Chapter V

SUMMARY AND CONCLUSIONS
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5.1 The present study is initiated to deal with the following objectives.

- to evaluate overall efficiency.
- to estimate exogenous credit risk.
- to compute endogenous credit risk.
- to estimate cost efficiency and
- to estimate revenue efficiency of Indian commercial banks. These banks can be grouped to form public, private and foreign sector banks.

To test validity of various hypotheses the data used are secondary, obtained from the Bulletins of Reserve Bank of India (RBI) for the financial year (2009-10).

The methodology is provided by Data Envelopment Analysis (DEA) and the basic tool is linear programming. The distance function used to accomplish the purpose is the Directional Distance Function invented and developed by Chambers et.al., (1998).

The first step involved to promote DEA is modeling the Indian Commercial Banks. To model a financial institution the researcher has to identify key variable on inputs and outputs that govern the institutions' behaviour.

Another key issue of DEA is choice of the optimization approach. For example, for a given input vector output may be maximized; for a given output vector inputs are minimized; profit maximization simultaneously reduces inputs and increase outputs.

To gauge efficiency two types of measures are used in the DEA literature.

- Radial measures.
- Non-radial measures.

Radial measures include Farrell's, Charnes, Cooper and Rhodes', (CCR, 1978) and Banker, Charnes and Coopers' (BCC, 1984) measures.
Various non-radial measures are, Russell’s measures, Hyperbolic Graph measures, slack based measures and finally the directional distance based measures.

The benchmarks provided fall on either convex or non-convex frontiers. The various frontier production functions are, constant returns to scale frontiers, variable returns to scale frontiers and Free Disposable Hull (FDH) frontiers.

The proposed study,

- uses linear programming problem as basic tool.
- uses directional distance function as a measure to gauge inefficiency.
- contracts inputs and expands outputs simultaneously.
- uses convex frontier production function to provide benchmarks.

Overall directional efficiencies are calculated for each bank of public, private and foreign sector.

- Foreign sector banks are best performers.
- Public sector banks perform better than private sector banks.
- The mean differences of directional efficiency scores of public and private sector banks do not differ significantly from zero.
- The mean difference of public and foreign; private and foreign is significantly different from zero at one percent level of significance.

5.2 The overall directional efficiency contains implicitly exogenous and endogenous risk efficiency differences. We disentangle exogenous risk differences from the overall directional efficiency, to obtain modified directional distance efficiency scores. In terms of them,

- best performers are foreign sector banks.
- public sector banks slightly perform better than the private sector banks.
- the mean difference of modified directional efficiency of public and private sector banks does not differ significantly from zero, at 1% level of significance.
- the difference of means of modified directional efficiency of public and foreign; private and foreign sectors do differ significantly from zero, implying that the foreign sector banks out perform the public and private sector banks.
From the modified directional efficiency endogenous risk differences are removed assuming that non-performing assets (NPAs=z) are endogenous.

- Foreign sector banks are best performers.
- Public sector banks perform slightly better than private sector banks.
- As evidenced from the previous cases the difference of means of public and private sector banks does not differ significantly from zero.
- The mean differences of public and foreign; private and foreign sector banks, of further modified (pure) directional efficiency scores, are significantly different from zero at one percent level of significance ($p < 0.01$).

5.3 The directional exogenous risk efficiency is obtained from the following difference:

$$\hat{D}(x_0, u_0, z_0; x_0, u_0) - \hat{D}(x_0, u_0, z_0; x_0, u_0, z_0)$$

If this difference is attained zero value the corresponding commercial bank is said to be directional exogenous risk efficient.

In all the sectors, viz., public, private and foreign sector banks losses of inputs and outputs are only marginal, implying that all the three sectors are directional exogenous risk efficient.

- The hypothesis, $H_0: \mu_{1,0}^{\text{mace}} = \mu_{1,0}^{\text{mace}} = \mu_{1,0}^{\text{mace}} = 0$ is accepted at 1% level of significance where $\mu_{1,0}$ is mean exogenous risk efficiency.

Directional endogenous risk efficiency is measured by the following ratio:

$$\hat{D}(x_0, u_0, z_0; x_0, u_0, 0) - \hat{D}(x_0, u_0, z_0; x_0, u_0, z_0)$$

If this difference is zero, then the corresponding commercial bank attains 100 percent directional endogenous risk efficiency.

- The above difference is tested against zero individually, for public, private and foreign sector banks.
- This did not differ significantly from zero for the three sectors.
- The hypothesis, $H_0: \mu_{1,0}^{\text{mace}} = \mu_{1,0}^{\text{mace}} = \mu_{1,0}^{\text{mace}} = 0$ is accepted at one
percent level of significance.

- Losses of inputs and outputs due to directional endogenous risk efficiency are only marginal in all the three sectors.

5.4 A commercial bank's primary objective is profit maximization, which is possible by decreasing inputs cost and increasing outputs revenue simultaneously.

The study examined how cost efficient the commercial banks are?

Cost efficiency is the ratio: \[ \frac{Q(u_0, p_0)}{p_0^x_0} \]

which lies between 0 and 1.

Numerator is the factor minimal cost and the denominator is observed cost, larger this ratio better is the cost efficiency.

- Foreign sector banks are best performers.
- Public sector banks perform slightly better than the private sector banks.
- The mean difference of cost efficiency scores of private and public sector banks do not differ significantly from zero at 5% level of significance.
- The mean difference of cost efficiency scores of public and foreign: private and foreign sector banks are found to differ significantly different from zero.

5.5 Revenue efficiency of a commercial bank is defined as follows.

\[ \frac{r_0^x_{u_0}}{R(x_0, r_0)} \]

The above ratio lies between 0 and 1. The denominator is potential revenue and numerator is observed revenue.

- Best performer is Foreign sector.
- Public sector performs slightly better, but the difference of means is not significantly different from zero.
- The difference of mean revenue efficiency scores of public and
foreign; private and foreign sector banks are found significantly
different from:

5.6 The difference between potential revenue and potential cost defines profit. The
Nerlove profit efficiency in the context of the present study takes the form:

\[ a = \frac{\pi - \pi^t}{\pi^t} \]

where
- \( a \): Nerlove directional profit.
- \( \pi \): potential profit.
- \( \pi^t \): Observed profit of \( k^t \) commercial bank whose efficiency
  is under evaluation.
- \( a \pi^t = \pi - \pi^t \).
- \( \pi = (1 + a) \pi^t \).

Potential profit is \((1 + a)\) times the observed profit of \( k^t \) commercial bank.

- The best performers are foreign sector banks.
- \( \pi = (6.1) \pi^t \).

Potential profit is 6.1 times the observed profit on an average for the foreign
sector banks.

- Public sector banks perform better than private sector banks.
- Potential profit of public sector banks is 7.3 times the realized profit on an
  average.
- For private sector banks, \( \pi = (8.05) \pi^t \).

On an average the potential profit of private sector banks is 8 times the observed
profit.
5.7 ALLOCATIVE EFFICIENCY:

<table>
<thead>
<tr>
<th>Sector Wise</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Sector Banks</td>
<td>6.0641</td>
<td>1.9293</td>
<td>31.8151</td>
</tr>
<tr>
<td>Private Sector Banks</td>
<td>10.8093</td>
<td>39.4673</td>
<td>34.21</td>
</tr>
<tr>
<td>Foreign Sector Banks</td>
<td>4.9761</td>
<td>7.2618</td>
<td>145.9336</td>
</tr>
</tbody>
</table>

The difference,

\[
\frac{\pi - \pi^*}{\pi^*} - \hat{D}(x_0, u_0; x_0, u_0)
\]

measures allocative efficiency.

When considered average performance, foreign sector performs better than public and private sector banks.

- The performance of public sector banks is better than private sector banks.

5.8 CONCLUSIONS:

1. In public, private and foreign sectors the input and output losses are only marginal due to both exogenous and endogenous risk.

2. Foreign sector banks are the best performers when their performance is gauged either by the overall directional efficiency or by the modified directional efficiency measure.

3. Nerlove's profit efficiency reveals foreign sector banks are the best performers and public sector banks perform better than private sector banks by only marginally.

4. The mean allocative efficiency scores reveal foreign sector banks perform the best; and public sector banks perform better than private sector banks.