Int. Journal of Economics and Management **6(1):** 35 – 57 (2012) ISSN 1823 - 836X

Measurement of Technical Efficiency and Its Sources: An Experience of Indian Banking Sector

SUPARN SHARMA[a*], DALIP RAINA[b] AND SURENDER SINGH[c]

[a,b]*Shri Mata Vaishno Devi University, Katra, India*
[c]*Chaudhary Devi Lal University, Sirsa, India*

ABSTRACT

A parametric stochastic frontier analysis model is applied in the present study to calculate the technical efficiency of Scheduled Commercial Banks in India along with the sources of inefficiency, using balanced panel data covering the period of 2005-06 to 2009-10. The empirical findings prepared on the basis of Cobb-Douglas production functional and inefficiency model indicate that the commercial banks have shown growth in technical efficiency level over the period of time and the relationship depends heavily on fixed assets and deposit inputs. Analyzing the sources of inefficiency, priority sector advance to total advance ratio and public owned banks are found to have significant and positive relationship with the technical efficiency of banks. Furthermore, cash-deposit ratio is also found to be positively related with technical efficiency, but is not statistically significant, and deposit to total liability ratio is experienced to have a statistically significant but negative relationship with banks technical efficiency. The results also concluded that SBI and Nationalised Bank group are relatively more efficient than Private and Foreign Banks in India and the inefficiency present in the bank groups are due to the internal factors that are under the control of banks. The study provides evidences that Antwerp Diamond Bank is found to be the most efficient bank over the period of study and also provides an evidence-based policy recommendation to enhance the technical efficiency and competitiveness of commercial banks.

Keywords: Commercial Banks, Technical Efficiency, Stochastic Frontier Analysis.

* Corresponding Author: E-mail: suparn329@yahoo.co.in.
Any remaining errors or omissions rest solely with the author(s) of this paper.

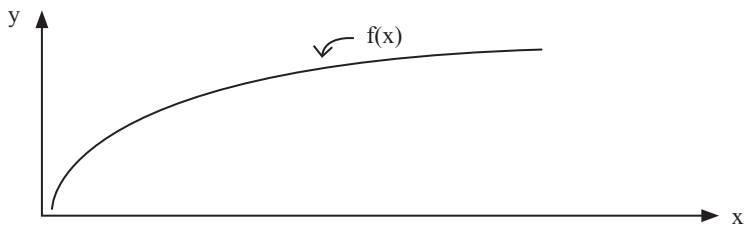
INTRODUCTION

After the initiation of banking reforms in 1992 the banks in India have been slowly but surely exposed to the thorough domestic and international competition. The entry of Foreign and New Private Banks made drastic changes in the Indian banking practices and industry. The competition in the banking sector has increased to a large extent after the post reforms period (Barman, 2007). In the present environment the optimum and efficient utilization of resources by the banks has become the crucial importance for the growth and development of an economy thus suggesting that banking sector can withstand in the competitive era along with the increase in their market share. Efficient intermediation of funds from savers to borrowers enables the allocation of resources to their most productive use. The more efficient a financial system is in its resource generation and allocation, the greater will be its contribution to productivity and economic growth (McKinnon, 1973). An efficient financial system is a primary requirement for country's economic development. Hence, the measurement of banking efficiency studies in any economy is vital for operational as well as academic purposes (Berger and Humphhery, 1997). Efficiency estimation is also useful for individual investment or loan and advances decisions and to judge past and current positions of banks alongwith the future potential and the risk associated with them.

In India the banking industry is the backbone of the country's economic development as it has always played a vital role in the prevention of the economic disasters taken place over the different time periods. It has attained admiration for its might in arise of economic crises that have pushed its worldwide counterparts to the boundary of fall down (Dwivedi & Charyulu, 2011). This sector is extremely competitive and growing in the right direction (Ram Mohan, 2008). The overall growth has been beneficial with the improvement in the performance of this sector. It has been the major achievement of this sector that with the financial turmoil of the western economies in 2008 with which the majority of countries has got affected, the Indian banking system has survived with the distress and showed the stable performance (Dwivedi & Charyulu, 2011). The banking sector in India has increased its total assets more than five times between March, 2000 and March, 2010. The banking sector in India is a mixture of different ownership groups and with the stiff competition in these groups, every banks sought to improve their performance by using their limited resources i.e. inputs effectively and efficiently.

While judging the performance of any production unit, one commonly examines whether or not the unit is efficient. The efficiency/inefficiency of a production unit means the comparison between the observed and the potential/optimal output or inputs. Modern efficiency measurement begins with Farell (1957) who drew upon the work of Debreu (1951) and Koopmans (1951) to define a simple measure of firm efficiency which could account for multiple inputs. Farell (1957) proposed that

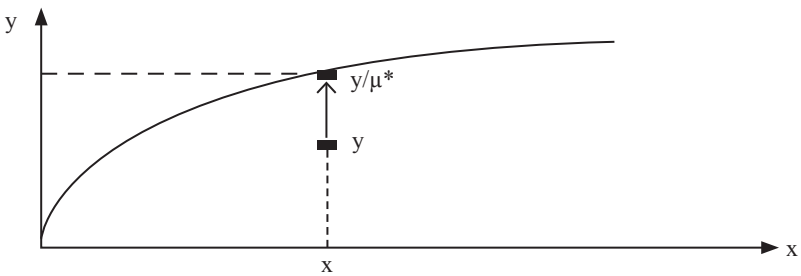
efficiency of a firm consists of two components, namely, allocative efficiency (AE) - the ability of a firm to use the inputs in optimal proportions, given their respective prices; and technical efficiency (TE) - the ability of a firm to produce existing level of output with the minimum inputs (input-oriented), or to produce maximal output from a given set of inputs (output-oriented). In other words the concept of TE is related to the productivity of inputs (Sathye, 2001). It is a comparative and relative measure of how well inputs actually processes to attain outputs, as compared to maximum potential for doing so which is signified by the production possibility frontier (Barros & Mascarenhas, 2005). The TE of any financial institution like bank a bank is its ability to transform multiple resources into multiple financial services (Bhattacharyya *et al*., 1997). On the other hand if bank fails to produce the multiple outputs from their limited and valuable resources and operates below the production frontier, it is considered to be technically inefficient.



Source: Kumbhakar & Lovel, 2000, P. 27

Figure 1 A Production frontier

The production frontier provides (as shown in the Figure 1) the upper boundary of production possibilities, and the input-output combination of each producer is located on or beneath the production frontier (Kumbhakar & Lovel, 2000).



Source: Kumbhakar & Lovel, 2000, P. 44

Figure 2 Measure of technical efficiency

In the case of a single output, an output-oriented measure of TE is given by the ratio of the observed output and the maximum level of output (Kumbhakar & Lovel, 2000):

$$TE = y_0 / y_{max}$$

Where, y_0 is observed output and y_{max} is maximum level of output.

In Figure 2, Technical Efficiency is measured by:

$$\mu = \frac{y}{y/\mu^*}$$

Where, y is the observed output and y/μ^* is the maximum output**.** TE is one of the crucial components of overall economic efficiency and in order to be economically efficient, one must firstly be technically efficient (Kumbhakar & Lovel, 2000).

The remainder of the paper is organized in the following ways. Section 2 briefly reviews the literature on the efficiency of banks. Section 3 describes the structure of Indian banking sector with reference to Public (SBI & Associates and Nationalized Banks), Private and Foreign Banks. Section 4 associates with the research methodology used in the present study and section 5 presents and discusses the empirical results pertaining to technical efficiency and inefficiency parameters of Indian banking industry. The final section concludes the findings and implications of the study and suggests the areas for future research.

LITERATURE REVIEW

Many studies for measuring efficiency (inefficiency) have been introduced by researchers using two prominent approaches. The one is data envelopment analysis - a non-parametric approach and the other one is stochastic frontier production function - a parametric or econometric approach and both approaches have their own place for the evaluation of efficiency.

To estimate the production frontier, early attempts were made by Farrel (1957) and subsequently by Aiger & Chau (1974) and these studies used the linear and quadratic programming methods for estimating such frontier. Several shortcomings' became apparent with the results of these studies and the most important among the disadvantages were that these production frontiers do not incorporate the effect of random shocks which are outside the control of firms. As a result "a few extreme measured observations determine the frontier and exaggerate the maximum possible output with given inputs" (Pitts & Lee, 1981, p.44) This problem has been overcome by the application of the stochastic production function proposed by Aiger *et al*. (1977) and Musem & Broeck (1977) later applied in numerous studies, specifies a functional form and explicitly incorporates the inefficiency component, the error term, in the estimate of production function. Pitt & Lee (1981) measured

the technical inefficiency in the Indonesian waving industry with time series cross sectional data.

Battese *et al*., (1988) applied stochastic frontier analysis model for measuring efficiencies of Indian rice firms using panel data. More models for the inefficiency effects in Stochastic Frontier Analysis (SFA) have been proposed by Kumbhakar *et al*., (1991) and Huang & Liu (1994). Kumbhakar *et al*., (1991) assumed that the technical inefficiency effects are non-negative truncations of a normal distribution with mean, which is a linear function of exogenous factors. Battese & Coelli (1992) used the frontier production function in estimating technical efficiencies of paddy farmers in India. Berger & Humphrey (1997) surveyed 130 studies that apply frontier-efficiency analysis to financial institutions in more than 20 different countries.

Nazami *et al*. (2004) identified key factors determining the technical efficiency differentials among Turkish commercial banks in the pre- and post-liberalization periods, using the technical inefficiency effects model. The study found that loan quality, size, ownership of the banks, and profitability has a positive and significant impact on the technical efficiencies of banks. Idialu (2010) used the Stochastic Frontier Analysis to measure the level of efficiency of Nigerian banks. The result of the study proved that there is inefficiency in the Nigerian banking system and that the level of inefficiency ranged from 0 to 19 per cent. The study also derives the individual bank's level of inefficiency.

Khatri (2004) using SFA technique measured the performance of Indian banks for the period 1995-2001. The results suggested that ownership significantly affects a bank's performance and also argued against the argument that Public banks are always worse than the privately owned banks. The income from fee-based services is also found to be an inefficiency factor among banks. Baten & Kamil (2010) used Battese & Coelli (1995) inefficiency model in exploring the determinants of factors causing profit efficiency differential on banking industry in Bangladesh. Using SFA technique the study examined the changes in the profit efficiency in accordance with Nationalized Commercial Banks, Islamic Banks, Foreign Banks and Private Banks and significant variations of efficiencies of banks for the period 2000 to 2007. The results indicated that the profit inefficiency declined over the reference period and Translog Production Function is more preferable than Cobb-Douglas Production Function. The results also concluded that Nationalized Commercial Banks are significantly inefficient and on the contrary Islamic Banks, Foreign Banks, and Private Banks are efficient in generating high level of profit.

Tahir & Haron (2008) examined the TE of the Malaysian commercial banks over the period of 2000-2006, using stochastic frontier approach. The findings explained that the level of efficiency of Malaysian commercial banks has increased during the period of study and also found that Domestic Banks are more efficient relative to Foreign Banks. The pioneering studies on analysing the performance of the Indian banks and comparison among them were Rangrajan & Mempilly (1972)

and Thyagrajan (1975). Swami & Subrahmanyam (1993) combined certain items of income and expenditure to construct an index of performance of banks. Probably the first published study on efficiency of Indian banks using parametric approach was Keshari & Paul (1994). They applied frontier approach to one year cross sectional data to determine the TE of Foreign and Domestic Banks and concluded that the efficiency of Foreign Banks was slightly lower than that of Domestic Banks.

Another study by Sarkar *et al*. (1998) analysed the ownership effect on Indian banking sector and found that there is a clear hierarchy among banks, as far as profitability is concerned with Foreign Banks being the most profitable. De (2004) determined the TE of the Indian banks through stochastic frontier production function using panel data for the years 1985-86 to 1995-96. The study used Cobb-Douglas technology and estimated results for two models concluding that the efficiency did not improve after liberalisation, and the Foreign Banks, as a group, had the highest efficiency. Das (2010) concluded that after financial liberalization there had been no significant change in the cost efficiency of the public sector banks. The finding also demonstrated a marginal decline in the cost efficiency of the public sector banks in the post reforms period.

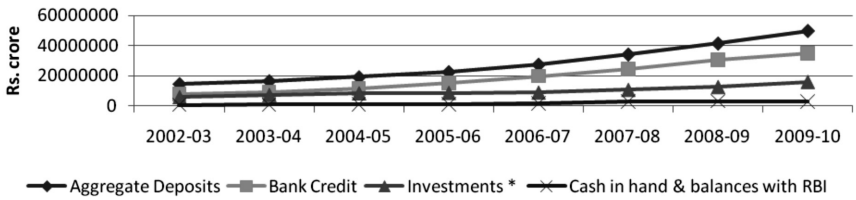
Shanmugam & Das (2004) in their endeavor evaluated TE of banks in four different ownership groups in India during period 1992–1999 by using the stochastic frontier function methodology and the results indicated that the efficiency of raising interest margin is time invariant while the efficiencies of raising other outputs-non-interest income, investments and credits are time varying. They also concluded that State Bank of India (SBI) group and Foreign Banks are more efficient than their counterparts. Bhattacharyya *et al*. (1997) divulged that deregulation has led to the improvement in the overall performance of Indian commercial banks. Gupta *et al*. (2008) evaluated the performance in the more recent period. It examined the productive efficiency on a cross sectional data over several years. Samad (2009) examined the inefficiencies of Bangladesh banking industry using stochastic frontier production function model and indicated that the average efficiency of the industry is 69.5 per cent over the time invariant cross sectional data for year 2000. Kumar & Gulati (2010) in their study analysed that TE of Indian Public Sector Banks followed an upward trend.

The present study will bridge a gap with existing literature and measures the technical efficiency (inefficiency) using the stochastic production function model defined for the panel data, in which the non-negative technical inefficiencies of banks are assumed to be dependent on the banks specific variables. This measurement will put forward benefits to banks stakeholders, managers, policy makers, investors, borrowers, depositors etc., due to the concerned about the safety, reliability and preserving the confidence of different categories of customers in the banking systems. Efficiency estimation is also useful for individual investment or loan and advances decisions and to judge past and current positions of banks alongwith the future potential and the risk associated with them.

INDIAN BANKING SECTOR

Indian banking sector is financially stable and resilient to the shocks that may arise due to higher non-performing assets and the global economic crisis. Liberalisation provided the rapid growth in the economy of India, kick-started the banking sector in India, which has seen quick growth with strong contribution from all the three categories of banks, namely, Public Sector Banks (PSBs), Private Banks and Foreign Banks. The Reserve Bank of India is the central bank of India that regulates and controls the monetary policy as well as foreign currency reserves. This institution plays an important part in the development strategy of the government. The banking sector in India comprises of commercial banks and cooperative banks of which the former accounts more than 90 per cent of the assets of the banking system. Within the category of the commercial banks, there are two types of banks one is scheduled commercial banks (listed in the Schedule II_{nd} of the RBI act, 1934) and second is non- scheduled banks.

Depending upon the pattern of ownership, scheduled commercial banks can be classified into three types: PSBs which include State Bank of India (SBI) and its associate banks; and Nationalised banks (NB). While Private sector banks consists of private domestic banks (which can further be classified as old private banks that are in business prior to 1995, and new private banks that were established after 1995) and foreign banks. Others comprise regional rural banks (RRBs) and local area banks.



Source: Statistics Relating to Scheduled Commercial Banks at a Glance, RBI, 18 November, 2009.

Figure 3 Important indicators of commercial banks in India

Since 1990's, there has been spectacular growth in the Indian banking sector. Several variables like total asset, total deposit, total credit and net profit have been analyzed to study the relative progress of the Indian banking sector. It can been seen from the Figure 1 that the aggregate deposits, credit, investments for the commercial banks has revealed prominent growth, while that of cash in hand and balance with RBI a steady growth has been recorded during the year 2002-03 to 2009-10.

Nationalized Banks group, accounts for 51.2 per cent of the aggregate deposits, while State Bank of India and its Associates account for 22.5 per cent of it. The share of Private Sector Banks and Foreign Banks in aggregate deposits experienced to be 18.0 per cent and 5.2 per cent, respectively. In case of gross bank credit, Nationalized

Table 1 Statistics relating to progress of scheduled commercial banks

Important indicators	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Number of commercial banks	298	293	291	288	222	182	173	170	167
Number of bank offices in India	68195	68500	69170	70373	71685	74346	78666	82794	87768
Credit-deposit ratio (per cent)	53.8	56.9	55.9	62.6	70.1	73.5	74.6	73.8	73.6
Cash-deposit ratio (per cent)	7.1	6.3	7.2	6.4	6.7	7.2	9.7	7.3	7.7

Source: Statistics Relating to Scheduled Commercial Banks at a Glance, RBI, 15 February 2009.

Banks held the highest share of 50.9 per cent in the total bank credit followed by State Bank of India and its Associates at 23.1 per cent and New Private Sector Banks at 13.7 per cent. Foreign Banks, Old Private Sector Banks and Regional Rural Banks had relatively lower shares in the total bank credit at 5.2 per cent, 4.5 per cent and 2.5 per cent, respectively ("Quarterly Statistics on Deposits and Credit of Scheduled Commercial Banks- Reserve Bank of India, September 2010").

The credit deposit (CD) ratio reflects the management performance of the banks. It can be seen after financial liberalization, most of the banks reported higher CD ratio. At the bank group level, the CD ratio of State Bank of India and its Associates banks was observed to be 75.6 per cent and for New Private Sector Banks 74.5 per cent. While the CD ratio accounted for Old Private Sector Banks was 73.5 per cent, Nationalised Banks (73.2 per cent), Foreign Banks (73.3 per cent) and Regional Rural Banks (61.0 per cent), respectively (Reserve Bank of India, 2009).The Table 1 also demonstrates the progress that the Scheduled Commercial Banks (SCBs) have made over the period of time. There had been a decrease in the number of commercial banks in India, but number of offices had increased over the period.

RESEARCH METHODOLOGY

Review of literature suggests that efficiency can be measured by the parametric as well as non-parametric approaches. The nonparametric linear programming approach includes Data Envelopment Analysis and parametric econometric approaches include Stochastic Frontier Approach, Thick Frontier Approach, and Distribution-Free Approach (Tahir & Haron, 2008). As different types of TE estimation approaches are present, they differ from one another on the basis of the arbitrary assumptions used to disentangle efficiency differences from random error using a single observation for each firm. The present study uses the SFA to estimate TE of SCBs. SFA has several advantages over other methods for estimating the frontier Berger *et al*., (1993). This approach allows for the decomposition of the error term into random error and inefficiency effects rather than attributing all errors (Ojo, 2008). The production frontier model without random component can be written as:

$$Y_{i=} f(X_i, \beta). TE_i$$

Where, y_i is the observed scalar output of the producer i, i=1, 2, 3…, X_i is a vector of N inputs used by the producer i, $f(X_i, \beta)$ is the production frontier, and β is a vector of technology parameters to be estimated. TE_i denotes the technical efficiency defined as the ratio of observed output to maximum feasible output. $TE_i = 1$ shows that i-th firm obtains the maximum feasible output and is technically efficient, while $TE_i < 1$ provides a measure of the shortfall of the observed output from maximum feasible output showing that i-th firm is technically inefficient.

Data and Model

Selection of output and input variables for measuring the TE of banks has been matter of debate. Banking studies used production approach (Ferrell & Lovell, 1990; Wheelok & Wilson, 1995) or intermediation approach (Berger & Humphery, 1997; Samad, 2009; Elyasiani & Mehdian, 1990) to select the input and output variables and evaluate the efficiency of banks over the period of time. The former approach considers that banks use capital, labour and other non –financial inputs to provide the services to their customers , the later treats banks as the intermediaries that combine labour, assets and capital to produce earning assets (Wang, 2000) like loans, advances and investments (Tahir & Haron, 2008). The present study uses intermediation approach to define input and output variables as this approach is more inclusive of the total banking cost as it does not exclude interest expense on deposits and other liabilities; it appropriately categorizes the deposits as inputs and it has an edge over other definitions for data quality considerations Elyasiani and Mehdian (1990).

The present study uses firm (bank) level panel data compiled for 74 SCBs from various issues of the "Statistical Tables Related to the Banks in India", published by RBI, for the period of 2005-06 to 2009-10. During the period of study out of 83 SCBs, the relevant data were available only for 74 banks as they are having continuous financial statements available over this period (for list of banks refer annexure-I attached). The final data set is the balanced data of banks belonging to four ownership groups namely SBI group (7), Nationalised Banks group (20), Foreign Banks (25) and Private Banks (22). The following Cobb-Douglas functional form is used to evaluate the results:-

$$\ln Y_{it} = \beta_{0it} + \beta_{1t}\ln(D)_{it} + \beta_{2t}\ln(F)_{it} + \beta_{3t}\ln(B)_{it} + \beta_{2t}\ln(E)_{it} + V_{it} - U_{it} \qquad (1)$$

Where i =1, 2,…, 74 and t= 1, 2,…,5

Where, Y_i-advances (output) includes bills purchased & discounted, cash credit, overdraft & loans, term loans, secured by tangible assets, covered by bank/ government guarantees, unsecured, advances in India and outside India and four inputs consist of (D)-deposits includes demand deposit from banks & others, saving bank deposits, term deposit from banks and others, (F)-fixed assets includes premises, under construction, other fixed assets and (B)-borrowings from RBI, other banks, institutions & agencies, from outside India, secured borrowings, respectively and (E)-includes the number of employees working in the banks over the period of study; V_i is the 'noise' component, which will be considered as a two-sided normally distributed variable, and U_{it} is the non-negative random variable which are assumed to account for technical inefficiency in output and to be independently distributed as truncations at zero of $N(\mu,\sigma_u^2)$ distribution; where $U_{it} = \delta Z_{it}$; Z_{it} is (1x p) vector of variables which may influence the inefficiency of bank and δ is

a (p x1) vector of parameters to be estimated. The parameterization from Battese and Corra (1977) are used replacing σ_u^2 and σ_v^2 with $\sigma^2 = \sigma_u^2 + \sigma_v^2$.

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

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

Where, the random variable, W_{it} follows truncated normal distribution with mean zero and variance σ^2, such that the point of truncation is $- \delta Z_{it}$.

Hypothesis and Likelihood Ratio Test

A number of null hypotheses need to be tested during the analysis of different dimensions of technical efficiency and inefficiency with the help of the stochastic frontier production function. (i) the absence of inefficiency effects, (ii) the absence of stochastic inefficiency effects and (iii) the coefficient of the variables in the model for inefficiency effects are zero. A likelihood-ratio test (LR test) was used to test these hypotheses:

$$\lambda = -2\{\ln [L (H_0)] - \ln [L (H_1)]\} \quad (5)$$

Where, L (H_0) and L (H_1) are the maximized value of likelihood function for the frontier model under the null and alternative hypothesis. The LR test statistic has an asymptotic chi-square distribution with parameters equal to the number of restricted parameters imposed under the null hypothesis (H_0), except Hypotheses (ii), which have a "mixed" chi-square distribution (Kodde & Palm 1986). Hypotheses (ii) involve the restriction that γ is equal to zero, which defines a point on the boundary of the parameter space (Coelli 1996, p. 6). The restrictions imposed by the null hypothesis are rejected when λ exceeds the critical value.

Parameters of stochastic frontier given by equation 1 and inefficiency model by equation 2 are simultaneously estimated by using maximum likelihood estimation. After obtaining the estimates of U_{it} the technical efficiency of i-th bank at the t-th time period is given by:

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

In the present endeavor, the inefficiency effect model is defined as:

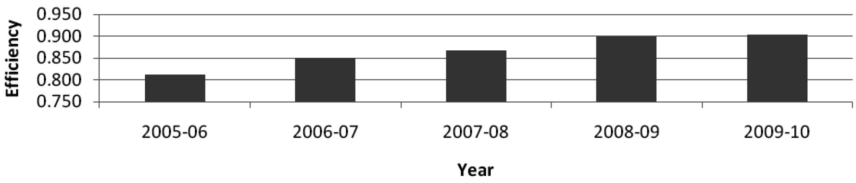
$$U_{it} = \delta_0 + \delta_1(X_1) + \delta_2 (X_2) + \delta_3(X_3) + \delta_4 (X_4) + W_{it} \quad (4)$$

where, δ_0 is the intercept and $\delta_j (j=1,2,3,4)$ are the parameters for the j-th explanatory variables, X_1 represents the cash-deposit ratio of individual banks; X_2 refers to the ratio of deposits to the total liabilities; X_3 indicates the ratio of priority sector

advances to the total advances and X_4 represents the ownership of the banks and is taken as the dummy variable, where 1 represents Public Sector banks (SBI and Nationalised group) and 0 represents the Private and Foreign bank groups.

RESULTS AND DISCUSSION

Managers and practitioners are interested to assess how internal changes may affect the performance with which firms transform resources into various financial services. Thus, a goal of policymakers as well as stockholders and managers is to devise policies that improve the performance of production or decision making units (Wheelock and Wilson, 1995). Hence, the measurement of banking efficiency studies in any economy is vital for operational as well as academic purposes (Berger and Humphhery, 1997). Efficiency estimation is also useful for individual investment or loan and advances decisions and to judge past and current positions of banks alongwith the future potential and the risk associated with them. The Figure 4 explains that at the aggregate level for all the banks the mean TE of SCBs lies between 81.3 per cent to 90.3 per cent and depicts that there is an increasing trend in the mean efficiency of banks over the period of study, although there is steady improvement in TE growth during the year 2009-10 and this may be due to spillover effects of the global slowdown experienced during the period 2008-09. These findings implies that SCBs in India have observed technical inefficiency level ranged from 9.7 per cent (1-90.3) to 18.7 per cent (1-81.3) realizing that banks should utilize their inputs by the above stated level of inefficiency so as to achieve the optimum level of technically efficiency.



Source: Authors' calculation

Figure 4 Mean TE of SCBs in India

The maximum likelihood estimates of the stochastic frontier are presented in Table 2. The parameter estimates turned out positive and attached with positive sign signifying the positive contribution of all these inputs towards generation of more advances in the banking system in a productive way. Notably, all variables are statistically significant at 1 per cent level of significance. In particular, the deposit variable and fixed assets are found dominating factors affecting bank advances which are visible by virtue of their relatively higher coefficient values as well as lower values of standard error.

Table 2 Results of stochastic frontier function for Indian commercial banks

Estimators	Coefficients	Standard Error
β0	1.216*	0.120
β1	0.136*	0.047
β2	0.567*	0.046
β3	0.120*	0.009
β4	0.097*	0.030
Inefficiency Model		
δ0	0.438*	0.352
δ1	-0.166	0.227
δ2	1.055*	0.198
δ3	-5.855*	0.325
δ4	-3.136*	0.307
σ2	1.679*	0.206
Γ	0.991*	0.002
LR	26.072	

Source: Authors' calculation
Note: * Statistically significant at 1 per cent level of significance

Table 2, in the lower half, also presents the parameter estimates of the inefficiency model embedded in the stochastic frontier. The results indicate that cash deposit ratio has a negative impact on the technical inefficiency of banks. This implies that with the increase in the amount of this ratio, the performance of the banks improves resulting in the enhancement of the technical efficiency of the banks. However, the result for this parameter is not found to be statistically significant as the value of standard error is high.

The coefficient ratio of deposit to the total liabilities turned to be out positive thereby reflecting a positive association with banks inefficiency, in other words this ratio is found affecting the banks' technical efficiency negatively further implying that with the increase in the ratio the liabilities of the banks decreases and thus results in the efficient performance of the banks primarily and then leads to the rise in the level of the technical efficiency of the banks. In other words, with the contraction of the liabilities of the banks in relation to total deposits, the banks are experiencing improvement in efficiency. It may be due to the relation that liability reduction may have spillover effect and may be working as a stimulus for augmentation of business for the banking sector. The coefficients of ratio of priority sector advances (PTA) to the total advances and classification of different ownership types among selected banks at firm level indicate that both the PTA and the public owned banks have a significant positive relationship with technical efficiency. The statistically significant positive relationship for the PTA implies that with the decline in this ratio,

the level of technical efficiency of banks' decreases while as in case of ownership the public owned banks are experienced to be relatively efficient.

Interestingly, the coefficient of σ^2 and γ are positive and statistically significant at 1 per cent level of significance revealing the level of inefficient performance of banks. In the present study γ equal to 0.991and thus the overall error variation (U_{it} and V_{it}) is mostly due to inefficiency components (U_{it}) and insignificantly caused by random error terms (V_{it}). This suggests that bank-specific variables explain the inefficiency-effects model efficiently. This result is consistent with that of Shanmugam & Das (2004). The estimated value of γ indicates that 99.0 per cent of the difference between actual and potential output is due to technically inefficient performance of banks and this amount of inefficiency are in control of these banks themselves instead of external factors. The likelihood–ratio tests of the hypothesis for technical inefficiency effects are presented in Table 3.

Table 3 Empirical results for hypotheses testing

Null hypothesis	Log-likelihood ratio statistics	Critical values	Decision
(i) H_0: $\gamma=\delta0=\delta1=\delta2=\delta3=\delta4=0$ (no. of restrictions 6)	513.41	16.811	Reject Null
(ii) H_0: $\gamma=0$ (no. of restrictions 3)	128.14	14.325*	Reject Null
(iii) H_0:$\delta0=\delta1=\delta2=\delta3=\delta4=0$ (no. of restrictions 1)	347.78	6.634	Reject Null

Source: Authors' calculation.
Note: All critical values for the test statistics are subject to the 1 per cent level of significance;
* indicates a mixture of the χ^2 distribution (Kodde & Palm, 1986).

The null hypothesis (i), which specifies that inefficiency effects are absent from the model ($\gamma=\delta0=\delta1=\delta2=\delta3=\delta4=0$), is strongly rejected at the 1 per cent level of significance, which implies that the model of inefficiency effects exists for the different banks. The null hypothesis that inefficiency effects are not "stochastic" ($\gamma=0$) is also strongly rejected, implying that the model of inefficiency effects is not reduced to a traditional mean response function and the inefficiency effects model exists, and, therefore, its estimated parameters can be identified. In addition, if the estimate of the variance parameter (γ) is close to 1, it indicates that overall residual variation (U_{it} and V_{it}) results largely from inefficiency components (U_{it}). As explained earlier, the estimated γ (0.991) shown in Table 2 is high for the commercial banks, indicating that much of the variation in the composite error term is due to inefficiency effects (U_{it}).

The last null hypothesis specifies that inefficiency effects are not a linear function of all explanatory variables ($\delta0=\delta1=\delta2=\delta3=\delta4=0$). In other words, the

null hypothesis specifies that all parameters of the explanatory variables are equal to zero. The LR test statistics is greater than the critical value of an approximately chi-square distribution at the 1 per cent level of significance. This implies that the null hypothesis for the coefficients of the explanatory variables are equal to zero is strongly rejected at the 1 per cent level of significance for the commercial banks as given in Table 3. According to the rejection of the last null hypothesis test, the model of inefficiency effects of the commercial banks in India can be assumed to be independently and identically distributed as truncations at zero of the normal distribution with mean, δZ_{it} and variance, σ_{μ}^2 (Battese & Coelli 1995).

Table 4 shows the performance of different types of SCBs in terms of TE score during the span of five years. The mean TE score during the period of study ranged from 86.5 per cent to 91.0 per cent for SBI group, 82.5 per cent to 90.6 per cent for Nationalised Banks, 81.8 per cent to 88.1 per cent for Private Banks and 69.2 per cent to 75.2 per cent for Foreign Banks. Lower mean values suggest that banks are still not able to provide efficient services to the customers and there is presence of sufficient potential to improve the level of efficiency without adding the additional resources. The mean TE score of Nationalised Banks and SBI group is relatively higher than the other groups and it is pertinent to mention that these banks undertook most of the government business transactions in country. Shanmugam and Das (2004) and Samad (2009) also corroborated these results. Thus, results reveals that ownership does play a vital role, while measuring the mean TE score of banks in India and same is confirmed by Sarkar *et al*., (1998).

The coefficient of variations of TE score of all SCBs lies from 4.079 per cent to 6.039 per cent, showing that there is less inconsistency in the level of TE. The mean TE score of 82.5 per cent indicates that on an average the sample banks realize only 82.5 per cent of their technical abilities in raising advances. That is, (1-0.825) of their technical potential is not yet utilized at all. With the same sprit it is interesting to have an explanation that the SBI group ranks first with mean TE value of (89.7) per cent. The Nationalized Banks group are ranked second (88.9) per cent followed by Private owned banks (85.6) and the Foreign Banks (71.9).

Table 4 Performance of SCBs group wise and Year wise in terms of TE

Categories	2005-06	2006-07	2007-08	2008-09	2009-10	Mean
SBI group (7)	0.865	0.886	0.908	0.915	0.910	0.897
Nationalised Bank (20)	0.825	0.900	0.908	0.908	0.906	0.889
Private Banks (22)	0.818	0.846	0.858	0.874	0.881	0.856
Foreign Banks (25)	0.692	0.692	0.711	0.750	0.752	0.715
All banks(74)	0.813	0.851	0.868	0.899	0.903	0.825
Standard Deviation	0.192	0.173	0.165	0.143	0.141	
Coefficient of Variations	4.079	4.722	5.020	5.917	6.039	

Source: Authors' calculation

Table 5 Year-Wise distribution of technical efficiency of different categories of commercial banks in India

Level of TE	2005-06				2006-07				2007-08				2008-09				2009-10			
	S	N	P	F	S	N	P	F	S	N	P	F	S	N	P	F	S	N	P	F
TE ≥ 0.95	-	1	-	1	-	1	-	1	-	1	-	2	-	-	-	1	-	-	1	2
0.95<TE ≥ 0.85	5	14	6	8	7	18	12	9	7	19	18	9	7	19	16	11	6	20	15	10
0.85<TE ≥ 0.75	2	4	12	6	-	1	7	3	-	-	3	2	-	1	5	5	1	-	6	5
0.75<TE ≥ 0.65	-	-	1	3	-	-	3	5	-	-	1	4	-	-	-	1	-	-	-	2
0.65<TE ≥ 0.55	-	-	3	2	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-	2
0.55<TE	-	1	-	5	-	-	-	7	-	-	-	5	-	-	-	4	-	-	-	4

Source: Authors' calculations

Note: S represents SBI and Associate Banks; N represents Nationalized Banks; P represents Private Banks and F represents Foreign Banks.

The Table 5 demonstrates that most of the banks from all groups operate between 85/95 per cent levels of technical efficiency which has improved over the years since 2005-06. There are only 33 banks from all groups operates in this range in 2005-06 and this number has increased to 51. Overall technical efficiency below 75 per cent level has increased over the years, whereas the efficiency level for the number of banks performing above 95 per cent level remains almost same. The private sector banks have improved considerably in their technical efficiency level since 2005-06 whereas for foreign sector banks level of performance in terms of TE almost remains same. Further it is to be noted that bank wise inter temporal TE scores are available in annexure 1.

The empirical results also confirm that in the year 2009-10 only three banks Antwerp Diamond Bank, Bank of Nova Scotia (Foreign Banks) and Dhanalakshmi Bank (Private Bank) are having mean technical efficiency score greater than 0.95 per cent whereas during the same period 4 banks, i.e., JP Morgan Chase Bank, Krung Thai Bank, Bank International Indonesia and Oman International Bank, fall in the array of TE score less than 0.55 per cent. Thus, the results from the above table conclude that there is less variation in technical efficiency score for the banks belonging to the SBI group and Nationalised Banks while that for Foreign Banks there is high variation in the range of efficiency score. The banks (Antwerp Diamond Bank and IDBI Bank Ltd.) emerge as the benchmark in the year 2005-06 followed by (Antwerp Diamond Bank and Canara Bank, 2006-07); (Punjab National Bank and Antwerp Diamond Bank, 2007-08); (Antwerp Diamond Bank, 2008-09) and lastly by (Antwerp Diamond Bank, Bank of Nova Scotia and Dhanalakshmi Bank) in the year 2009-10. Thus, Antwerp Diamond Bank emerges as the most efficient bank and Oman International Bank as the least efficient bank and both fall under the ownership of Foreign Banks.

CONCLUSION AND IMPLICATIONS

At present, banks in India are venturing into non-traditional areas and generating income through diversified activities other than the core banking activities. Strategic mergers and acquisitions were being explored and implemented. With this, the banking sector is currently on the threshold of an exciting phase (Tandon *et al*., 2010).The present attempt applied SFA approach on pooled database to measure the technical efficiency of 74 commercial banks over the period 2005-06 to 2009-10, and further the study also attempted to identify the factors affecting the level of efficiency. Empirical evidence from the SFA highlights that the banks' technical-efficiency performance is relatively high, with an average technical efficiency score of 0.83 (or 83 per cent).

The empirical results of this study reveals that all the inputs included in this study plays a essential role for the improvement in the performance of banks, the coefficients of all inputs are positive depicting that they are having positive

relationship with the dependent variables and they play an important role for providing loan and advances in productive manner. Bank management and policy-makers are expected to provide significant insights with regard to the optimal utilization of facility and allocation of scarce resources in the banking sector. This would also facilitate them the directions for the efficiency improvement of future banking operations in India. The study also indicates the dominance of fixed assets and deposits, while producing the output. Beside this, it has been found that the SBI and Nationalized Bank group perform better than their counter parts. On the other hand, the Antwerp Diamond Bank (Foreign Bank) is found to the most efficient bank over the period of study

The results also confirm the presence of inefficiency effects and these effects are proving to be stochastic in nature. The study verified that the inefficiency effects are a linear function of some firm-specific variables together with an additive stochastic error. It has been concluded that banks need to focus on the cash-deposit ratio as this ratio shows the positive relationship with the efficiency of banks. On the other hand, PTA and public ownership also have a significant relationship with a banks' technical efficiency implying that with the decline in the PTA ratio, the level of technical efficiency of banks' decreases while in case of ownership the public owned banks are found to be relatively more technical efficient. Hence, the management should have a tendency to monitor the bank carefully and effectively. Moreover, there is also need to check the level of liabilities in relation to total deposits of the banks of the banks as lower level of liabilities result into more technical efficient a commercial bank.

In this way, there is also an urgent need for the policy makers and managers of bank to focus on the internal factors as the inefficiency present in the banks are lying inside them and make a possible recommendations and solutions so as to decrease the level of inefficiency among the different type of banks in India. These findings could help the policy and decision makers to review their policies on the financial system. Hopefully, the findings of this study will open a fruitful avenue for future research in the area of Indian banking system. Further, there is need of the theoretical and applied work at the bank's branches level data so as to obtain better and broader models for stochastic frontiers and the technical inefficiency effects associated with the analysis of panel data of commercial banks in India.

REFERENCES

Aiger, D. J. and Chau, S. F. (1974) On Estimating Industry Production Function, *American Economic Review,* **58**, 826 – 839.

Aigner, D., Lovell, J. and Schmidt, P. (1977) Formulation and Estimation of Stochastic Frontier Models, *Journal of Econometrics*, **6**, 21 – 37.

Barman, R. B. (2007) Determinants of Profitability of Banks in India, Presidential Address Delivered at the 43rd Annual Conference of The Indian Econometric Society (TIES) held at Indian Institute of Technology, 5-7 January.

Barros, C. P. and Mascarenhas, M. J. (2005) Technical and Allocative Efficiency in a Chain of Small Hotels, *Hospitality Management,* **24(3)**, 415 – 36.

Baten, A. and Kamil, A. A. (2010) A Stochastic Frontier Model on Measuring Online Bank Deposits Efficiency, *African Journal of Business Management*, **4(12)**, 2438 – 2449.

Battese, G. E. and Coelli, T. J. (1988) Prediction of Firm Level Technical Efficiencies With a Generalized Frontier Production Function and Panel Data, *Journal of Econometrics,* **20**, 325 – 332.

Battese, G. E. and Coelli, T. J. (1992) Frontier Production Function, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India, *Journal of Productivity Analysis,* **3**, 153 – 169.

Battese, G. E. and Coelli, T. J. (1995) A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data, *Empirical Economics,* **20**, 325 – 332.

Battese, G. E. and G. S. Corra (1977) Estimation of a Production Frontier Model: With Application to the Pastoral Zone of Eastern Australia, *Australian Journal of Agricultural Economics*, **21(3)**, 169 – 179.

Berger, A. N. and Humphhery, D. B. (1997) Efficiency of Financial Institutions: International Survey and Direction for Future Research. The Wharton Financial Institution Centre, University of Pennsylvania Working Paper, No. 97-05.

Berger, A. N., Hunter, W. C. and Timme, S. G. (1993) The Efficiency of Financial Institutions: A Review and Preview of Research Past, Present and Future, *Journal of Banking and Finance*, **17(2-3)**, 221 – 250.

Bhattacharyya, A., Lovell, C. A. K. and Sahay, P. (1997) The Impact of Liberalization on the Productive Efficiency of Indian Commercial Banks, *European Journal of Operational Research*, **98**, 332 – 345.

Coelli, T. (1994) *FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation*. Department of Econometrics, University of New England: Armidale, NSW.

Coelli, T. J. (1996) *A Guide to FRONTIER Version 4.1: a Computer Program for Stochastic Frontier Production and Cost Function Estimation*, Working paper 96/07, Centre for Efficiency and Productivity Analysis, Armidale, University of New England.

Das, S. K. (2010) *Financial Liberalization and Banking Sector Efficiency: The Indian Experience*, 12th Money and Finance Conference, 11 – 12th March 2010 IGIDR, Mumbai, 1-28.

De, P. K. (2004) Technical Efficiency, Ownership, and Reforms: An Econometric Study of Indian Banking Industry, *Indian Economic Review*, **39(1)**, 261 – 294.

Debreu, G. (1951) The Coefficient of Resource Utilization, *Econometrica,* **19**, 273 – 92.

Dwivedi, A. K. and Charyulu, D. K. (2011) Efficiency of Indian Banking Industry in the Post-Reforms Era, Working Paper, No. 2011-03-01.

Elyasiani, E. and Mehdian, S. M. (1990). A Nonparametric Approach to Measurement of Efficiency and Technological Change: The Case of Large U.S. Commercial Banks, *Journal of Financial Services Research*, **4**, 157 – 168.

Farell, M. J. (1957) The Measurement of Productive Efficiency, *Journal of Royal Statistical Society*, **120(3)**, 253 – 81.

Farrell, G. D. and Lovell, C. A. K. (1990) Measuring Cost Efficiency in Banking; Econometric and Linear Programming Evidence, *Journal of Econometric*, **46**, 229 – 245.

Gupta, O. M., Doshit, Y. and Chinubhai, A. (2008) Dynamics of Productive Efficiency of Indian Banks, *International Journal of Operations Research*, **5(2)**, 78 – 90.

Huang, C. J. and Lau, J. T. (1994) Estimation of Non-Neutral Stochastic Frontier Production Function, *Journal of Productivity Analysis*, **5**, 171 – 180.

Idialu, J. U. and Yomere, G. O. (2010) Stochastic Frontier Analysis of the Efficiency of Nigerian Banks, *Indian Journal of Economics and Business*, **9(1)**, 75 – 86.

Keshri, P. K. and Paul, M. T. (1994) Relative Efficiency of Foreign and Domestic Banks, *Economic and Political Weekly*, **29(26)**, 31 – 36.

Khatri, D. (2004) *Performance of Indian Banks: Stochastic Frontier Approach*. IGIDR, Mumbai.

Khatri, D. (2004) Performance of Indian Banks: Stochastic Frontier Approach. Retrieved from http://ssrn.com/abstract=639801.

Kodde, D. A. and Palm, F. C. (1986) Notes and Comments Wald Criteria for Jointly Testing Equality and Inequality Restrictions, *Econometrica*, **54(5)**, 1243 – 1248.

Koopmans, T. C. (1951) *Activity Analysis of Production and Allocation*. Willey: New York.

Kumar S. and Gulati, R. (2010) *Dynamics of Cost Efficiency in Indian Public Sector Banks: A Post-Deregulation Experience*. Twelfth Annual Conference on Money and Finance in the Indian Economy. 11th and 12th March, 2010, available at http:\\ www.igidr.ac.in/~money/.../ Dynamics%20of%20cost%20efficiency_sunil%20kumar.pdf

Kumbhakar, S. and Lovell, C. (2000) *Stochastic Frontier Analysis.* Cambridge University Press: Cambridge.

Kumbhakar, S.C., Ghose, S. and McGuckin, J. T. (1991) A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in U.S. Dairy Farms, *Journal of Business and Economic Statistics*, **9**, 279 – 286.

McKinnon, R. (1973) *Money and Capital in Economic Development*. Brooking Institution: Washington, D.C.

Meeusen, W. and Vanden, J. B. (1977) Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error Term, *International Economic Review*, **18**, 435 – 444.

Nazmi, D. S. and Mahmud, S. B. (2005) The Technical Inefficiency Effects of Turkish Banks After Financial Liberalization, *The Developing Economies*, **63(3)**, 396 – 411.

Ojo, S. O. (2008) Effects of Land Acquisition for Large Scale Farming on the Performance of Small Scale Farming in Nigeria, *Journal of Human Ecology*, **24(1)**, 35 – 40.

Pitt, M. M. and Lee, L. F. (1981) Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry, *Journal of Development Economic*s, **9**, 43 – 64.

Rangrajan, C. and Mempilly, P. (1972) Economies of Scale in Indian Banking in Technical Studies for Banking Commission Report, *Reserve Bank of India*, Mumbai, 244 – 268.

Reserve Bank of India (2009) Statistics Relating to Scheduled Commercial Banks at a Glance, Mumbai.

Reserve Bank of India (2010) Quarterly Statistics on Deposits and Credit of Scheduled Commercial Banks, September, Mumbai.

Samad A. (2009) Measurement of Inefficiencies in Bangladesh Banking Industry Using Stochastic Frontier Production Function, G*lobal Journal of Business Research*, **3(1), 41 – 48**.

Sarkar, S., Sarkar, J. and Bhaumik, S. K. (1998) Does Ownership Always Matter? Evidence from Indian Banking Industry, *Journal of Comparative Economics*, **26**, 262 – 281.

Sathye, M. (2001) X-efficiency in Australian Banking: An Empirical Investigation, *Journal of Banking and Finance*, **25**, 613 – 630.

Shanmugam, K. R. and Das, A. (2004) Efficiency of Indian Commercial Banks During the Reforms Period, *Journal of Applied Financial Economics*, **14**, 681 – 686.

Subramanyam. G. and Swamy, S.B. (1993) Production Efficiency Difference Between Large and Small Banks, *Artha Vijnana*, **36(3)**, 183-193.

Tahir, I. M. and Haron, S. (2008) Technical Efficiency of Malaysian Commercial Banks: A Stochastic Frontier Approach, *Journal of Bank and Bank System*, **3(4)**, 65 – 72.

Tandon, S., Choudhary, V. and Gupta, S. (2010) Total Factor Productivity of Public Sector Banks in India: A Malmquist Approach. Retrieved from http://www.accman.co.in/i09/j10/total%2520factor%2520productivity.doc.

Tyagrajan, M. (1975) Expansion of Commercial Banking, an Assessment, *Economic and Political Weekly*, **10**, 1819 – 1824.

Wang J. C. (2000) *Bank Production, Risk, and Output Measurement: Theory*. Unpublished Manuscript, Department of Economics, University of Michigan.

Wheelock, D. C. and Wilson, P. W. (1995) Evaluating the Efficiency of Commercial Banks: Does our View of What Banks do Matter? *Review: Federal Reserve Bank of ST Louis*, 39 – 52.

ANNEXURE-I

Category-wise List of all Commercial Banks with Technical Efficiency Scores

Name of Banks	2005-06	2006-07	2007-08	2008-09	2009-10
SBI Group					
STATE BANK OF INDIA	0.867	0.901	0.921	0.925	0.924
STATE BANK OF BIKANER & JAIPUR	0.862	0.880	0.901	0.915	0.913
STATE BANK OF HYDERABAD	0.847	0.890	0.922	0.924	0.910
STATE BANK OF INDORE	0.851	0.887	0.899	0.914	0.913
STATE BANK OF MYSORE	0.864	0.876	0.897	0.904	0.875
STATE BANK OF PATIALA	0.876	0.893	0.913	0.916	0.921
STATE BANK OF TRAVANCORE	0.909	0.894	0.911	0.912	0.918
Nationalised Bank Group					
ALLAHABAD BANK	0.878	0.926	0.925	0.906	0.901
ANDHRA BANK	0.872	0.896	0.915	0.927	0.915
BANK OF BARODA	0.854	0.878	0.925	0.914	0.917
BANK OF INDIA	0.877	0.889	0.907	0.913	0.912
BANK OF MAHARASHTRA	0.802	0.878	0.921	0.934	0.887
CANARA BANK	0.004	0.957	0.919	0.917	0.909
CENTRAL BANK OF INDIA	0.863	0.894	0.906	0.923	0.924
CORPORATION BANK	0.878	0.896	0.895	0.917	0.908
DENA BANK	0.835	0.948	0.888	0.908	0.900
INDIAN BANK	0.827	0.824	0.864	0.902	0.916
INDIAN OVERSEAS BANK	0.870	0.907	0.900	0.903	0.894
ORIENTAL BANK OF COMMERCE	0.873	0.910	0.930	0.927	0.917
PUNJAB AND SIND BANK	0.905	0.948	0.873	0.852	0.869
PUNJAB NATIONAL BANK	0.876	0.878	0.979	0.913	0.915
SYNDICATE BANK	0.891	0.921	0.908	0.922	0.917
UCO BANK	0.891	0.895	0.902	0.914	0.908
UNION BANK OF INDIA	0.882	0.898	0.908	0.901	0.901
UNITED BANK OF INDIA	0.871	0.860	0.877	0.869	0.914
VIJAYA BANK	0.849	0.881	0.925	0.893	0.895
IDBI BANK LTD.	0.954	0.946	0.922	0.919	0.914
Private Banks					
AXIS BANK	0.793	0.830	0.862	0.891	0.885
BANK OF RAJASTHAN	0.648	0.829	0.838	0.823	0.916
CATHOLIC SYRIAN BANK	0.912	0.930	0.896	0.891	0.820
CITY UNION BANK	0.858	0.856	0.900	0.937	0.911
DEVELOPMENT CREDIT BANK	0.737	0.740	0.795	0.805	0.782
DHANALAKSHMI BANK	0.846	0.922	0.868	0.884	0.964
FEDERAL BANK	0.842	0.859	0.880	0.896	0.890

HDFC BANK	0.839	0.855	0.882	0.864	0.881
ICICI BANK	0.883	0.906	0.910	0.916	0.919
INDUSIND BANK	0.852	0.842	0.856	0.851	0.839
ING VYSYA BANK	0.830	0.835	0.861	0.856	0.831
JAMMU & KASHMIR BANK	0.833	0.879	0.884	0.885	0.885
KARNATAKA BANK	0.827	0.859	0.872	0.896	0.940
KARUR VYSYA BANK	0.862	0.868	0.883	0.892	0.930
KOTAK MAHINDRA BANK	0.835	0.851	0.858	0.862	0.877
LAKSHMI VILAS BANK	0.832	0.913	0.880	0.885	0.880
NAINITAL BANK	0.806	0.742	0.798	0.828	0.846
RATNAKAR BANK	0.813	0.839	0.865	0.871	0.844
SBI COMMERCIAL & INTERNATIONAL BANK	0.635	0.660	0.690	0.807	0.917
SOUTH INDIAN BANK	0.922	0.946	0.911	0.927	0.882
TAMILNAD MERCANTILE BANK	0.857	0.866	0.882	0.948	0.921
Foreign Banks					
YES BANK	0.791	0.842	0.856	0.863	0.864
ABN AMRO BANK	0.915	0.914	0.914	0.909	0.901
ABU DHABI COMMERCIAL BANK	0.324	0.494	0.601	0.623	0.827
ANTWERP DIAMOND BANK	0.972	0.972	0.972	0.973	0.977
BANK INTERNASIONAL INDONESIA	0.611	0.374	0.149	0.286	0.293
BANK OF AMERICA	0.925	0.932	0.903	0.887	0.863
BANK OF BAHRAIN & KUWAIT	0.702	0.678	0.733	0.782	0.814
BANK OF CEYLON	0.838	0.704	0.890	0.670	0.883
BANK OF NOVA SCOTIA	0.914	0.917	0.935	0.942	0.950
BARCLAYS BANK	0.138	0.121	0.361	0.907	0.884
BNP PARIBAS	0.842	0.840	0.877	0.893	0.861
CALYON BANK	0.745	0.930	0.840	0.906	0.915
CHINATRUST COMMERCIAL BANK	0.815	0.860	0.866	0.871	0.936
CITIBANK	0.866	0.884	0.880	0.895	0.879
DBS BANK	0.875	0.752	0.679	0.776	0.714
DEUTSCHE BANK	0.739	0.681	0.735	0.783	0.820
HONG KONG & SHANGHAI BANKING CORPORATION	0.821	0.832	0.831	0.842	0.802
JP MORGAN CHASE BANK	0.014	0.255	0.689	0.647	0.534
KRUNG THAI BANK	0.778	0.659	0.580	0.505	0.496
MASHREQ BANK	0.527	0.895	0.914	0.942	0.700
MIZUHO CORPORATE BANK	0.911	0.931	0.956	0.918	0.875
OMAN INTERNATIONAL BANK	0.241	0.201	0.098	0.092	0.102
SOCIETE GENERALE	0.585	0.474	0.516	0.502	0.566
SONALI BANK	0.569	0.424	0.408	0.626	0.628
STANDARD CHARTERED BANK	0.869	0.853	0.882	0.872	0.870
STATE BANK OF MAURITIUS	0.817	0.769	0.612	0.757	0.770