CHAPTER V

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5.1. Summary

To measure productive efficiency an alternative to a production function is the 'Distance function' which can be used as a basic tool. Most of the classical production functions can handle multiple inputs but a single output. Production functions are parametric and subjected to specification error. The output distance function in terms of a production frontier may be expressed as,

\[ D_0(x,u) = \frac{u}{\Phi(x)} \]

where \(0 \leq D_0(x,u) \leq 1\)

However, to estimate the output distance function, the linear programming method established by Bankar, Charnes and Cooper (1984) as

\[ [D_0(x_u)]^{-1} = \max \theta \]

Subject to:

\[ \sum_{j=1}^{s} \lambda_j x_j \leq x_0 \]

\[ \sum_{j=0}^{s} \lambda_j u_j \leq \theta u_0 \]

\[ \sum_{j=0}^{s} \lambda_j = 1 \]

\[ \lambda_j \geq 0 \]
But, DEA estimates of output technical efficiency are doubtful in the presence of outliers. Thus, in the presence of outliers, a stochastic frontier is recommended in the place of a full frontier.

The present study chooses translog output distance function that can handle multiple inputs and multiple outputs with comfortable ease. The translog output distance function is a second order approximation of an arbitrary output distance function.

\[
\ln D_0(x,u) = \alpha_0 + \sum_{i=1}^{4} \alpha_i \ln x_i + \sum_{j=1}^{3} \beta_j \ln u_j \\
+ \frac{1}{2} \sum_{i=1}^{4} \sum_{k=1}^{4} \alpha_{ik} \ln x_i \ln x_k + \sum_{j=1}^{3} \sum_{l=1}^{3} \beta_{jl} \ln u_j \ln u_l \\
+ \frac{1}{2} \sum_{i=1}^{3} \sum_{l=1}^{3} \gamma_{il} \ln x_i \ln u_l
\]

The output distance function has to satisfy certain structural properties which in turn needed to impose restrictions on the parameters of translog output distance function.

\[
\sum_{j=1}^{3} \beta_j = 1 \\
\sum_{j=1}^{3} \beta_{jr} = 0, r = 1,2,3. \\
\sum_{r=1}^{3} \beta_{jr} = 0, j = 1,2,3. \\
\sum_{r=1}^{3} \gamma_{ir} = 0 \\
\beta_{jr} = \beta_{jr} \\
\alpha_{i} = \alpha_{i} \\
\gamma_{i} = \gamma_{i} \\
\beta_{j} \geq 0.
\]
\( \gamma_n \) and \( \alpha_n \) are unrestricted for sign

\( \alpha_i \leq 0, i = 1,2,3,4 \).

50 commercial banks comprised of Private, Public and Foreign Sectors whose data are published in the Reserve Bank of India bulletins are considered for the efficiency study.

Selection of inputs and outputs is the primary step in data envelopment analysis. One should be parsimonious in the selection of inputs and outputs. If an additional input is to be augmented to DEA analysis, the BCC constraints will increase by one and the BCC output technical efficiencies decrease and move closer to unity. Consequently, the number of output efficient decision making units will increase and DEA looses its discriminatory power. In DEA if inputs are \( m \) and outputs are \( n \) in number, then \( (m+n) \) DMUs emerge to be output technical efficient. In this case DEA requires \( 2(m+n) \) observations.

5.2 Conclusions

The present study identifies four inputs combined to produce three outputs by 50 commercial banks - private, public and foreign sector operating in India
Inputs:  1.  Total assets  
        2.  Interest expended  
        3.  Operating expenses  
        4.  Other expenditure  

Outputs:  1.  Deposits  
        2.  Advances  
        3.  Total income  

Output technical efficiencies of the 50 commercial banks are obtained employing the stochastic frontier and output oriented DEA approach which is non-parametric.  

The stochastic output distance function, which is translog approximation is estimated by the corrected least squares procedure. The parametric estimates obtained are equivalent to maximum likelihood estimates. Eleven out of twenty eight parameters emerged to be statistically significant at 5 per cent level of significance. The high output technical efficiencies of the commercial banks reveal that the observations of all the commercial banks are closely scattered around the stochastic frontier. The structural efficiencies of private, public and foreign sector banks are found to be almost the same.  

The output technical efficiencies of all the 50 commercial banks have fallen in the interval [0.9914, 0.9954]. The private,
public and foreign sector banks closely compete with each other securing high output technical efficiency values. Thus, output losses experienced due to output technical inefficiency are only marginal.

Imposing constant returns to scale, the output based data envelopment analysis revealed considerable deviations of the commercial banks from the ideal benchmark value which is equal to unity. The linear programming problem solved to each of the 50 commercial banks is as follows:

\[
\left[ D^0_\theta \left( x_0, u_0 \right) \right]^1 = \text{Max} \ \theta \\
\text{subject to} \quad \sum_{j=1}^n \lambda_j x_j \leq x_0 \\
\sum_{j=1}^n \lambda_j u_j \geq \theta u_0 \\
\lambda_j \geq 0.
\]

Only eight of the 50 commercial banks are found to be output technical efficient under constant returns to scale. These are - the Bank of Rajasthan, Sangli Bank, UCO Bank, Abu-Dhabi Commercial Bank, Mashreq Bank, Oman International Bank, Societe Generale and the Sonali Bank.

A commercial bank that does not experience any input losses under constant returns to scale is always pure technical and scale efficient.
Economic data on production are influenced by returns to scale. Output or input DEA can only classify a commercial bank either enjoying increasing, constant returns to scale or suffering from decreasing returns to scale. Eight out of 50 commercial banks are found enjoying constant returns to scale, hence these banks experience no output losses due to scale inefficiency. These banks are the Bank of Rajasthan, Sangli Bank, UCO Bank, Abu-Dhabi Commercial Bank, Mashreq Bank, Oman International Bank, Societe Generale, Sonali Bank. Among these eight banks five belong to foreign sector.

When structural output technical efficiencies are compared, the performance of private banking sector dominates the public banking sector, which in turn is found to dominate the performance of the foreign sector. Fifty nine per cent of outputs are lost due to overall output technical inefficiency for Bank of America. The Deutsche Bank experienced 60 per cent of its outputs due to free disposability.

The commercial banks are classified into four categories, (i) Extremely efficient, (ii) Efficient but not extremely efficient (iii) Weakly efficient and (iv) Inefficient.

Bharat Overseas Bank is output pure technical efficient, its peers are Bank of Rajasthan, Sangli Bank and Sonali Bank.
\( \lambda_j^* = 0 \)

\( \lambda_j^* \neq 0 \) for three \( j \) values.

This bank is efficient but not extremely efficient. All the banks furnished in table (4.3.2) are efficient, but not extremely efficient. These banks are 35 in number. Rest of the 15 banks are extremely efficient. For each bank the peer banks are arranged according to their influence, measured by the magnitudes of relevant \( \lambda_j^* \neq 0 \).

The efficiency estimates derived by the stochastic and deterministic approaches differed considerably, in particular if constant returns to scale is imposed. If variable returns to scale are imposed all the 50 commercial banks are found to be output pure technical efficient. For these private, public and foreign sector banks the stochastic output pure technical efficiency are found marginally lower than unity. The structural efficiencies revealed are healthier than the foreign banks sector. Out of 50 commercial banks operating in India, thirty three are found to be efficient but not extremely efficient, but the remaining 17 are extremely efficient. Forty two out of 50 banks experienced significant output losses due to scale inefficiency. In case of merger of banks is to be considered such banks which are enjoying increasing returns to scale have to be considered.
5.3 Suggestions for Further Research

In the present research study, under Data Envelopment Analysis (DEA) approach, a distance function has been used to measure the productive efficiency. A stochastic translog output distance function has been estimated by using the corrected least squares method to compute the output technical efficiencies of commercial banks.

The present study can be further extended in similar lines by considering a stochastic input distance function to measure input technical efficiencies. Various types of technical efficiencies can be computed by different parametric approaches such as Farrell and Timmer approaches. Then, these technical efficiencies can be compared with that of non-parametric methodology proposed in the present study.

In the context of further research, the distance function tool may be used in the usual three approaches of DEA namely (i) the input orientation (ii) the output orientation and (iii) the graph orientation approaches, to measure the productive efficiency.

The research contribution made in the present study, It is hoped will generate an immense interest in other researchers to take up further extension of research work.