CHAPTER V

SUMMARY AND CONCLUSIONS
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5.1 In bank’s business Credit Risk (CR) is there in every debt instrument. Since risk is associated with uncertainty its impact on business can not be assessed exactly. Credit risk arises due to exogenous non-discretionary factors such as intervention of government through its fiscal policies, intervention of the Central Bank through its monitory policies, increased competition due to globalization and liberalization, economic recession and so on. These exogenous environmental variables which can not be controlled by commercial bank, but banks can adjust their business intune with the exogenous credit risk environment. Credit risk is influenced by endogenous discretionary and non-discretionary factors. Scrutiny of the credit applications, collateral security, legal section of the bank, control of rate of interest are some issues which determine endogenous environment of commercial banks.

Of the two popular methods to model a bank viz., the production approach and intermediation approach, the former approach is chosen. The inputs are chosen apriori as Number of Employees and Fixed Assets. However, the outputs are chosen by a stepwise method. Deposits, Advances and Investments are found to the most influencing outputs on output technical efficiency.

The impact of credit risk is often found in the non-performing assets per unit of deposits. This variable is chosen as an undesirable output that is null joint with desirable outputs and weakly disposed. Null jointness requires that undesirable output is zero provided that desirable outputs are zero. That is there will be no NPAs if there are no loans and advances. Inputs and desirable outputs are freely disposed while undesirable output is weakly disposed. In banking business with NPA provisions are associated. These provisions are meant to clear up NPAs which leads to a fall in other outputs such as loans and advances and investments.

The present study is based on secondary data collected from Reserve Bank of India for the financial year 2008-09.
Data Envelopment Analysis (DEA) models are chosen as basic tools to assess efficiency of production of 78 commercial banks. Any DEA study should originate from Charnes, Cooper and Rhodes (CCR, 1978) model and Banker, Charnes and Cooper (BCC, 1984) model. These models should be tailored to meet the objectives of the researcher, and this study is no exception. We have formulated new DEA methodology to measure output productivity efficiency.

(1) **CCR Efficiency:**

The CCR model does not take into consideration environmental factors exogenous and endogenous, and returns to scale into consideration. Hidden in the CCR technical efficiency score the influence of environment and returns to scale differences.

\[
\theta (CCR) = \text{Max } \delta
\]

subject to \( \sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{i0}, \quad i = 1, 2 \)

\[
\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, \quad r = 1, 2, 3
\]

\( \lambda_j \geq 0 \)

(2) **BCC Efficiency:**

The BCC (1984) model removes the influence of output returns to scale differences from \( \theta (CCR) \).
\[ \theta(\text{BCC}) = \text{Max} \ \delta \]

subject to \[ \sum_{i=1}^{n} \lambda_i x_{i} \leq x_{i0}, \quad i = 1, 2 \]

\[ \sum_{r=1}^{3} \lambda_r y_{r} \geq \delta y_{r0}, \quad r = 1, 2, 3 \quad (5.1.2) \]

\[ \sum_{j} \lambda_j = 1 \]

\[ \lambda_j \geq 0 \]

\[ y \]

\[ \theta(\text{CCR})y_A \]

\[ \theta(\text{BCC})y_A \]

\[ y_A \]

\[ x_A \]

Below there are two frontiers one emanating from origin which is consistent with constant returns to scale, the other formulated by the line segment CD, DE and EF. The production unit that operates at A is technically inefficient. If \( y_A \) is vertically projected on to the variable returns to scale frontier, A, gives \( \theta(\text{BCC}) \). A further projection onto the constant returns to scale frontier, A, gives \( \theta(\text{CCR}) \). Output scale efficiency is obtained as,
\[ \theta(\text{SE}) = \frac{\theta(\text{CCR})}{\theta(\text{BCC})} \geq 1 \]  

The scale efficiency of public sector banks are distributed over the interval (1.00, 4.68).

\[ \theta(\text{SE}) \] is measured along horizontal axis and the frequency of banks is measured along vertical axis. In the interval (1.0, 2.0) there is only one commercial bank. In the next interval (2.0, 3.0) the efficiencies of 7 banks have fallen and in the subsequent interval 18 banks are found. Finally, in the interval (4.0, 5.0) only one bank’s efficiency has fallen. Larger values of \( \theta(\text{SE}) \) implies greater output technical inefficiency. The frequency distribution is skewed towards poor output scale efficiency.

Among private sector banks, as found in public sector banks there is no single bank attaining scale efficiency. The frequency distribution of scale efficiency is found as follows:
The mode of the scale efficiency distribution is found to fall in the interval (2.0, 3.0). The mode of public sector banks belongs to the interval (3.0, 4.0). In terms of scale efficiency private sector banks perform better than the public sector banks.

We find four banks attaining output scale efficiency among foreign sector banks. For foreign sector banks output scale efficiency is distributed on only one interval (1.0, 4.0147) revealing that this sector is the best when output scale efficiency is considered as a parameter.
This distribution of scale efficiency is skewed and sectoral efficiency of foreign sector banks dominate the sectoral scale efficiency of public and private sector banks.

**SCALE EFFICIENCY:**

Public Sector Banks : $1.5829 \leq \theta (SE) \leq 4.6771$

Private Sector Banks : $1.0355 \leq \theta (SE) \leq 4.4393$

Foreign Sector Banks : $1.0000 \leq \theta (SE) \leq 4.0147$

For equality of scale efficiency distribution of public, private and foreign sector banks an F-test is performed and the null hypothesis is rejected at 5% level of significance. A t-test is also performed to test the significant difference between sectoral scale efficiency of public and private, public and foreign, and private and foreign sector banks.
Public – Private Sector \( p = 0.005 < 0.01 \)
Public and Foreign Sector \( p = 0.001 < 0.01 \)
Private and Foreign Sector \( p = 0.002 < 0.01 \)

The above \( p \) – values reveal the equality between sectoral means is decisively rejected. Therefore, the output scale environment is not uniform over the public, private and foreign sector banks.

5.2 EXOGENOUS CREDIT RISK EFFICIENCY:

\[ u = (\text{Non-Performing Assets/Advances}), \text{ may be viewed as an undesirable output, and in case of inefficiency this output can not be freely disposed off. John Ruggiero (1996, 2004, 2006) chose such a variable as an environmental variable determined by non-discretionary factors exogenous to the production unit whose efficiency is under evaluation. He claimed that while efficiency of a Decision making Unit (DMU) is under evaluation, with its performance, the performance of DMUs performing in equal or inferior environment should be compared. In (BCC, JR) model the reference set varies from one commercial bank to another.} \]

\[
\theta(\text{BCC, JR}) = \max \theta \\
\text{subject to } \sum_{i \in I} \lambda_i x_{ij} \leq x_{io} \\
\sum_{i \in I} \lambda_i y_{ij} \geq \theta y_{io} \tag{5.2.1} \\
\sum_{i \in I} \lambda_i = 1 \\
\lambda_i \geq 0
\]

Larger is \( u \), greater is environmental disadvantage.
Following Fare and Grosskopf, the ratio $\theta(BCC) / \theta(BCC, JR) = \theta(Exo) \geq 1$, measures exogenous credit risk efficiency. $\theta(BCC, JR)$ removes the influence of exogenous risk impact from $\theta(BCC)$. $\theta(Exo)$ measures exogenous credit risk efficiency.

Exogenous risk efficiency scores of public sector banks are distributed in the interval (1.0, 1.4).

Figure (5.2.1)

The mode of the distribution falls in the interval (1.0, 1.2). The mean exogenous credit efficiency score of the public sector banks is, 1.0606.

Among private sector banks only two banks are found attaining exogenous credit risk efficiency. The exogenous risk efficiency is distributed on the interval, (1.0, 4.5635).
The exogenous risk efficiency distribution of private sector banks is found to have its mode in the interval (1.0, 1.2). The exogenous risk efficiency scores of 13 private sector banks fall in the above interval.

Among foreign sector banks 11 banks attained exogenous credit risk efficiency. The remaining banks are found to suffer from exogenous credit risk inefficiency.
The mean exogenous risk efficiency score of foreign sector banks is 1.1256. The hypothesis of uniform exogenous credit risk environment is rejected at 10 percent level of significance. We have statistically compared the means of public-private, public-foreign and private-foreign sector bank.

<table>
<thead>
<tr>
<th>Sector Type</th>
<th>Hypothesis Test</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Sector Banks</td>
<td>$1.00 \leq \theta(\text{Exo}) \leq 1.2791$</td>
<td>0.06</td>
</tr>
<tr>
<td>Private Sector Banks</td>
<td>$1.00 \leq \theta(\text{Exo}) \leq 4.5635$</td>
<td>0.08</td>
</tr>
<tr>
<td>Foreign Sector Banks</td>
<td>$1.00 \leq \theta(\text{Exo}) \leq 1.6450$</td>
<td>0.20</td>
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</tbody>
</table>

The hypothesis of uniform exogenous credit risk environment between public-private and private-foreign is rejected at 10 percent level of significance, while the hypothesis is accepted for private-foreign sector.

5.3 **ENDOGENOUS CREDIT RISK EFFICIENCY:**

Credit risk efficiency is influenced by internal discretionary and non-discretionary factors. A strong internal risk control system prevents NPAs from occurring. With weak disposability imposed we solve the following linear programming problem:
\[ \theta(BCC, JR, BM, WD) = \text{Max } \delta \]

subject to \[ \sum_{i \in I_0} \lambda_i x_{i0} \leq x_{\alpha} \quad i = 1, 2 \]
\[ \sum_{r \in I_0} \lambda_r y_{r0} \geq \delta y_{\alpha} \quad r = 1, 2, 3 \]
\[ \sum_{j \in I_0} \lambda_j u_j = u_0 \]
\[ \sum_{j \in I_0} \lambda_j = 1 \]
\[ \lambda_j \geq 0, \forall j \in I_0 \]

where \( I_0 = \{ j : u_j \geq u_0 \} \) 

(5.3.1)

It was already shown that,

\[ \theta(BCC, JR) \geq \theta(BCC, JR, BM, WD) \]

(5.3.2)

The ratio,

\[ \theta(\text{Endo}) = \frac{\theta(BCC, JR)}{\theta(BCC, JR, BM, WD)} \geq 1 \]

Among public sector banks 9 banks attained endogenous credit risk efficiency. \( \theta(\text{Endo}) \) is distributed over the interval (1.0, 1.1870). The small mean value 1.0337 of endogenous risk efficiency imply the public sector banks almost endogenous risk efficient.

When we come to private sector banks \( \theta(\text{Endo}) \) is found to distribute on the interval (1.00, 2.2489). Among the private sector banks only 5 banks attained endogenous credit risk efficiency. The sectoral endogenous credit risk efficiency attained is 1.0794.
For foreign sector banks the endogenous credit risk efficiency score is distributed on the interval (1.00, 1.9985). 23 banks attained endogenous risk efficiency score of 100 percent. The hypothesis of uniform endogenous risk efficiency is accepted at 1 percent level of significance.

Public – Private Sector : \( p = 0.40 > 0.05 \)
Public and Foreign Sector : \( p = 0.68 > 0.05 \)
Private and Foreign Sector : \( p = 0.59 > 0.05 \)

All the three hypotheses of uniform endogenous risk environment for public-private, public-foreign and private foreign are accepted.