{it}, \qquad (3)$$

Where f is a functional form.

On the basis of the estimation of a particular functional form f, cost efficiency for bank i is measured as the ration between the minimum cost $(C_{\min})$ necessary to produce that bank's output and the actual cost (C_i);

$$CE_i = \frac{C_{\min}}{C_i} = \frac{\exp[f(y,p)]\exp(\ln v)}{\exp[f(y,p)]\exp(\ln v)\exp(\ln u)} = \exp[-\ln u]. \qquad (4)$$

Under the formulation, an efficiency score of 0.95 for example, implies that the bank would have incurred only 95 percent of its actual costs had it operated in the frontier.

Stochastic profit frontier model

The profit efficiency measures how close a bank is to attaining the maximum possible profit as a best practice bank on the frontier for a given level of inputs and output prices (quantities) and other exogenous variables. Given the input and output price vectors (p) and (y) respectively, the bank maximizes profits by adjusting the amount of inputs and outputs. The profit frontier is derived as

$$\Pi = \Pi(y, p, v, u) \qquad (5)$$

In log form, alternative profit function can be written as follows:

$$\ln(\pi + \theta) = \ln f(y, p) + \ln v - \ln u \qquad (6)$$

Where, π represents net profit after tax, θ is a constant added to the profits of each firm in order to attain positive values, thus able to take logarithms.
The profit efficiency is measured as the ratio between the actual profit (P) of a bank and the maximum possible profit that is achievable by the most efficient bank i.e., profit frontier (P*). After obtaining the estimates of Uit the profit efficiency of i-th bank at t-th time period is given by:

$$PE_{it} = {p_i}\Big/{p_{\max}} = \frac{\exp[f(y,p)]\exp(\ln v)\exp(-\ln u)}{\exp[f(y,p)]\exp(\ln v)} = \exp(-\ln u). \qquad (7)$$

For example, if the profit efficiency score of a bank is 90%, it means that the bank is losing about 10% of its potential profits to managerial failure in choosing optimum output quantities and input prices.

DATA AND VARIABLES DESCRIPTION

The data set used in this study collected from the annual reports of the specific banks of Bangladesh and from annual accounts of Scheduled 17 Commercial Banks published by Bangladesh Bank, the central bank of Bangladesh for the period of 2001 to 2010 into two categories of bank (i) National Commercial Banks (NCBs), (ii) Private Banks (PBs). All variables except for the input price and output are measured in millions of Bangladeshi taka.

In order to conduct SFA estimation, outputs and inputs need to be defined. The output vectors include (1) Cost is measured as total cost, is defined by all expenses of bank such as salary and allowances, Rent, taxes, Insurance, Lighting, Stationary, Managing Director's remuneration, Depreciation cost of bank. (2) Profit is measured as total profit after tax (3) Advance is measured as total loan and advance minus loan (4) Other earning assets is measured by total other assets (5) Off-balance Sheet Items are measured by total Off-balance Sheet items including contingent liabilities. All input price are found (1) Price of fixed assets are measured as total repairing cost of fixed assets (2) Price of labour are measured as total salary and allowances (3) Price of Borrowed fund are measured by total borrowed including inside and outside of Bangladesh. All values are transformed into natural logarithms and described as a summary of statistics in Table 1.

The functional form of the stochastic frontier was determined by testing the adequacy of the Cobb Douglas relative to the less restrictive translog. The specification of translog cost frontier model can be expressed in terms of banks as multi-product and multi-input banks.

$$\ln C_{it} = \alpha_0 + \sum_i^3 \beta_i \ln y_i + \frac{1}{2}\sum_i^3\sum_j^3 \beta_{ij} \ln y_i \ln y_j + \sum_k^3 \beta_k \ln p_k + \frac{1}{2}\sum_k^3\sum_m^3 \beta_{km} \ln p_k p_m$$
$$+ \sum_i^3\sum_k^3 \beta_{ik} \ln y_i \ln p_k + \ln v_{it} + \ln u_{it} \qquad (8)$$

Table 1: Summary Statistics of Output，Input Quantity and Input Price Variables.

Variable and Description	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Output				
Total Cost	3480.694	12044.072	102.46	156341
Profit after Tax	1002.206	1142.129	8.23	6860.34
Advance (Y_1)	29803.8	46154.689	229.383	398432.89
Other Earning Assets (Y_2)	11018.182	29997.426	54.2	176625.2
Off-balance Sheet items (Y_3)	32410.732	106807.038	923.67	987634.8
Input Price				
Price of Fixed Assets (P_1)	136.596	128.3027	0.077	619.49
Price of Labour (P_2)	969.078	2324.091	1.61	28125.12
Price of Borrowed Fund (P_3)	1724.787	2503.066	0.46	14200.44

where, ln is natural logarithm, Ci is the ith bank's total cost; yi is the i'th output; P is the k'th input price, and vit is the random error, uit is the inefficiency term. β_i, β_{ij} are parameter to be estimated for the frontiers of output. β_k, β_{km} are parameter to be estimated for input price of frontier model. β_{ik} is parameter to be estimated for interaction effect.

The specification of the translog stochastic profit model is defined as follows:

$$\ln(\pi+\theta)_{it} = \beta_0 + \sum_{i=1}^3 \beta_i \ln y_{it} + \sum_{k=1}^3 \beta_k \ln p_{kt} + \frac{1}{2}\sum_{i=1}^3\sum_{j=1}^3 \beta_{ij} \ln y_{it} \ln y_{jt} +$$
$$\frac{1}{2}\sum_{k=1}^3\sum_{l=1}^3 \beta_{kl} \ln p_{kt} \ln p_{lt} + \sum_{k=1}^3\sum_{i=1}^3 \beta_{ki} \ln p_{kt} \ln y_{it} + \ln v_{it} - \ln u_{it} \qquad (9)$$

Where, π represent net profit after tax of the bank i; θ is a constant added to the profits of each bank so that natural log is taken of a positive number since minimum profits are typically negative.

Likelihood ratio tests

The likelihood ratio test is an imperative feature and helps to determine whether Cobb-Douglas or Translog cost and profit models are appropriate or not. The likelihood ratio is used to test the null hypothesis that there is no technical inefficiency; there is no effect of time on technical efficiency etc. It is measured as follows:

$$\lambda = -2\{\ln[L(H_0)/L(H_1)]\} = -2\{\ln[L(H_0)] - \ln[L(H_1)]\} \qquad (10)$$

Where $L(H_0)$and $L(H_1)$ are the values of the likelihood function under the null and alternative hypothesis (note that this statistic has a mixed chi-square distribution). The null hypothesis is rejected when $\lambda_{LR} > \chi_c^2$.

The following null hypotheses will be tested:

$H_0 : \beta_{ij} = 0,$ the null hypothesis that identifies an appropriate functional form either the restrictive Cobb-Douglas or Translog production function. It specifies that the second-order coefficients of the stochastic frontier production function are simultaneously zero.

$H_0 : \gamma = 0,$ the null hypothesis specifies that the technical inefficiency effects in banks are zero. This is rejected in favor of the presence of inefficiency effects. Here 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 [26].

RESULTS AND DISCUSSION

Estimation of the cost and profit efficiency

The maximum likelihood estimates of the stochastic frontier cost function of the selected bank in Bangladesh are reported in Table 2. A significant positive or negative coefficient for any variable suggests that it increases or decreases the bank's cost efficiency.

The coefficient of advance β_1 (0.334) is highly significant at 1% level and the coefficient of off-balance sheet items β_3 (0.339) is significant at 5% level of

significant as well as the positive effects on the cost efficiency of the banks. These results suggest that the output variable advance is positively affected for total operating cost. Other earning assets and price of borrowed fund are observed insignificant and negative coefficient but other variables are observed to be positive. The square term of Advance, Other earning assets Price of borrowed fund are statistically insignificant and positive; the coefficients of other variables are negative for cost function. The value of Gamma ( ) is observed 0.3 and significant at 5% level.

Table 2: Maximum Likelihood Estimates of Translog Stochastic Cost Frontier Model.

Variable	**Parameter**	**Coefficient**	**Standard-error**	**T-ratio**
Constant	β_0	0.177$^{@}$	0.528	0.335
y_1	β_1	0.334***	0.123	2.710
y_2	β_2	-0.098$^{@}$	0.114	-0.864
y_3	β_3	0.339**	0.149	2.270
p_1	β_4	0.139$^{@}$	0.093	1.485
p_2	β_5	0.093$^{@}$	0.090	1.031
p_3	β_6	-0.018$^{@}$	0.062	-0.301
y_1^2	β_{11}	-0.067$^{@}$	0.735	-0.091
y_2^2	β_{22}	0.116$^{@}$	0.735	0.158
y_3^2	β_{33}	-0.052$^{@}$	0.737	-0.071
p_1^2	β_{44}	-0.006$^{@}$	0.732	-0.008
p_2^2	β_{55}	-0.103$^{@}$	0.733	-0.141
p_3^2	β_{66}	0.096$^{@}$	0.737	0.130
$y_1\, y_2$	β_{12}	0.024$^{@}$	0.888	0.027
$y_1\, y_3$	β_{13}	-0.059$^{@}$	0.887	-0.067

$y_2\ y_3$	β_{23}	0.032[@]	0.886	0.036
$p_1\ p_2$	β_{45}	-0.054[@]	0.886	-0.061
$p_1\ p_3$	β_{46}	0.044[@]	0.887	0.050
$p_2\ p_3$	β_{56}	-0.003[@]	0.887	-0.004
$y_1\ p_1$	β_{14}	-0.036[@]	0.887	-0.041
$y_1\ p_2$	β_{15}	-0.085[@]	0.887	-0.096
$y_1\ p_3$	β_{16}	0.014[@]	0.886	0.016
$y_2\ p_1$	β_{24}	0.055[@]	0.887	0.062
$y_2\ p_2$	β_{25}	0.006[@]	0.887	0.007
$y_2\ p_3$	β_{26}	0.106[@]	0.887	0.119
$y_3\ p_1$	β_{34}	-0.029[@]	0.887	-0.032
$y_3\ p_2$	β_{35}	-0.077[@]	0.887	-0.087
$y_3\ p_3$	β_{36}	0.022[@]	0.889	0.024
SIGMA-SQUARED	σ^2	0.145	0.015	9.233
GAMMA	γ	0.308	0.120	2.558
Likelihood function		-66.534		

The maximum likelihood estimates of the stochastic frontier profit model of the selected bank in Bangladesh are reported in Table 3. Advance, Other earning assets, Off-balance sheet items, Price of fixed assets and Price of labour are found affected profitability of the selected banks and are recorded to be highly significant. The advance, other earning assets, price of borrowed fund are observed significant and negative effects on the banks at 1% level. Off-balance sheet items, Price of fixed assets, Price of labour are found significant and positive effects on the sampled banks. The coefficients of all input variables are observed to be significant at 1% level. The square term of other earning assets, Price of labour, Price of borrowed fund are observed insignificant but negative and Advance, Off-balance sheet items, Price of fixed assets are recorded insignificant but positive for the selected banks. All squared and interaction terms

are insignificant but Advance and other earning assets (β_{12}), other earning assets and price of fixed assets (β_{24}), other earning assets and price of labour (β_{25}), other earning assets and price of borrowed fund (β_{26}), off-balance sheet items and price of fixed assets (β_{34}) are recorded positive and others are negative coefficient for profit efficiency model.

Table 3: Maximum Likelihood Estimates of Stochastic Profit Frontier Model.

Variable	**Parameter**	**Coefficient**	**Standard-error**	**T-ratio**
Constant	β_0	-0.771***	0.160	-4.815
y_1	β_1	-332.398***	0.894	-371.668
y_2	β_2	-1835.550***	0.860	-2133.801
y_3	β_3	830.590***	0.886	936.419
p_1	β_4	166.420***	0.446	372.692
p_2	β_5	917.644***	0.199	4608.146
p_3	β_6	-415.021***	0.383	-1082.552
y_1^2	β_{11}	0.220@	1.497	0.146
y_2^2	β_{22}	-0.048@	0.107	-0.044
y_3^2	β_{33}	0.315@	0.791	0.398
p_1^2	β_{44}	0.0007@	0.662	0.001
p_2^2	β_{55}	-0.141@	0.361	-0.391
p_3^2	β_{66}	-0.072@	0.875	-0.082
$y_1\ y_2$	β_{12}	0.0002@	0.750	0.0003
$y_1\ y_3$	β_{13}	-0.288@	1.528	-0.188
$y_2\ y_3$	β_{23}	-0.144@	0.250	-0.575
$p_1\ p_2$	β_{45}	-0.140@	0.874	-0.161

$p_1\ p_3$	β_{46}	-0.071[@]	0.839	-0.085
$p_2\ p_3$	β_{56}	-0.213[@]	0.825	-0.258
$y_1\ p_1$	β_{14}	-0.078[@]	0.710	-0.110
$y_1\ p_2$	β_{15}	-0.220[@]	0.726	-0.304
$y_1\ p_3$	β_{16}	-0.151[@]	0.841	-0.179
$y_2\ p_1$	β_{24}	0.289[@]	0.393	0.736
$y_2\ p_2$	β_{25}	0.140[@]	1.646	0.085
$y_2\ p_3$	β_{26}	0.226[@]	1.909	0.118
$y_3\ p_1$	β_{34}	0.018[@]	1.889	0.009
$y_3\ p_2$	β_{35}	-0.119[@]	0.111	-0.107
$y_3\ p_3$	β_{36}	-0.045[@]	0.432	-0.104
SIGMA-SQUARED	σ^2	0.403		
GAMMA	γ	0.391		

*** Significant at the 0.01 level. ** Significant at the 0.05 level.

* Significant at the 0.10 level @ means insignificant.

Results of hypothesis tests

The results of various hypothesis tests of the cost and profit efficiency model are presented in Table 4 and Table 5. The first null hypothesis is $H_0 : \gamma = 0$ which specify that there is no technical efficiency effect in the cost and profit efficiency model. The hypothesis is accepted so we can conclude that there is no technical efficiency effect in the model.

The second null hypothesis is $H_0 : \beta_{ij} = 0$, which specifies that Cobb-Douglas stochastic frontier cost and profit models are more preferable than Translog stochastic cost and profit frontier models. From the results, it is observed that the null hypothesis is rejected so Translog Cost and Profit models are more preferable than Cobb-Douglas stochastic cost and profit frontier models.

Table 4: Generalized Likelihood-Ratio Test of Hypothesis of Stochastic Cost Frontier Model.

Null Hypothesis	**Log-Likelihood Function**	**Test Statistics** λ	**Critical Value***	**Decision**
$H_0 : \gamma = 0$	-68.898	4.72	38.301	Accept H_0
$H_0 : \beta_{ij} = 0$	-70.843	21.56	5.138	Reject H_0

Table 5: Generalized Likelihood-Ratio Test of Hypothesis of the Stochastic Profit Frontier Model

Null Hypothesis	**Log-Likelihood Function**	**Test Statistics** λ	**Critical Value***	**Decision**
$H_0 : \gamma = 0$	-252.172	243.47	38.301	Reject H_0
$H_0 : \beta_{ij} = 0$	-117.392	22.76	5.138	Reject H_0

Notes: All critical values are at 5% level of significance.

Estimation of the bank-wise cost and profit efficiency

The cost and profit efficiency scores for the selected banks are illustrated in Table 6. The average cost inefficiency (16.3%) and average profit efficiency with (91%) respectively are observed. The lowest cost inefficiency is 5.3% for United Commercial Bank Limited while the highest cost inefficiency is 44.7% for Janata Bank on the other hand the lowest profit efficiency is 76.9% for Janata Bank while the highest profit efficiency is 94.9% for Eastern Bank Limited. Average cost inefficiency of AB Bank, Bank Asia, Mercantile Bank, Eastern Banks is above 12%, BRAC Bank, Dhaka Bank, South East Bank, Sonali Banks is 23%, DBBL, National Bank, One Bank, Prime Bank, Pubali Bank, UCBL, Uttara Banks inefficiency is found less than 10% and only one bank inefficiency above 45% while in the average profit efficiency, most of the banks is recorded more than 93%. The average profit efficiency of AB Bank Limited, South East Bank Limited, Sonali Bank and Janata Banks is recorded below 85%.

Table 6: Average Cost and Profit Efficiency of Selected Banks using Stochastic Frontier Analysis (SFA).

Name of the banks	**Number of Banks**	**Average Cost Efficiency**	**Average Profit Efficiency**
AB Bank Limited	1	1.169	0.890
Bank Asia Limited	2	1.154	0.930
BRAC Bank Limited	3	1.296	0.940
Dhaka Bank Limited	4	1.211	0.934
Dutch Bangla Bank Limited	5	1.097	0.930
Eastern Bank Limited	6	1.200	0.949
Mercantile Bank Limited	7	1.123	0.933
Mutual Trust Bank Limited	8	1.101	0.925
National Bank Limited	9	1.098	0.940
One Bank Limited	10	1.091	0.929
Prime Bank Limited	11	1.065	0.939
Pubali Bank Limited	12	1.082	0.916
South East Bank Limited	13	1.258	0.879
Sonali Bank	14	1.245	0.839
United Commercial Bank Limited	15	1.053	0.915
Uttara Bank Limited	16	1.080	0.911
Janata Bank	17	1.447	0.769
	Mean	1.163	0.910

*The critical value are obtained from table of Kodde and Palm (1986). The null hypothesis which includes the restriction that is zero does not have a chi-square distribution because the restriction defines a point on the boundary of parameter space.

The bank wise cost and profit efficiency scores are illustrated in Figure 1. The

average profit efficiency (91%) and average cost inefficiency (16.3%), respectively, are reported for the selected banks. Eastern Bank profit efficiency (94.5%) is observed very high from others banks. On the other hand Janata Bank profit efficiency (76.9%) is very low comparing to others banks. It is observed that Janata Bank is less efficient in case of profit model; on the other hand it is most inefficient for cost model. UCBL is less inefficient for cost model but profit efficiency is high for Janata Bank, Sonali Bank, South East Bank, AB Bank and Uttara Bank. Cost inefficiency is (5.3%) very low for UCBL while the cost inefficiency (44.7%) is very high for Janata Bank. The profit efficiencies of Bank Asia, BRAC Bank, Dhaka Bank, DBBL, Eastern Bank, Mercantile Bank, MTB, National Bank, One Bank, Prime Bank and Pubali Bank are found almost stable while DBBL, Mercantile Bank, MTB, National Bank, One Bank, Prime Bank, Pubali Bank and Uttara Bank are almost stable in terms of cost inefficiency model.

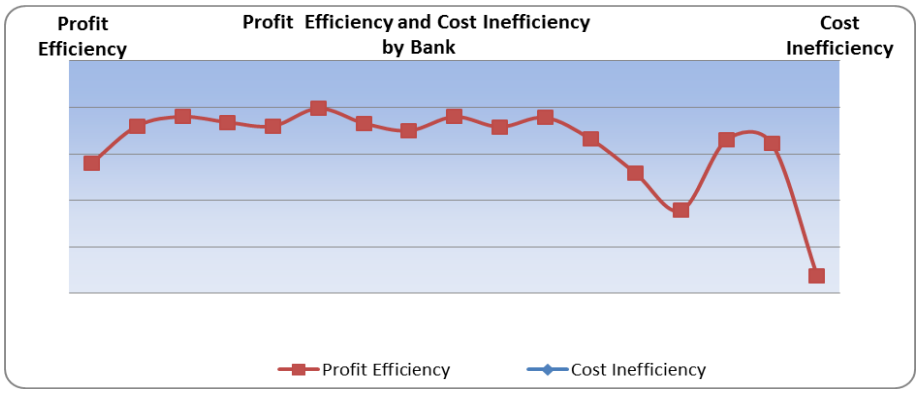

Figure 1: Average Cost and Profit Efficiency of Selected Banks for Stochastic Frontier Analysis.

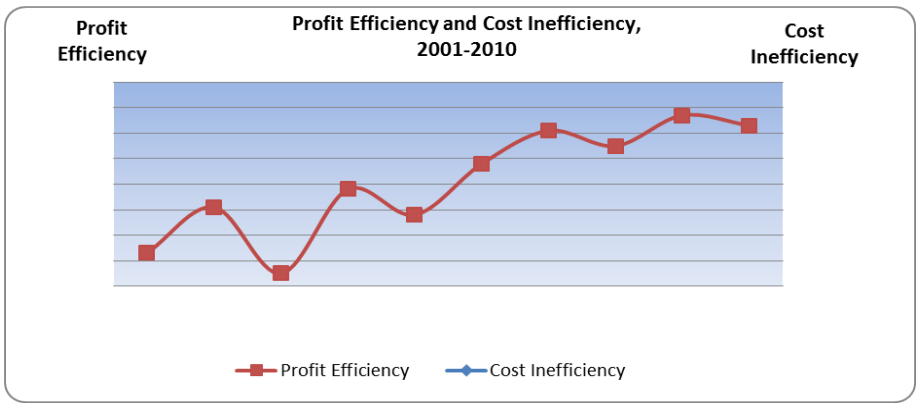

Figure 2: Year-wise Average Cost and Profit Efficiency.

Estimation of the year-wise cost and profit efficiency

Year-wise average cost inefficiency during the period 2001 to 2010 is 16.4% while the average profit efficiency is 91.1% represented by Table 7. The highest cost inefficiency is 28% in the year of 2003 while the highest profit efficiency is 93.7% in the year of 2009. The lowest cost inefficiency is found 11% in the year of both 2008 and 2010 while the lowest profit efficiency is 87.5% in the year of 2003 for the selected banks. Profit efficiency is recorded 90% above for the reference years with the exception of the years 2001, 2003 and 2005. Cost inefficiency is found 25% above in the years of 2002 and 2003, and below 20% for the remaining reference years.

The profit and cost efficiency scores for the selected banks are illustrated in Figure 2. The average profit efficiency of 91.1% and average cost inefficiency of 16.3% respectively, are reported during the period 2001 to 2010. The trend for profit efficiency is increasing by year to year –from a low 87.5% in 2003 to an increase to 93.7% in 2009, but profit efficiency increases 2001 to 2002, on the other hand in the year 2003 it is observed very low efficiency, but in the year 2010 slightly decreases compared to the year 2009. The trend for cost inefficiency scores increases from 19% to 28% from 2001 to 2003, and then decreases from 28 to 12% during 2003 to 2005, and then increases 12% to 17% in 2006 and then decreases again 17% to 11% during 2008 and 2010.

Table 7: Yearwise Average Cost and Profit Efficiency by Stochastic Frontier Analysis.

Year	**Cost Efficiency**	**Profit Efficiency**
2001	1.190	0.883
2002	1.260	0.901
2003	1.280	0.875
2004	1.150	0.908
2005	1.120	0.898
2006	1.170	0.918
2007	1.130	0.931
2008	1.110	0.925
2009	1.120	0.937
2010	1.110	0.933
Mean	1.164	0.911

CONCLUSION

This study was set out to provide estimates of bank profit and cost efficiency and to compare efficiency estimates of NCBs and PBs of Bangladesh banking industries using stochastic frontier analysis during 2001 to 2010 [27]. The cost and profit efficiency of selected banks were compared according to both year wise and bank wise. Translog Cost and Profit models were found preferable than Cobb-Douglas Cost and Profit models and Likelihood Ratio (LR) test independently was tested in this matter as well as Translog Stochastic Frontier Cost and Profit models were analyzed.

From the results of cost efficiency model, the estimated coefficient of Price of borrowed fund with -0.018 indicated that the level of inefficiency was decreased by price of borrowed fund. Advance and Off-balance sheet items were found significant with positive values represented increasing the value of cost inefficiency. In profit efficiency model, the estimated coefficient of Advance, Other earning assets and Price of borrowed fund were recorded highly significant with negative values represented decreasing the level of efficiency. Off-balance sheet items, Price of fixed assets and Price of labour were found significant with positive values represented increasing the level of profit efficiency. In comparison to both cost and profit efficiency models, the estimated coefficient Off-balance sheet items was found significant with positive and in case of Advance, it was recorded significant with negative for profit model and positive for cost model.

Bank wise average profit efficiency and cost inefficiency were recorded 0.910 and 0.163 respectively. The most efficient bank was found to be Eastern Bank with score 0.949 and the less efficient bank was found to be Janata Bank with score 0.769 for profit model. More inefficient bank was found Janata Bank with score 0.447 and less inefficient bank was found United Commercial Bank with score 0.053 for cost model.

Year wise efficiencies of the selected banks from the profit model were found 0.911%. Profit efficiency of private banks is found most efficient (92.5%) comparing to national commercial banks (80.4%). During the years 2004 to 2008, the profit efficiencies of private banks were observed almost stable and it was around 92.9 percent. On the other hand the estimated year wise cost inefficiencies of the sample banks were recorded 0.164. The cost inefficiency of private banks was observed most inefficient (15.2%) comparing to national commercial banks (34.6%). During the years 2008 to 2010, costs inefficiencies of national commercial banks were almost stable, and it was decreasing from the years 2003 and 2006 around 4.1% and during the years 2006 to 2007 costs inefficiencies of private banks almost stable and around 11.5 percent.

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