Chapter - III

Survey of Existing Literature on Banking Efficiency

3.1: Introduction

The measurement of financial institutions' efficiency using parametric and non-parametric frontier models has received considerable attention over the past two decades. Among the various approaches used, the use of Data Envelopment Analysis (DEA) approach has been frequent. There exists a great amount of literature on bank efficiency across the globe. But there has been little research effort in measuring and analyzing efficiency of banks in India using the approach - DEA during the post reform period. Rapid changes in the financial service industry make it important to determine the efficiency of financial institutions. Banks play an important role in financial market in developing countries like India and it is important to evaluate whether banks are operating efficiently or not. Therefore, investigation and measurement of efficiency and productivity in the banking sector have always been areas of interest for economic research. Numerous attempts have been made to study the efficiency of banks in developed countries. There is a vast literature on bank efficiency particularly in United States (see surveys in Berger et al.[1], 1993; Berger and Humphrey[2], 1997). In recent times examining the efficiency of financial institutions with frontier techniques has expanded rapidly in several other countries including India[3]. But, the studies analyzing the efficiency of banks using modern approach in India are far fewer. As a result there has been a serious gap in this respect in India and the effort of the present study is to fill this gap.

Thus, review of banking efficiency literature is framed in this study in two phases- literature on banking efficiency of the countries other than India and banking efficiency literature in Indian context.

3.2: Literature Review in Global Context

Several studies have analyzed the performance of the banking industry in developed and other countries. Berger and Humphrey[4] (1997) reviewed the empirical studies of efficiency of banking industry in the world. Of the 130 studies of financial institutions efficiency, 116 were published between 1992 and 1997. They find that, overall depositor financial institutions/banks operate at an annual average technical efficiency level of around 77% (median 82%). The non-parametric technique has been

extensively used to evaluate the efficiency of the US banking. Some notable studies on US banking efficiency are:

Rangan et al.[5] (1988) examined the technical efficiency of 215 bank in1986. Using three inputs (viz. labour, capital, purchased fund) and five outputs (viz. commercial and industrial, consumer, real estate loans, demand and time & savings deposit) they found an average efficiency of 70%. Decomposing total efficiency produces pure technical efficiency 72% and scale efficiency 97% implying that efficiency problem is caused by pure technical not scale inefficiency.

Grabowski et al.[6] (1994) estimated the efficiency of a group of banks of 670 using same three inputs and five outputs like Rangan et al. (1988) only exception with securities in place of time and savings deposit. They concluded that pure technical inefficiency is the main source of total technical inefficiency.

Aly et al[7]. (1990) explored various measures of efficiency for 322 banks in 1986. They find technical, scale and pure technical efficiencies are .75, .97 and .77. They agreed that bank size is positively related with efficiency. But, product diversity has negative relation with efficiency. They also reported that there is a positive link between urbanization and efficiency.

Ferrier and Lovell[8] (1990) and Elyasiani and Mehdian[9] (1990) estimated productive performance of the US banks they considered for their studies. They suggested that efficiency of US banking industry ranges from 65% to 90%.

Miller et al[10]. (1996) investigated technical efficiency – pure and scale of 201 large-sized banks from 1984 to 1990 considering four inputs (total transactions deposit, total non-transaction deposit, total interest and total non-interest expenses) and six outputs (commercial and industrial, consumer, real estate loans, investment, total interest income and total non-interest income). They suggested that average technical inefficiency was just over 5%. Large and profitable banks have higher levels of technical efficiency. They also reported that larger banks are more likely to operate at decreasing returns to scale.

Barr et al.[11] (1999) used a constrained multiplier, input-oriented, data envelopment analysis (DEA) model to evaluate the productive efficiency and performance of U.S. commercial banks from 1984 to 1998. They found strong and

consistent relationships between efficiency and the inputs and outputs, as well as independent measures of bank performance. Further, their results suggested that the impact of varying economic conditions was mediated to some extent by the relative efficiencies of the banks that operate in these conditions. Finally, they found that a close relationship exists between efficiency and soundness as determined by bank examiner ratings.

Efficiency studies on banking firms operating in countries other than US have also been rapidly increasing over the last a few years. Some notable studies are

Jackson and Fethis'[12] (2000) study on Turkish banks found that the profitable banks are more likely to operate at higher levels of technical efficiency and the capital adequacy ratio has a statistically significant adverse impact on the performance of banks.

Rezvanian et al.[13] (2002) examined production performance and cost structure of the Singaporean banks using both parametric and non-parametric technique. Non-parametric approach indicated that Singapore banks could have reduced cost by 43% had they all been overall efficient.

Isik et al.[14] (2002) estimated the efficiency of Turkish banks over the 1988-1996 periods. Result of their study indicated that dominance of source of inefficiency in Turkish banks is due to technical inefficiency rather than allocative inefficiency, which is mainly attributed to diseconomies of scale. Bank management is responsible for scale inefficient operations.

Ali et al.[15] (2002) examined the performance of banks in Kuwait during the period of financial renaissance, 1994–1997. They computed several measures and productivity changes on the basis of the Data Envelopment Analysis and the Malmquist Index. The result indicated that cost efficiency of Kuwait banks averaged 68% only. The empirical results also suggested that Kuwaiti banks fail to optimally utilize a significant proportion of their resources. The sources of bank inefficiency appear to be both allocative (regulatory) and technical (managerial) in nature. The results also indicated that smaller banks in Kuwait are more efficient than larger ones, although all banks have improved their efficiency-levels and experienced some gains in productivity

Casu and Molyneuxs'[16](2003) study on European banking concluded that debt equity ratio had no effect on efficiency; more profitable banks were more efficient, listed

banks were more efficient than non-listed banks and commercial banks were more efficient than cooperative banks. Efficiency differences across European banking markets appear to be mainly determined by country-specific factors.

Fries et al.[17] (2005) examined the relative cost efficiency of a sample of 289 banks in 15 east European countries for the years 1994–2001. They found that privatized banks with majority foreign ownership are the most efficient and those with domestic ownership are the least. They also suggested that early stages of reform are associated with cost reductions, while costs tend to rise at more advanced stages.

Al-Faraj et al.[18] (2006) investigated the performance of the Saudi commercial banking industry using DEA to evaluate the technical efficiency of Saudi banks for the year 2002 and compared with world mean efficiency scores. Their study revealed that the mean efficiency score of Saudi commercial banks compares very well with the world mean efficiency scores. They recommended that Saudi banks should continue their efforts of adapting new technologies and providing more services in order to sustain competitive advantages as Saudi Arabia continues to deregulate the banking industry.

Lili Cao[19] (2007) selected 4 major state-run commercial banks and 10 shareholding system commercial banks to evaluate the management efficiency from 2001 to 2003 using a C2R model and super-efficiency models. The result indicated that super-efficiency models can really carry on full appraisal and sort. Chinese commercial banks' management efficiency is generally improved. but not high yet. Shareholding system commercial banks' efficiency is generally higher than state-run commercial banks.

DENG Chen-guo et al[20]. (2007) estimated efficiency of fourteen Chinese commercial banks in 1999 using BCC model of DEA technique. They also used super-efficiency model to rank all the banks completely.

Tahir and Haron[21] (2008) examined the technical efficiency of the Malaysian commercial banks over the period of 2000-2006, using the stochastic frontier approach (SFA). The findings revealed that Malaysian commercial banks have exhibited an average overall efficiency of 81 percent implying an input waste of 19 percent. The results also found that the level of efficiency has increased during the period of study.

Malak REDA[22] (2008) in his current study measured the efficiency and productivity change of Egyptian commercial banks from 1995 to 2003, using a non-

parametric technique -Data Envelopment Analysis (DEA) and Malmquist Productivity Index. Results indicated that Egyptian commercial banks' technical inefficiency was 22 percent. In general, smaller banks were found to be least efficient. Malmquist results for a panel of 24 banks indicated that the productivity of commercial banks deteriorated by four percent per year on average during the study period. Moreover, most Egyptian banks operate at incorrect scale.

Supachet Chansarn[23] (2008) examined the relative efficiency of Thai commercial banks. He revealed that the efficiency of 13 Thai commercial banks during 2003 – 2006 via operation approach is very high and stable with the average efficiencies over 90% in every year while via intermediation approach moderately high but somewhat volatile with the average efficiencies about 86% in 2003 and 2005 and about 72% in 2004 and 2006.This result reflected that size of commercial banks does not have any influence on the performance of Thai commercial banks in costs /revenues management. Moreover, small banks, in average, are the most efficient banks via intermediation approach.

Ahmed & Ahmad[24] (2008) estimated technical efficiency of profit of 33 commercial banks operating in Pakistan in the year 2004. They investigated the technical efficiency using input oriented DEA technique under two different specifications. This study provided an insight to commercial banks about their technical efficiency level of profit with respect to other banks operating in the market. At the same time, it ranked the commercial banks on the basis of input used to produce profit and intermediate output produced to generate profit.

Roberto et al.[25](2009) estimated cost, technical and allocative efficiencies for the Brazilian banking system in the recent period (2000-2007) suggesting that Brazilian banking inefficiency is high if compared to other countries. The average allocative and technical efficiencies (inefficiencies) are about 66.9% (51.40%) and 63.3% (57.98%), respectively. They also found that non-performing loans is an important indicator of efficiency level, as well as market share. Size is not an important factor for economic efficiency although descriptive statistics suggests that small banks are more efficient within the time period under analysis. Banks with foreign participation and the foreign banks are the least economic efficient compared to other ownership types, which suggests that global advantage hypothesis is not prevailing in Brazil.

Nigmonov[26] (2010) measured the efficiency of Uzbek banks during 2004-2006 applying two basic DEA models. The study found that the main source of inefficiency is due to the pure technical efficiency. It, then, compared the relative performance between the private, joint-stock and foreign banks for which no significant divergence were found. The investigation of differences between the small, medium and large banks lead to the observation of significant difference between the small and medium sized banks.

Khalid Al Khathlan et al.[27] (2010) used basic DEA models i.e. CCR and BCR to evaluate the relative efficiency of Saudi Banks using annual data from 2003 through 2008. The average index of technical efficiency during the study period varied in between 81.91% to 86.78%, of pure technical efficiency varying at 87.88% to 95.34%, and of scale efficiency varying at 89.16% to 93.55%. So, the results shown that, on a relative scale, Saudi banks are efficient in the management of their financial resources.

Md. Usman et al.[28](2010) employed data envelopment analysis to a panel of commercial banks operating in Pakistan for a period 2001 – 2008 in order to measure the technical efficiency of banks. They found foreign owned banks to be the most efficient, followed by state owned banks and domestic private banks are found to be the least efficient. Further, the scale inefficiency is found to be the main source of overall technical inefficiency.

There are many studies which have attempted to analyse efficiency issues by using non-parametric techniques viz. Sherman and Gold[29] (1985), Parkan[30] (1987), Oral and Yolalan[31] (1990), Berg et al.[32] (1993), Fukuyama[33] (1993), Yeh[34] (1996), Grifell-Tatje' and Lovell[35] (1996), Humphrey and Pulley[36] (1997), Jackson et al.[37] (1998), Avkiran[38] (2000), Patti and Hardy[39] (2005) and Kumbhakar and Wang[40] (2007). These studies have examined efficiency and associated effects on the performance of banks from several different perspectives such as ownership, bank size, differences in the regulatory framework, deregulation policy and merger & acquisitions. Kumar and Gulati[41] (2008a) have provided an extensive review on the impact of deregulation on the efficiency of banking.

3.3: Literature Review in Indian Context

From the beginning, the Reserve Bank of India (RBI) and Government of India has been constituted various committees for study, in order to make the banking sector

more viable and efficient[42]. In 1977, the Reserve Bank of India set up a committee to study the efficiency, productivity and profitability of the nationalized banks. This is popularly known as Luther Committee[43] which studied the performance of the nationalized banks for the period 1969-1975. This study measured operational efficiency using defined efficiency indicators. PEP Committee[44] (1977) proposed a system of assessment of relative performance banks on four major aspects, viz. productivity, social objectives,(spatial), social objectives (sectoral) and profitability. Sukhmoy Chakrabarty Committee [45](1985) observed the concept of operational efficiency associated with cost effectiveness, profitability, customers' service, priority sector lending, and mobilization of deposit, deployment of credit in rural and backward regions and so on. There are other studies which reported time to time for adoption of various measures to improve the performance of the Indian banks. The other studies are: Pendekhar Working Groups[46] (1982-83), Padmanabhan Working Group[47] (1991), Narasimham Committee (1991[48], 1997[49]) and Verma Committee[50] (1999).

In Indian context the whole literature of efficiency of the banking sector which has been a major concern especially since 1970s can be divided into two parts based on the methodologies used (i) Studies based on comparison of financial and operational performance using traditional measures (ii) more recent studies that use parametric or non-parametric techniques i.e. frontier approaches

3.3.1: Studies based on Traditional Measures

The major works under traditional measures are:

Divatia and Venkatachalam[51] (1978) used factor analysis to construct a composite index of efficiency and productivity for fifteen major public sector banks. Later Angadi[52] (1983) used data on operating costs and output (measured in terms of total deposits and deposit accounts and total credit and credit accounts) to construct and determine operational efficiency. Angadi[53] (1987) ranked twenty-eight public sector banks by accounting and economic profits. Swami and Subrahmanyam[54] (1994) combined certain items of income and expenditure to construct an index of performance of banks. Hansda and Venkatachalam[55] (1995) used principal component analysis to construct a composite index of performance of twenty eight public sector banks. Using principal component analysis, Sarkar and Das[56] (1997) also developed a composite index of bank efficiency.

This study examined the interbank difference in the productivity and profitability for 73 major banks (public, private and foreign) for the year 1994-95.

Sathye[57] (2005) utilized financial ratios to study the effect of privatization on the performance and efficiency of banks. Efficiency was defined in terms of net profit per employee and deposit and loans per employee. This study concluded that the financial performance of partially privatized banks were significantly better than that of the fully public sector banks. There was no significant difference in performance of partially privatized banks and fully private banks. Ram Mohan[58] (2002) found a trend towards convergence in performance among the three categories of banks – public, private and foreign using financial measures of performance. The latter study by Ram Mohan[59] (2003) used risk adjusted return performance to compare bank across ownership groups and concluded that there is no statistical difference between the performance of public and private sector banks.

An important study on banking sector reform analysis by Rakesh Mohan[60] (2005) gave a quantitative review of the performance of the Indian baking sector. He pointed out that there were very significant improvements over the decade of reforms by analyzing reform measures based on variables of financial statement of the commercial banks only. A few contemporary works have discussed the post liberalization banking business in India.

There are some recent works on performance analysis of the Indian commercial banks which include C Rangarajan[61] (1998), Y. V. Reddy[62] (2002), Rakesh Mohan[63] (2006) and. All the studies have shown the pre and post reform Indian baking scenario from the perspective of banking regulations, guidelines and reform measures. They examine whether various reform measures have accelerate the profitability, efficiency and stability of the Indian banking sector as a whole. An important works regarding performance analysis of the baking sector in India has been done by Bhide et al.[64] (2002). This study assess the performance of the commercial banks on the basis banking groups i.e. ownership pattern taking into account the factors like risk management, corporate governance, universal banking, deposit insurance etc.

3.3.2: Studies based on Modern Measures

There are basically two approaches: parametric and non-parametric approach. Probably the first published study on efficiency of Indian banks using parametric approach was Keshari and Paul[65] (1994). They applied frontier approach to one year cross sectional data to determine the technical efficiency of foreign and domestic banks. Sum total of advances plus deposits was taken as a measure of output, and labor, capital and materials as inputs. Their conclusion was that the efficiency of foreign banks is slightly lower than that of domestic banks.

De [66](2004) used an econometric approach to determine the technical efficiency of the Indian banks, relationship between ownership and efficiency and impact of reforms on efficiency. Panel data for the years 1985 to 1995-96 were used in a stochastic frontier production function. Two alternative measures of output (gross income and total earning assets) and four inputs (sum of deposits and borrowings, fixed capital, number of officers and number of other employees) were used for a Cobb-Douglas technology. The study concluded that the efficiency did not improve after liberalization, and the foreign banks, as a group, had the highest efficiency.

Kumbhakar and Sarkar (2003[67], 2004[68]) used the parametric method to evaluate the efficiency of the Indian banking system using panel data for the period 1986-2000. Postulating a cost function and using stochastic cost frontier, they determined the changes in efficiency over time. Using dummy variables, they also found contribution of reforms and role of ownership to the change in efficiency. They found the Indian banking system to be cost inefficient but the tendency for inefficiency to decline over time. They found the private sector banks to be more cost efficient than public sector banks. The deregulation resulted in increase in inefficiency and there was no significant difference in impact of deregulation on private sector and public sector banks.

One of the first published studies using non-parametric production frontier approach was Noulas and Ketkar[69] (1996). Using intermediation approach with three inputs and two outputs, they determined the technical and scale efficiency of public sector banks for 1993. They found average technical inefficiency of 3.75 percent, of which two thirds was due to scale inefficiency. Hence, they concluded that efficiency of banks in India could increase by increasing the scale.

Bhattacharya et al.[70] (1997) examined the efficiency of Indian banks using a two step procedure, DEA technique to determine the technical efficiency and then applying stochastic frontier approach to explain variation in calculated efficiency. They applied intermediation approach using two inputs (interest expense and operating expense) and three outputs (deposits, advances and investments) on five-year data of 70 banks, for the period 1986-1991. They constructed one grand frontier on the entire data set for DEA analysis and found that the public sector banks were more efficient than foreign banks, which in turn were marginally more efficient than private sector banks. The average efficiency of the sector as a whole was found to be 80.35 percent, ranging from an average of 75.37 percent for private sector banks and 87.40 percent for public sector banks. They also found that 78 percent of banks operated with decreasing returns to scale while 16 percent showed increasing returns to scale. For the second stage, regression analysis, they used a set of variable to account for time, ownership and regulatory policy. They concluded that public sector bank efficiency declined over time whereas that of foreign sector banks improved over time. The performance of private sector banks remained almost unchanged.

Das[71](1997) studied technical, allocative and scale efficiency of different public sector banks for the period 1990-96 using non-parametric DEA approach. He used the intermediation approach with two inputs-labour and loanable funds – and one output measures. The efficiencies were calculated for each year for all the banks. The study found decline in overall efficiency over time, decline in technical efficiency with slight improvement in allocative efficiency. Thus, change in inefficiency was due to technical inefficiency rather allocative inefficiency. The State bank was found to be more efficient than other public sector banks.

Das [72](1999) compared performance among public sector banks for three years 1992, 1995, 1998. He found a certain convergence in performance. He noted that there was a welcome increase in non-interest income, bank tended to show risk –adverse behavior by opting for risk- free investments.

Das[73] (2000) determined the efficiency of 27 public banks using cross-sectional data for the year 1998. SBI group was more efficient than nationalized bank group. Inefficiency in PSBs was both technical and allocative in nature.

Saha and Ravishankar[74] (2000) analyzed the performance of Indian banks using DEA approach. They examined performance of 25 public sector banks over a period 1992-1995. Their findings indicated that efficiency of public sector banks improved over the time period.

Mukherjee et al.[75] (2002) shown that Indian banks of different ownership pattern outperformed in the rapidly evolving and liberalizing sector during 1996-99.

Sathya[76] (2001) compared productive efficiency of publicly owned, privately owned and foreign owned banks operational in India in the year 1997/1998 and found that private sector commercial banks as a group is paradoxically lower than that of public sector and foreign banks.

Sathye[77](2003) measured the productive efficiency of 94 banks in India, including public sector and private sector banks and foreign banks, assuming VRS technology, applying DEA. The efficiency was calculated for 1996-97. In one model, he used interest expense and non-interest expense as inputs and interest income and non-interest income as outputs. A second DEA analysis was also run using deposits and staff members as inputs and loans and non-interest income as outputs. The study found that the average efficiency score of 0.83, and that the public sector banks were on average more efficient than foreign banks, which in turn were more efficient than private banks.

Ram Mohan and Ray[78] (2003) studied productivity and efficiency of public and private sector banks in India, using non-parametric DEA, for the period 1992-2000. They examined 27 public sector banks, 21 old private sector banks and 14 foreign banks. They employed three measures: Tornquist total factor productivity growth, Malmquist efficiency index and revenue maximization efficiency. They assumed CRS technology and used intermediation approach with interest cost and operating cost as inputs and loan income, investment income and non-interest income as outputs. They found public sector banks to be more efficient and productive compared to their private sector competitors.

Shanmugam and Das[79] (2004) analyzed the efficiency of Indian commercial banks during the reform period, 1992-1999 using a parametric methodology. The results

indicated that the efficiency of raising interest margin was time invariant while the efficiencies of raising other outputs-non-interest income, investments and credits were time varying. They found that the foreign banks are more efficient than their counterparts namely, public sector and privately owned domestic banks.

Das et al.[80] (2004) measured various DEA efficiencies of scheduled commercial Indian banks during 1997-2003. They found that there were no much differences in terms of input or output oriented technical efficiency and cost efficiency but having difference sharply in respect of revenue and profit efficiencies among the Indian banks. They also observed the bigger banks in particular have improved during post reform period.

Chakrabarti and Chawla[81] (2005) estimated the efficiency of 70 Indian banks during 1990-2002 and found that the foreign banks as a group, have been considerably more efficient that all other bank groups followed by private banks and then public banks.

Debasish[82] (2006) examined the relative efficiency of the Indian banks using output oriented CRR DEA model over the period 1997-2004. The study shown the increasing trend of efficiency across all the bank groups ranging mean efficiency score of 44.5% (1998) to 77.9% (2004)

Ray[83] (2007) used data covering the period 1997 through 2003 to measure size levels of efficiency of individual Indian banks. The findings do suggest wide spread size inefficiency across banks and years.

Omprakash et al.[84] (2008) measured relative efficiencies of 57 Indian domestic banks using DEA for the period 1999-2003. The study raveled that SBI and its group have the highest efficiency followed by private banks, and the other nationalized banks. The results were consistent over the period, but efficiency differences diminish over period of time. The capital adequacy ratio was found to have a significantly positive impact on the productive efficiency.

Kumar and Gulati[85] (2008a) examined the efficiency levels among Indian public sector banks (PSBs) during the post-reforms period spanning from 1992/1993 to 2005/2006. The empirical results indicated that the majority of PSBs have observed an ascent in technical efficiency during the post-reforms years. They also found that the banks with low level of efficiency at the beginning of the period were growing more

rapidly than the highly efficient banks. In sum, the study confirmed a presence of convergence phenomenon in the Indian public sector banking industry. In another study, Kumar and Gulati[86] (2008b) measured the extent of technical, pure technical, and scale efficiencies in 27 public sector banks (PSBs) operating in India in the year 2004/05. The empirical finding revealed that PSBs operate at 88.5 percent level of overall technical efficiency. They also observed that pure technical inefficiency contributed more towards overall technical inefficiency. Further they found that majority of the public banks are operating in the region where decreasing returns-to-scale prevails. The results of logistic regression analysis provided that the exposure of the banks to off-balance sheet activities (i.e., non-traditional activities) has a strong and positive impact on the overall technical efficiency of banks. Very recent efficiency study by Kumar and Gulati[87] (2009) using cross-sectional data for 51 domestic Indian banks operating in the financial year 2006-2007 estimated the average technical efficiency score of .79 with a dominance of de novo private sector banks on the efficient frontier. Managerial inefficiency was the main source of Overall Technical Inefficiency in the Indian domestic banking industry. The efficiency differences between public and private sector banks are not statistically significant and there is a significant difference between large and medium banks with regard to Scale Efficiency.

Kaur and Kaur[88] (2010) empirically examined the impact of mergers that have been going over the post liberalization period of 1990-91 to 2007-08 on the cost efficiency of Indian commercial banks by using a non-parametric Data Envelopment Analysis. The findings of this study were that over the entire study period average cost efficiency of public sector banks was found to be 73.4 and for private sector banks 76.3 percent. The findings of this paper suggested that to some extent merger programme has been successful in Indian banking sector. The Government and Policy makers should not promote merger between strong and distressed banks as a way to promote the interest of the depositors of distressed banks, as it will have adverse effect upon the asset quality of the stronger banks.

There are many other studies since the 1990s in India, which have been confined to analyse the effect of deregulation on efficiency and productivity of banks. The basic hypothesis underlying deregulation is that it promotes competition and, thus, can induce

efficiency improvements[89]. It is expected a priori that deregulation would unleash competitive forces in the operating environment. Such competition would, in turn, enable banks to alter their input and output mix which when combined with technological developments facilitates increase in output that raises overall bank productivity and efficiency[90]. However, some important studies which have shown a positive impact of deregulation and liberalization policies on the efficiency and productivity of Indian banks are Bhattacharyya et al.[91] (1997), Ram Mohan and Ray[92] (2004), Shanmugam and Das[93] (2004), Ataullah et al.[94] (2004), Reddy[95] (2004), Das et al.[96] (2005), Chatterjee[97] (2006), Mahesh and Rajeev[98] (2006), Sensarma[99] (2006), Rezvanian et al.[100] (2008). A few studies which have shown an adverse or insignificant impact of the deregulation policy on the performance of Indian banks include Kumbhakar and Sarkar[101] (2003), Sensarma[102] (2005), Das and Ghosh[103] (2006). Kumbhakar found that public sector banks have not responded well to deregulatory measures and TFP has not been observed significant. Profit efficiency has shown a declining trend during deregulation period up to 2003 (Sensarma). DAS and Ghosh did not witness any significant increase in number of efficient banks and some banks have high degree of inefficiency during the liberalization period of 1992-2002.

So, an inspection of literature highlights that there are many empirical studies which rely on non-parametric technique - DEA for measuring banking efficiency. The most studies examining the empirical efficiency analysis focus mainly on developed economies. Banking efficiency studies using these techniques are expanding rapidly in other emerging economics also. Empirical results appear to vary depending on the country; bank ownership, and size[104].

However, the general conclusions that emerge from the above extensive review of literature on banking efficiency in Indian context are: First, there is still room for improvement in resource utilization of the Indian banks with the range of 5% to 30%. Second, there is an improvement in profit efficiency accelerated by the non-interest income source. Third, average cost efficiency has increased due to reduction of intermediation cost with the help technology used in banking operations. Fourth, there is an improvement in profit efficiency accelerated by the non-interest income source. On the whole most of the studies agree that deregulation has had a positive and favorable

impact on efficiency improvement of Indian banking industry. But, most of the studies which use non-parametric DEA technique to compute the efficiency scores for Indian banks are not in a comprehensive manner. Many of them use data for a single time period. While some studies concentrate on the efficiency of only public sector banks. Main focus of many other studies is to show the impact of reform measures on the efficiency only. Very few adopts of multiple measures of DEA efficiencies. There are hardly any studies which use super-efficiency scores for ranking of the Indian banks. Therefore, the present study will be able to throw further light on the existing banking literature in Indian by examining the relative technical efficiency of different measures and providing ranks to the Indian banks in a very comprehensive manner during the recent period covering from 2004-05 to 2007-08.

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