CHAPTER 7

DETERMINANTS OF EFFICIENCY AMONG INDIAN COMMERCIAL BANKS

In chapter 5 analysis was made on measures of cost efficiency of Indian banking system obtained from Data Envelopment Analysis (DEA) over the period 1990-2012. The empirical findings highlight that cost efficiency and its components have changed during the entire study period and these efficiency measures are different across banks. Alternatively, it can be said that some banks have reported improvement in efficiency, others did not. This indicates that there are certain factors, which may affect the efficiency of banks. Notable among these factors are the ownership structure, GDP (Gross domestic product), per capita income, inflation rate etc. These factors are treated as environmental variables used to describe factors, which could influence the efficiency of banks, and these factors are not the traditional input and output variables and considered to be outside the control of management.

In light of this, the present chapter focuses on the detailed explanation of environmental factors affecting the efficiency of banks. To view this objective the present chapter has been structured into four sections. Section 7.1 provides the issue of determinants of efficiency among banks. Section 7.2 reviews the existing literature on the determinants of efficiency of banks and provides the national and international evidence on the determinants of efficiency of banks. Section 7.3 describes the variables and methodology applied for the purpose in the present case. Section 7.4 describes empirical findings.

Section 7.1

Determinants of Bank Efficiency

A closer look at the literature provides that efficiency is generally expressed as a function of several bank and industry specific factors. Some of these factors may be neither inputs nor outputs in the production process, but rather circumstances faced by
particular bank (Sufian, Fadzlan 2007). The factors, which may have significant association with the efficiency of banks, can be classified into three groups viz. internal bank-specific or micro economic variables, external or macro economic factors and other factors. The internal bank–specific factors are termed as the endogenous factors, originate from bank accounts and these are under the control of management, and have limited influence over particular industry segments. The internal bank–specific factors include the factors such as organization of management, capital employed, input utilization, balance sheets and profit and loss accounts, labor productivity. The bank specific variables are within the scope of the bank and differ from bank to bank. The macro economic factors include exogenous factors such as GDP, per capita income, inflation rate, stock market capitalization, liberalization that are not related to bank management but reflect the economic and legal environment that affects the operation and performance of financial institutions and which have a strong influence on the efficiency and productivity of banks. The macroeconomic or external factors are beyond the control of the company and affect the profitability of banks. Other factors include the factors such as ownership, merger, number of branches, bank branch concentration that may have significant impact on the performance measures of banks.

Section 7.2

Review of Literature

Suffian, Fadzlan (2009) conducted a study to look into the variation in calculated efficiency scores to a set of explanatory variables. The author had applied two-stage data envelopment analysis technique. At the first stage, DEA is used to measure the efficiency scores of banks and at the second stage ROA, log of total assets, and log of total deposits, non-interest income, and other total assets ratio, log of GDP, ownership dummy and location dummy are used to explain variation in efficiency scores. To accomplish this objective author has used the Tobit regression analysis. The findings of Tobit regression analysis provides that banks with higher loan to assets ratio tend to have higher efficiency scores, while efficiency among Malaysian banks is negatively related to expense preference behavior and economic conditions such as GDP.
Attaullah and Lee (2006) applied two DEA models to derive technical efficiency estimates of commercial banks in India, used technical efficiency scores as dependent variable, and regressed on a set of explanatory variables using ordinary least square (OLS) method and General Moment method. The empirical findings reported that bank size is significantly related to the efficiency of banks while ROA has negatively affected the efficiency of Indian banks. Besides this, the empirical findings reported negative association between GDP and efficiency among Indian commercial banks.

Grigorian and Manale (2002) employed Tobit regression model to investigate the impact of various bank specific, macroeconomic regulatory and business environmental factors on the efficiency of banks in transition countries. The empirical findings of the study suggest that well capitalized banks are ranked higher in terms of efficiency than their poorly capitalized counterparts. The study also found that banks with larger share of a given country market are termed as more efficient than their small counterparts. Further, the findings indicate that banks with foreign ownership are found to be more efficient than domestic banks because of the ability of foreign owned banks to access better risk management and operational techniques.

Suffian and Majid (2007) applied Tobit regression model to study the impact of various economic and bank specific factors viz. profitability, bank size, capitalization, loan quality, overhead cost on the efficiency of Singapore banks. The results highlighted that bank size is significantly related to the efficiency measures obtained from DEA models whereas the profitability of bank was found to be significantly and positively associated with the efficiency of banks. In addition, the findings showed that higher cost resulted in better bank performance in Singapore and the level of loan quality was highly associated to efficiency scores of banks.

Favro and Papi (2002) pointed out that inefficiency among Italian banks is best explained by size and location variable while Miller and Noulas (2000) examined that in US banks size and profitability of banks is positively and significantly related with pure technical efficiency scores.
Previous studies provided different results on factors affecting efficiency of banks. However, from the above discussion it can be concluded that relationship among efficiency and other factors is not consistent and it depends upon the relative importance of factors in a given country.

Section 7.3

Model specification

An inspection of literature depicts that most of the studies have followed two-stage process to analyze the impact of various environmental factors on the efficiency of banks. At the first stage, efficiency measures for each bank in each sample year have been obtained by applying DEA technique and at the second stage efficiency scores are regressed on a range of explanatory variables. It is apparent from the analysis that efficiency scores differ among different banks. The analysts, bank managers and policy makers are interested in knowing whether these differences are significant or not, in statistical sense. However, they need to know what the inefficient firms can do to improve their efficiency. This study uses the multivariate regression analysis approach to examine the characteristics and their influence on the efficiency of Indian commercial banks. As the efficiency scores derived from DEA model lie between 0 and 1, application of simple regression model may provide biased results and application of Tobit regression model is more appropriate than simple regression model which handles data that is skewed and truncated (Avkiran, 1999). Contrary to some researchers pointed out that 100 percent efficiency or 0 percent inefficiency is a valid score and no higher (or lower) score is possible, by definition. In a sense the data is not truly censored at 1 or 0, OLS is therefore quite appropriate. To sum up there is no consensus among researchers on the preferred technique for studying the determinants of bank efficiency. Following Gupta et al. (2008), Suffian (2009), Grigorian et al. (2002), Attaullah and Lie (2006) Haunar (2004), the present study has used Tobit regression model rather than standard OLS regression model.

Tobit Model: The existing empirical literature on the determinants of bank efficiency has shown the impact of three types of variables on the estimated efficiency scores. The
present study relies on bank-specific and other factors to explain their relationship with estimated cost efficiency and its two components viz. TE and AE. As mentioned earlier the present study has unbalanced panel data, which has the advantage that certain effects, which may not be observable in pure time series data, can be detected and measured. A data set that comprises both time series and cross-sectional elements is known as a panel of data or longitudinal data. In panel data models, the data set consists of n cross sectional units, denoted i = 1, ..., N, observed at each of T time periods, t = 1, ..., T. In data set, the total observation is nxT (Gujarati, 2003).

Random or fixed effect models could be used for Tobit regression. Econometricians recommend the random effects (RE) method as an efficient estimator for unbalanced panel data models (Baltagi, 1999). The random effect estimator is expected to generate more efficient results after controlling for possible endogeneity. For analyzing the impact of environmental variables on efficiency, the study followed Kumar and Arora (2009) and applied the following random effect model. For the computation of the above model, STATA Version 10 is used to estimate the parameters by the method of maximum likelihood.

\[ y_{it} = \sum_{j=1}^{\infty} \beta_j x_{it} + \mu_i + \nu_{it} \]

\[ y_{it} = y_{ir} \text{ if } y_{ir} < 1 \text{ and } \]

\[ y_{it} = 1, \text{ otherwise} \quad (1) \]

Where \( \mu_i \sim \mathcal{N}(0, \sigma_\mu^2) \) and \( \nu_{it} \sim \mathcal{N}(0, \sigma_\nu^2) \) are assumed to be independent of \( X_{i1} - \ldots - X_{iT} \).

Using \( f \) as generic notation for a density or probability mass function the likelihood function of model (1) can be written as:

\[ f = \left( (y_{i1} \ldots \ldots \ldots \ldots, y_{iT} / x_{i1} \ldots \ldots \ldots, X_{iT}), \beta_j = \int_{-\infty}^{\infty} \prod_{t=1}^{T} f (y_{it} / x_{it}, \mu_i, \beta_j) f(\mu_i) d\mu_i \right. \quad (2) \]
Determinants of Bank Efficiency among Indian Commercial Banks

The explanatory variables that have been used at second stage regression are quality of staff, operational risk, profitability, size, exposure to off balance sheet activities and two dummies (Dumerger and Dupvt). Three separate regression equations have been estimated with technical, cost and allocative efficiency as the dependent variable.

\[ TEFF = \alpha_0 + \alpha_1 \text{SIZE} + \alpha_2 \text{ROA} + \alpha_3 \text{OE} + \alpha_4 \text{OFFBALANCE} + \alpha_5 \text{ORISK} + \alpha_6 \text{DUMERGER} + \alpha_7 \text{DUPVT} + \epsilon_i \quad (7.1) \]

\[ CEFF = \alpha_0 + \alpha_1 \text{SIZE} + \alpha_2 \text{ROA} + \alpha_3 \text{OE} + \alpha_4 \text{OFFBALANCE} + \alpha_5 \text{ORISK} + \alpha_6 \text{DUMERGER} + \alpha_7 \text{DUPVT} + \epsilon_i \quad (7.2) \]

\[ AEFF = \alpha_0 + \alpha_1 \text{SIZE} + \alpha_2 \text{ROA} + \alpha_3 \text{OE} + \alpha_4 \text{OFFBALANCE} + \alpha_5 \text{ORISK} + \alpha_6 \text{DUMERGER} + \alpha_7 \text{DUPVT} + \epsilon_i \quad (7.3) \]

where:

\[ \epsilon_i \] is the disturbance term and \( \epsilon_i = \nu_i + \mu_i \), where \( \nu_i \) is capturing the unobserved bank specific effect and \( \mu_i \) = idiosyncratic error ; \( i = 1,2,3 \)

TEFF = Technical Efficiency

AEFF= Allocative Efficiency

CEFF= Cost Efficiency

\( \text{SIZE} = \) Log of total assets

\( \text{ROA} = \) Return on assets as a measure of profitability
OFFBALANCE = Off balance sheet activities of banks (commission, brokerage)

OE = Operating expenses (establishment expenditure, salaries and amount of wages)

OPRISK = a measure of operating income and risk taking behavior of bank management

DUMPVT = Ownership dummy

= 1 for private sector banks 0 otherwise

DUMMERGER = measure to study the impact of merger incidence on the efficiency of banks

= 1 for banks that participate in merger activity, 0 otherwise

Table 7.1 shows the description of the explanatory variables and their hypothesized relationship with efficiency of banks.

Table 7.1: Description of the variables used in the regression analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Hypothesized relationship with efficiency</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE</td>
<td>Natural logarithm of total assets</td>
<td>+</td>
<td>is used as a proxy to examine the association of Bank size with efficiency and it is expected to take a positive sign</td>
</tr>
<tr>
<td>ROA</td>
<td>Net profits over total assets</td>
<td>+</td>
<td>is used as a proxy variable to examine the relationship between profitability and efficiency. A positive relationship is expected.</td>
</tr>
<tr>
<td>Operating Expenses (OE)</td>
<td>Establishment expenses + salaries over total no. of employees</td>
<td>+/-</td>
<td>is used as a proxy variable for overheads cost and there is no priori expectation on the variable sign.</td>
</tr>
<tr>
<td>Exposure to off balance sheet activities (OFFBALANCE)</td>
<td>Non -interest income over total assets</td>
<td>+/-</td>
<td>is used as a proxy for banks diversification strategy. A positive relationship is expected.</td>
</tr>
<tr>
<td>Operational risk</td>
<td>Total loans over total assets</td>
<td>+</td>
<td>is used as a measure of risk.</td>
</tr>
</tbody>
</table>
DUMMERGER Dummy variable that takes a value 1 for banks that participate in merger activity, 0 otherwise + is used to examine the impact of merger on the efficiency of banks. This variable is expected to have positive sign.

DUMPVT Dummy variable that takes a value 1 for Private sector banks, 0 otherwise +/- is used to examine the association between bank ownership and efficiency. There is no priori expectation on the variable sign.

Section 7.4 Results and discussion

In order to check the existence of the problem of multicollinearity between explanatory variables, correlation coefficient test was applied. Correlation above 0.8 between independent variables indicates the existence of the problem of multicollinearity (Guajarati, 2003.) As depicted in Table 7.2 all the correlation co-efficient between independent variables are less than 0.8, so there is no problem of serious multicollinearity.

Table: 7.2 Correlation Coefficient between variables

<table>
<thead>
<tr>
<th></th>
<th>LA</th>
<th>Offbalance</th>
<th>Qstaff</th>
<th>Oprisk</th>
<th>Profitability</th>
<th>Dumpvt</th>
<th>Dumerger</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offbalance</td>
<td>0.173</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qstaff</td>
<td>0.791</td>
<td>0.297</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oprisk</td>
<td>0.517</td>
<td>0.167</td>
<td>0.202</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td>0.268</td>
<td>0.251</td>
<td>0.123</td>
<td>0.217</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dumpvt</td>
<td>0.040</td>
<td>0.160</td>
<td>-0.02</td>
<td>-0.32</td>
<td>0.139</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dumerger</td>
<td>0.155</td>
<td>-0.41</td>
<td>0.076</td>
<td>0.161</td>
<td>-0.21</td>
<td>-0.322</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 7.3 shows the results of the unbalanced panel data Tobit regression model. The results are based on 1204 observations during the period 1990-2012. The following are major findings of Tobit regression analysis.

**Size:** Log of total assets is used as a proxy of size to determine the possible cost advantages associated with size. The reason behind using logarithmic transformation is to compress the difference among the values of the variables. Previous studies in banking sector have predicated a strong and positive relationship between size and bank efficiency. Most of these studies have applied either different bank size groups like large, medium and small banks (see Fethi, M.D et al., 2005) or log of total assets as proxy variable for bank size. It is evident from Table 7.3 that the value of size co-efficient has worked out to be (0.04363) for all Indian CBs in case of CE, (0.586016) for TE and (0.24710) for AE and the values of these co-efficients are found to be positively and statistically significant. The empirical findings of the study suggest that larger the bank size, the more efficient the bank will be because of the U-shaped scale economies implied by the empirical literature, which may be due to the fact that larger banks have more capital that can be used to adopt new technology and that can help the banks for minimizing their management cost. The findings also suggest that when banks achieve economies of scale large banks are able to attract more loan and deposits which further result in high level of efficiency scores. The results are consistent with the findings of Hurner (2004). Moreover, similar sign of co-efficient has been found by Hall et al. (2008) for the Hong Kong banks and Attaullah and Lee (2006), Mahesh H.P (2006) found a negative relation with inefficiency which implies that larger banks are less cost efficient than smaller banks.

**Exposure to Off balance-sheet Activities:** The present study has used the ratio of non-interest income to total assets to investigate the influence of banks diversification strategy into non-traditional activities and it is considered as another important variable that affects the efficiency of banks in India. The empirical findings suggest that the value of OFFBALANCE co-efficient turned out to be (0.224975) in case of cost efficiency and it is found to be statistically significant at 5 % level of significance. The findings suggest that the banks tend to become more cost efficient as they increasingly engage themselves...
in modern banking activities. The results for allocative efficiency and technical efficiency have also shown the same trend. For TE the value of OFFBALANCE coefficient worked out to be (0.167648) and (0.14625) for AE and it found to be significant at 1 percent level of significance in case of TE and at 5 percent in case of AE. The results indicate that positive sign of the coefficient is in accordance to the priori expectations. Therefore, OFF BALANCE sheet activities have been observed as an important variable affecting efficiency of banks in India. The findings point out that income from balance sheet items such as brokerage, exchange, fees, and commissions have increased among banks in India especially after the deregulation. These findings are consistent with the findings of Kwan (2006) which provides strong impact of exposure to off –balance sheet activities on the efficiency of banks.

Operating Expenses: Operating expenses can be treated as another important variable affecting efficiency of Indian banks during the entire study period. This variable represents the total amount of wages and salaries, as well as cost of running branch office facilities. Most of the previous studies suggest that reduced expenses improve the efficiency of banks, which indicates that banks that allocate more expenses to their personnel being less efficient. Sathye (2002) suggested that in India efficiency of banks is affected by establishment expenses because it contributes a high percentage of total expenses of banks, so negative sign is expected. Table 7.3 indicates that the value of operating expenses works out to be (-0.16273) for CE, (0.018) for TE, and (-0.02183) for AE. As shown in the table except TE, all other measures of efficiency are negatively and significantly related to OE, which implies that banks which incurred more expenditure on staff are found to be less efficient. The findings reveal that negative sign of the coefficient is accordance to the priori expectations. The policy implication of this finding is that human skills play an important role in the functioning of banks and there is need to pay greater attention to the training of their staff so that productivity of staff in the bank’s should be improved which will result in higher level of efficiency. These findings are consistent with the findings of Badola and Verma (2006).
### Table 7.3: Findings of Tobit Regression Analysis

<table>
<thead>
<tr>
<th>dependent Variable → Explanatory Variable</th>
<th>CE</th>
<th>TE</th>
<th>AE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Co-efficient</td>
<td>Z-Value</td>
<td>P-Value</td>
</tr>
<tr>
<td>Constant ($\alpha_0$)</td>
<td>0.5811328**</td>
<td>8.61</td>
<td>0.000</td>
</tr>
<tr>
<td>LA($\alpha_1$)</td>
<td>0.436345*</td>
<td>2.07</td>
<td>0.039</td>
</tr>
<tr>
<td>OFFBALANCE($\alpha_2$)</td>
<td>0.224975*</td>
<td>2.82</td>
<td>0.005</td>
</tr>
<tr>
<td>QSTAFF($\alpha_3$)</td>
<td>-0.16273*</td>
<td>2.37</td>
<td>0.018</td>
</tr>
<tr>
<td>OPRISK($\alpha_4$)</td>
<td>0.0004356</td>
<td>-1.81</td>
<td>0.071</td>
</tr>
<tr>
<td>Profitability($\alpha_5$)</td>
<td>0.325455**</td>
<td>6.57</td>
<td>0.000</td>
</tr>
<tr>
<td>DUMPVT($\alpha_6$)</td>
<td>0.59561*</td>
<td>2.24</td>
<td>0.025</td>
</tr>
<tr>
<td>DUMERGER($\alpha_7$)</td>
<td>-0.0059</td>
<td>0.28</td>
<td>0.781</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>415.637</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LR-Test(Null$\sigma_0=0$)</td>
<td>63.64</td>
<td>-</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: ** and * indicates significant at 1% and 5% level of significance respectively.
Operational Risk: Operational risk can be considered as one of the most important variables affecting cost efficiency of banks in India. It is apparent from the previous literature that most of the studies have used S.D of ROA as a proxy variable for operational risk. Following Seelanather, S.L (2007) Altunbas et al. (2002), Suffian (2009), this study applied the total loans to total assets ratio as a proxy variable for operational risk. Operational risk variable proved to be a very useful variable for measuring the risk observing behavior of banking sector. It has been well studied in the literature that profit-seeking banks mostly participated in high risk lending portfolios to capture higher interest income. The need for risk management in the banking sector is inherent in credit risk which may reflect changes in the health of banks loan portfolio (Rogers,K.E, 1998). Most of the existing literature shows that loans are considered as the largest segment of interest bearing assets and other things remaining constant, more the deposits are transformed into loans the higher is the level of efficiency of banks. So this variable is expected to have positive relationship with efficiency of banks. The results of the Tobit regression analysis are presented in Table 7.3. It is apparent from the analysis that both TE and AE have been found to be positively related with operational risk. The findings further reveal that AE has recorded a significant relationship with operational risk at 1 % level of significance whereas CE is negatively but not significantly associated with operational risk and indicates that bank should put more emphasis to improve operational efficiency and should devote more funds into productive resources.

Profitability: Previous studies have used two indicators namely ROA and ROE ( ie. Doshit et al. 2003, Attulah and Lee (2006) Suffian (2009), Suffian, (2007) and the return to equity (Griograin and Mohole (2002), Pasiouras , F (2006) to symbolize the profitability of banks. Profitability shows the firm’s ability to earn excess revenue from its total expenditure. The return on assets is an indicator on how efficiently a bank is being run and gives information on how much profit is generated on an average by each unit of assets whereas the return on equity indicates the return to the shareholders on their equity. Following Suffian (2009), Doshit at.al (2003), the present study has applied return on assets as a proxy variable for banks profitability. It has been well studied in the literature that higher level of profitability leads to higher level of efficiency among banks.
As shown in Table 7.3 the value of ROA co-efficient worked out to be (0.3254) in case of CE and is found to be highly significant at 1 percent level of significance. For TE the value of co-efficient turned to be (0.172754) for TE and (0.283422) for AE. All the co-efficient bear expected signs and are found to be statistically significant at 1 percent level of significance. Therefore, ROA has proved to be the major determinant of efficiency among Indian commercial banks. These findings are consistent with the findings of Jackson and Fethi (2000), Suffian (2009), Doshite et al. (2003), which showed that more profitable banks are more efficient.

**Ownership**: Ownership characteristics of the bank has also emerged as important factor contributing to the variation in the efficiency of commercial banks as it is expected that there will be performance variation across groups of banks. Private and public sector banks are operated with different objectives. Therefore, in the present study to investigate the relationship between ownership of bank and bank efficiency DUPRIVATE is used as explanatory variable in the regression model. It takes a value 1 if the bank belongs to private sector and zero otherwise. It is apparent from the analysis that the estimated co-efficient of the ownership dummy variable indicate that PVT banks were significantly more cost efficient and allocative efficient than public sector banks. The value of DUPRIVATE is found to be 0.5936 in case of CE and 0.0656 in case of AE efficiency and these values are found to be significant at 1 percent and 5 percent level of significance respectively. Thus, it emanates from the analysis that majority of PVT sector banks have accessed advanced technology and expertise, better risk management and corporate governance. These findings are consistent with the findings of Mohan and Ray (2004).

In the present study DUMERGER is used as a dummy variable to study the relationship between merger activity and efficiency of banks. This variable takes the value of 1 if the bank participates in merger activity and zero otherwise. Generally, it is predicted that merger resulted in improvement in efficiency of banks and it is hypothesized that DUMERGER has positive association with efficiency of banks. It is clear from the findings of Tobit regression analysis that the estimated co-efficient of merger dummy variable is found to be (-0.0059) for cost efficiency which is not found to
be significant. DUMMERGER variable shows negative sign across various measures of efficiency except TE, which indicates that merger, causes a decline in efficiency performance. This variable is not found to significant at any conventional level of significance. These findings are consistent with the findings of Berger and Humphrey (1992). Berger (2003) shows that merger can decrease bank’s efficiency due to an increase in costs-legal expenses, consultation charges, different organizational cultures and managerial skills.

**Conclusion:** The whole analysis reveals that ROA coefficient has significant and positive relationship with all measures of efficiency. This indicates that higher level of profitability leads to higher level of efficiency among banks. Another important variable which significantly affects the efficiency of banks is bank size, indicates that larger the bank size, the more efficient the bank will be because of the U-shaped scale economies. There is a need to pay greater attention to the training of banks staff so that productivity of staff in the banks should be improved which will result in higher level of efficiency. From the above analysis it may be concluded that merger is not only one of the factors responsible for affecting the efficiency of banks but there are several other bank-specific and macroeconomic variables which influence the efficiency of banks.