CHAPTER- 2

REVIEW OF LITERATURE

2.1 Introduction

The main idea behind “Review of Literature” is to do surveys of scholarly articles, books, and other sources such as dissertation, conferences, and proceedings relevant to a particular issue and area of research. It aims to review the critical points of current knowledge including substantive finding as well as theoretical and methodological contribution to a particular topic. The ultimate goal is to bring the researcher up to date with current literature on the topic and form the basis for future research that may be needed in the area. The review of studies provides valuable information regarding the impact of government policy such as the effect of deregulation, financial and institutional failure, market structure, the issue of corporate control, risk and stability over time and firm level efficiency and mergers.

The banking industry in the U.S. and several countries in Western Europe, Latin America, and Asia underwent a significant change in the 1980s and 1990s. Banks were substantially deregulated in the U.S. and in Western Europe, but countries deregulating in Latin America and Asia did so at a slower pace. Studies of efficiency have not kept pace with the speed of deregulation. Efficiency studies have been conducted for American and European banks but very limited studies of banking in developing countries can be found.

This chapter provides a detailed survey of efficiency studies on the banking industry conducted using the traditional, parametric and non-parametric approaches. We can divide studies on the banking performance in three broad categories. The first category is performance of banks in the developed countries. The second category is performance of banks in the developing countries and the third category is performance of banks in India. The purpose of this review is not to be exhaustive, but rather to present the main development in the fields so as to identify the remaining gaps in the literature.
2.2 Performance of Banks in Developed Countries

Rangan, Grabowski, Aly, Pasukra (1988)\(^1\) examined the technical efficiency of US banks for the year 1986 and used DEA technique for this purpose. They employed three inputs (labour, capital and purchased funds) and five outputs (real estate loans, commercial and industrial loans, consumer loans, demand deposits and time and saving deposits). The results indicate that the banks could have produced the same level of output with just 70% of the inputs actually used. Most of this inefficiency was the result of pure technical inefficiency, i.e., wastage of resources. Almost all banks were operating at constant returns to scale and thus scale inefficiency was relatively small. Regression analysis indicates that the technical efficiency measure were positively related to bank size and negatively related to product diversity. The extent to which branch banking was allowed was found to be statistically unrelated to technical efficiency.

Aly, Grabowski, Pasurka and Rangan (1990)\(^2\), examined technical, scale and allocative efficiencies in US banking for the year 1986 and used DEA technique for this purpose. They used intermediation approach to specify five outputs (real estate loans, commercial and industrial loans, consumer loans, all other loans and demand deposits) and three inputs (labour, capital, and loanable funds) in their study. They found that overall technical efficiency was negatively related to product diversity and positively related to the extent of urbanization. In addition, the pure technical efficiency was positively related to size irrespective of whether size was measured in terms of total deposits and number of branches.

Ferrier and Lovell (1990)\(^3\) investigate the extent of cost efficiency in U.S. banking by comparing of econometric and programming techniques for the year 1984. Using data on banks operating costs and outputs for 575 institutions, they show that these two estimation techniques produce very similar results, with banks appearing to have higher inefficiency from the results given by programming techniques.

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Berger and Humphrey (1992)\(^4\) used a thick frontier approach, which is a modified version of the stochastic econometric method, to compare bank cost efficiency between 1980 to 1984 on the one hand and 1988 on the other using data from virtually all USA banks. They used the value added approach to specify two outputs (deposits and loans) and three inputs (labour, physical capital and purchase funds) in their study. They found that thick frontier approach gives slightly higher estimates of inefficiencies, i.e. banks are less efficient than stochastic frontier approach suggests. This is especially true when they allow inefficiencies to vary over time. Finally, they concluded that the bank itself may still be fully efficient relative to a conventional bank frontier that allows to be measured as efficient even if they have branches that are inefficient.

Elyasiani and Mehdian (1995)\(^5\) examined the comparative efficiency performance of small and large US commercial banks in the pre- and post-deregulation period from 1979 to 1986 and used DEA techniques for this purpose. They used intermediation approach specify four outputs (investment, real estate loans, commercial and industrial loans and other loans) and four inputs (time and saving deposits, demand deposits, capital and labour) in their study. They found that small banks were more efficient than large banks in 1979 but the gaps became insignificant in 1986. The efficiency measures of both small and large banks show a decline in mean between 1979 and 1986 but the declines were steeper for small banks. In addition, small banks exhibited a substantial increase in the dispersion of the efficiency measures over the same time period. Finally, they suggested that small and large banks were affected differently on the average and that the small banks themselves were affected differently within the groups by changes in the market conditions.

Berger and Mester (1997)\(^6\) examined the source change in the performance of United State’s banks for the period from 1984 to 1997 and used three different

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optimizing concepts i.e. cost minimizing, standard profit maximization and alternative profit maximization. Throughout their study, they used gross total assets (total assets plus loan and lease loss reserve and allocated transfer risk reserve) as a superior measure of bank size to total asset alone. They found that during the period 1991-1997, the cost productivity improved substantially, particularly for banks engaged in mergers. The banks tried maximizing profit by raising revenue as well as reducing costs and that the banks provided additional services or higher service quality that not only raised cost but also raised revenue more than increase in cost. Finally, they concluded that methods of measuring productivity that excluded revenues might be misleading.

Berger and Humphrey (1997)\(^7\) reviewed 130 studies that relate the analysis of frontier efficiency to financial institution's efficiency in 21 countries. They covered studies of different types of depository institutions such as commercial banks, savings and loan institutions, credit unions, and as well as firms in the insurance industry. The main objective of this paper is to summarize and review empirical estimates of financial institution's efficiency and attempt to arrive at a consensus view. The average of efficiency that Berger and Humphrey found was approximately 77% (median 82%), with a standard deviation of 13 percentage points. They found that the efficiency estimates from nonparametric studies (DEA and FDH) were mostly the similar as those of parametric frontier models (the SFA, the DFA, and the TFA). They also found nonparametric methods generally yielded lower mean efficiency estimates and seemed to have a larger spread than the results of the parametric methods, probably because there was a different assumption about the error terms in both approaches. They reported that the deregulation of financial institutions can either improve or worsen efficiency levels, depending on industry conditions prior to the deregulation. Finally, they concluded that the majority of the studies on banking efficiency focused on the banks of developed countries (about 95% and most of them in the U.S.), so they suggested that more research was needed in developing countries.

Pastor, Perez, Quesada (1997)\(^8\) compared productivity, efficiency, and differences in the technology of different European and U.S banking system for the

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year 1992 and used non parametric approach (DEA) for this purpose. The sample they used in their study included the banking systems in U.S., Australia, Spain, Germany, U.K., Italy, Belgium and France. They used the intermediation approach to specify three outputs (loans, deposits, and other productive asset) and two inputs (non-interest expenses, personal expenses) in their study. They found that there was a difference in the efficiency level of the banking system among the countries in the sample. The most efficient banks were in France, Spain, and Belgium, while less efficient banks were in the U.K., Austria, and Germany. They also found that the Austrian, German and US banking system showed evidence of scale efficiencies.

Bauer, Berger, Ferrier and Humphrey (1998)\(^9\) compared the efficiency of the US banking industry for the period 1977-1998 and used four major methods of estimating bank efficiency, i.e. the stochastic frontier approach, distribution free approach, thick frontier approach and data envelopment analysis. The authors proposed a set of consistency conditions that frontier efficiency measures should meet to be most useful for regulatory analysis or other purpose. Their finding suggests that the parametric method were generally consistent with one another. However, the finding also suggests that parametric and non-parametric methods were generally not mutually consistent; the rank order correlation between the approaches was very low.

Camacho and Dyson (1999)\(^{10}\) examined the efficiency of the Portuguese bank branches for the year 1996 and used DEA technique for this purpose. They used the production approach to specify four inputs (number of employees in the branch, floor space of the branch, operation cost and number of external ATMs) and five outputs (number of general service transactions performed by branch staff, number of transactions in external ATMs, number of all types of accounts at the branch, the value of savings and value of loans) in their study. They found that branches efficiency has positive effects on the profits, although the high profitability is not necessarily directly related to high efficiency. They also found that the relation between branch size and efficiency indicated that most of the branches have significant scale inefficiencies mainly due to increasing returns to scale.

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Wheelock and Wilson (1999)\textsuperscript{11} examined productivity change in the United States commercial banks for the period 1984 - 1993 and used DEA technique. They used an intermediate approach to specify three inputs (labour physical capital, and purchase fund) and five outputs (real estate loans, commercial and industrial loans, consumer loans, all other loans and total deposits) in their study. They found that, on an average, commercial banks experienced diminished productivity growth during the period 1984-1993. Technological advances and productivity declines especially for smaller banks were found comparatively larger in the period 1984-1989 than in the year 1989-1993. Finally, they concluded deregulation and technical change had different effects on banks of different sizes.

Barr, Killgo, Zimmel, (1999)\textsuperscript{12} evaluated the productive efficiency and performance of U.S. commercial banks for the period 1984 - 1998 and used DEA technique for this purpose. They used the intermediation approach to specify three outputs (earning asset, interest, and non-interest income and five inputs (salary expenses, premises and fixed assets, other non-interest expense, interest expense and purchase fund) in their study. They found that the relationship between efficiency and interest income and expense was not as pervasive, perhaps as a result of market competition, but there was still a noticeable tendency for efficiency to be positively correlated with interest income and negatively related to interest expense. There was also a strong negative relationship between the most efficient and least efficient quartiles of banks on the percentage of assets that were fixed assets and the percentage of total assets that were loans. Finally, they concluded that the level of nonperforming loans to total loans was significantly and negatively related to the efficiency scores of the most and least efficient quartiles from 1984 through 1993.

Bikker (1999)\textsuperscript{13} examined cost efficiency of nine European banks for the period 1989 - 1997 and used stochastic cost frontier approach for this purpose. He reported that the banking systems in Luxembourg and Switzerland generally benefited from the kind of favourable conditions that come from bank secrecy and tax regimes.


He also estimated the cost levels and found that Spanish banks had a higher cost level of 33% above the European average, although the banks in Luxemburg were 34% below the European average. He found that the less efficient banks were Spanish banks, followed by French and Italian banks. Banks in Germany, the Netherlands, and the U.K. were in the middle level of efficiency. However, the most efficient banks were in Luxemburg, followed by banks in Belgium and Switzerland. Finally, they suggested that merging between banks was important to improve the banking industry in the European countries.

Altunbas, Liu, Molyneux, and Seth (2000)\textsuperscript{14}, examined the impact of risk and quality factors on bank costs in Japanese commercial banks for the period 1993 - 1996 and used the stochastic frontier approach for this purpose. They used the intermediation approach to specify three outputs (total loans, total securities, and total off-balance sheet items) and three inputs (price of labour, price of funds, and price of physical capital) in their study. The authors reported that strong evidence of scale economies across a wide range of bank sizes, even for the largest firms. They also reported that the financial capital influenced the scale efficiency estimates because of the reflection of the decline in capital strength of the banking system in Japan during the period of study. They found that the X inefficiency estimates varied between 5% and 7% and showed less response to risk and quality factors. In addition, they found that the scale efficiency estimates were more sensitive to risk and quality factors than the X-inefficiencies. Finally, they concluded that the largest banks could be more efficient in reducing costs by decreasing output rather than improving X-efficiency.

Semenick Alam (2001)\textsuperscript{15}, analysed the productivity, efficiency, and technological changes for large U.S. commercial banks for the period 1980 - 1989 and used DEA technique for this purpose. He used four models in order to calculate productivity and efficiency of US commercial banks. He employed four outputs (securities, real estate loans, commercial and industrial loans) and six inputs (Equity, Capital, labour, purchased funds, demand deposit and other deposit) in Model I. He used two outputs (securities and total loans) and six inputs (Equity, Capital, labour,


purchased funds, demand deposit and other deposit) in Model II. He incorporated two outputs (securities and total loans) and five inputs (Equity, Capital, labour, purchased funds and core deposit) in Model III. Finally he used two outputs (securities and total loans) and four inputs (Equity, Capital, labour and loanable funds) in Model IV. He found that there was a significant increase in productivity between 1983 and 1984. He also found that after 1985 there was a sustained increased in productivity of US commercial banks. Finally, he concluded that Productivity movements are primarily attributable to technological changes rather than scale changes or convergence to the production frontier.

Maudos and Pastor (2001)\(^{16}\) evaluated profit and cost efficiency of banks in countries belonging to Organization for Economic Cooperation and Development (OECD) for the period 1986 - 1999 and used stochastic frontier approach for this purpose. The sample they used in their study included the banking systems in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Holland, Italy, Luxembourg, Portugal, Spain, Sweden, the U.K., Japan, and the U.S. They used three outputs (loans, other earning assets, and deposits) and two inputs (net income and profit before tax) in their study. They found that the efficiency level of the banking sector in the U.S. improved from 1986 to 1995 and that the efficiency level of the banking sector in Japan decreased sharply from 1988 to 1995. The banking sector in Europe was stable during the period of study. Finally, they concluded that the increase in the competition led to improving the profit efficiency in the U.S. and Europe but not in the Japanese banking system.

Drake and Hall (2003)\(^{17}\) analysed efficiency of 149 Japanese banks for the year 1997 and used DEA technique for this purpose. They used the intermediation approach to specify three outputs (Total loans and bills discounted, Liquid assets and other investments in securities, and Other income) and three inputs (General and administrative expenses, Fixed assets, Retail and wholesale deposits) in their study. They found that large banks have the least potential X-efficiency gains and there was a low level of pure technical inefficiencies of all Japanese banks. They also found that pure technical efficiency tends to deteriorate with size up to the middle ranking banks.


Finally, they observed controlling for the exogenous impact of problem loans was important in Japanese banking, especially for smaller regional banks.

Casu and Molyneux (2003)\(^{18}\) analysed the comparative study of efficiency in European banking for the period 1993 to 1997 and used DEA technique for this purpose. They also evaluated the determinants of the efficiency of European banking by using the Tobit regression model approach in order to analyse the influence of various countries' specific and environmental factors relating to bank efficiency. The sample they used in their study included the banking systems in France, Germany, Italy, Spain, and the United Kingdom. They used the intermediation approach to specify two outputs (total loans and other earning assets) and two inputs (total costs and total customers and short term funding) for their study. They found low average efficiency levels during the period of study. They suggested that there was a slight improvement in the average efficiency levels over the period 1993-1997 for all banking systems in the sample except Italy's banking system. Finally, they concluded that there was a difference in the efficiency level across European banking systems and that this difference was due to each country's specific factors relating to banking technology, regulation and managerial strategies.

Casu, Girardone, Molyneux (2004)\(^{19}\) examined the productivity change in European banking for the period 1994-2000 and compared parametric and non-parametric techniques. The sample they used in their study included the banking systems in France, Germany, Italy, Spain and U.K. They used the intermediation approach to specify two outputs (total loans, growing non-lending activities) and three inputs (average cost of labour, deposits and capital) in their study. They found that the competing methodologies do not yield markedly different result in terms of identifying the main components of productivity growth.

Allen and Liu (2005)\(^{20}\) examined the cost efficiency and the economies of scale of the six largest banks in Canada using quarterly data for the period 1983-2003 and used four econometric models: a time-varying fixed-effects panel model, a


stochastic cost efficiency frontier model, a system of seemingly unrelated regression model, and a time-varying fixed-effects model. They used intermediation approach to specify five outputs (consumer loans, non-mortgage loans, mortgage loans, security investment, and non-traditional banking activities) and three inputs (labour, capital, and deposits) in their study. They found that inefficiency of Canadian banks was approximately 10 percent. They also found that larger banks were more efficient than smaller banks.

Akhigbe and McNulty (2005) examined the profit efficiency of banks in the U.S. by looking separately at large and small banks for the period of 1995-2001 and used profit efficiency methodology for this purpose. In order to estimate profit efficiency they used three outputs (total loans, retail deposits, and non-interest income) and three market prices for bank as inputs (wage for labour, average interest rate for borrowed funds and price for physical capital). They found that small banks were more efficient than large banks and those factors like structure performance, relationship development and expense preference play significant roles in explaining the efficiency of small banks.

Hahn (2005) studied the environmental determinants of banking efficiency for the period 1995 - 2002 and used a four-stage DEA methodology by employing a slacks-based DEA model in combination with a Tobit regression and then the Bootstrap method in order to eliminate the dependency problem in the DEA techniques. He used the profit-oriented approach by specifying three outputs (net interest revenue, net commission revenue, and other income) and three inputs (employee expenses, other non-interest expenses, and risk-weighted assets) in his study. He also used the intermediation approach by using two outputs (total loans and other earnings) and two inputs (first, total cost covering interest expenses, non-interest expenses, and employee expenses, and second, total deposits). He found that controlling for the impact of environmental factors raised the average efficiency and reduced the average range of volatility during the period of study. He also found that a decomposition of the initial and environment-adjusted efficiency scores along the lines of the traditional segmentation of the Austrian banking system yields that

managerial efficiency of the commercial banks tends to be overrated due to favourable environmental factors and that of cooperative banks to be underrated due to harsher local market conditions. Efficiency levels of savings banks and mortgage banks, however, remain unaffected by changing environmental conditions.

Pasiouras, Kosmidou (2006)\(^2\) examined the factor influencing the profitability of domestic and foreign commercial banks in 15 EU countries over the period 1995-2001 and used stochastic frontier analysis. They reported that the profitability of both domestic and foreign banks was affected not only by bank’s specific characteristics but also by financial market structure and macroeconomic conditions. They found that all the variables, with the exception of concentration in the case of domestic banks’ profits, were significant although their impact and relation to profits was not always the same for domestic and foreign banks.

Havrylchyk (2006)\(^3\) analysed the efficiency of the Polish banks for the period 1997 to 2001 and used non parametric (DEA) technique to estimate cost, allocative, technical, pure technical, and scale efficiency. He used the intermediation approach to specify three outputs (loans, government bonds, and off-balance sheet items) and three inputs (capital, labour, and deposits) in his study. He reported that the average efficiency was 52.92% of the domestic banks and 73.23% for the foreign banks. Finally he concluded that the efficiency in the banking system in Poland did not improve during the period of the study.

Yildirim and Philippatos (2007)\(^4\), analysed the efficiency level of commercial banks in 12 Central and Eastern Europe (CEE) countries for the period 1993 and 2000 and employed two techniques — the SFA and the DFA — to estimate cost and profit efficiency of 325 banks. The sample they used in their study included the banking systems in the Czech Republic, Estonia, Croatia, Hungary, Latvia, Lithuania, FYR of Macedonia, Poland, Romania, Slovenia, the Slovak Republic, and the Russian Federation. They used three outputs (loans, investments, and deposits) and three inputs (Borrowed funds, labour, and physical capital) in their analysis. They found

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that the average cost efficiency level for twelve countries was 72% with DEA and 77% with the SFA. They also found that the most cost efficient countries were Poland and Slovenia and that the Russian Federation, Lithuania, Latvia, and Estonia were the least efficient countries. They suggested that the cost efficiency levels were significantly higher than the profit efficiency levels.

Pasiouras (2007)\(^{26}\), analysed the impact of regulations, supervision for the year 2003 and using two stage Data Envelopment analysis. His samples contain 715 publicly owned commercial banks operating in 95 countries. He used intermediation approach to specify three outputs (loans, other earning asset, and non-interest income) and three inputs (total deposits, total cost, and equity). He reported that average banks in sample could improve its overall efficiency by 33.20%, pure technical efficiency by 29.20%, its deviates 5.5% of its efficient size scale. He found that higher size lower loan activity results in higher pure technical efficiency under all circumstances, while profitability does not have a significant impact on any of the specifications. Capitalization and expenses related to assets have a positive and negative impact on efficiency respectively however; their statistical significance was not robust across the specifications. Finally, he observed that several other country specific variables, such as protection private property rights, market capitalization of GDP, banks claim to GDP, and the number of branches, ATMs relative to the population, the presence of Government and foreigner owned banks, and concentration have significant impact on the bank’s technical efficiency.

Ioannidis, Molyneux, Pasiouras (2008)\(^{27}\) analysed the relationship between bank efficiency changes and stock price returns for the period 2000-2006 and using the stochastic frontier analysis. Their sample included 260 banks operating in 19 countries. They used the intermediation approach to specify three outputs (loans, other earning assets, and non-interest income) and two input prices (cost of borrowed funds, and the cost of non-financial inputs). They found that a positive and robust relationship between profit efficiency changes and stock returns and no evidence that cost efficiency changes are reflected in stock returns. Furthermore, they observed that


the changes in the return on equity do not provide incremental information. Finally they concluded that shareholders are interested in profits rather than costs.

Pasiouras, Tanna, Zopounidis (2009)\textsuperscript{28} examined the impact of banking regulations on banks' cost and profit efficiency for the period of 2000-2004 and used stochastic frontier approach. Their sample consists of 615 banks from 74 countries. They used the value added approach to specify three outputs (loans, other earning assets and total deposits) and three inputs prices (cost of borrowed funds, the cost of physical capital and cost labour) in their study. They found that cost efficient banks were not necessarily profit efficient, both cost and profit efficiency were influenced positively by higher official supervisory power and the requirements for disclosures and incentives that enhance market discipline. On the one hand, greater market discipline associated with accurate and timely disclosures could help private agents to monitor banks effectively and allow powerful supervisors to intervene if necessary. Finally, they concluded that stricter capital requirements, related to the first pillar of Basel II, had a positive impact on cost efficiency but a negative impact on profit efficiency.

Wang (2011)\textsuperscript{29} examined the productivity and performance of Australian's four major banks in the deregulation period between 1983 and 2008 and used DEA for this purpose. They used intermediation approach to specify three outputs (net loans, investment, and branch number) and four inputs (loanable funds, physical capital, number of employees and non-employee operating expense). The empirical results demonstrate the effect of deregulation and periodic financial crisis's on the performance of individual banks, and the major part of the Australian banking sector. Overall the productivity performance of Australians banks tended to improve considerably in those periods of strongest economic growth.

2.3 Performance of Banks in Developing Countries

Odedokun, M.O (1992)\textsuperscript{30} examined the portfolio behaviour of Nigerian commercial banks for each of the years 1986 to 1988 and used ratio and regression

analysis technique for this purpose. Empirical results suggest that deposits are immediately being almost completely used in financial holding of short-term liquid assets with very little being used in financing loans and advances. Also, financing of miscellaneous exogenous assets (less miscellaneous exogenous liabilities) is largely at the expense of holding of short-term liquid assets, with only a fraction being financed through an immediate curtailment of loans and advances. He also detects some evidence in support of the contention that an increase in the number of branch network of a bank, all other things being equal, should increase loans and advances in its portfolio by making the bank more accessible to prospective borrowers. In addition, the rate at which the banks are able to bridge the gap between the actual and desired stocks of loans and advances is rather very low-about 15% of the gap being closed in a year. Finally, bank size is found to have some influence on portfolio behaviour. In particular, the fraction of deposit used in financing the supply of loans and advances is found to be relatively high for larger banks just as the speed of adjustment of the actual to the desired stock of loans and advances.

Ismail and Smith (1994)\textsuperscript{31} examined the impact of deregulation on the Malaysian banking system and used ratio analysis for this purpose. The results of the analysis indicate that first, an increase in the degree of competition and reduction in liquidity, and a better reallocation of banks' portfolios. Second, financial fragility and poor asset quality (the result of recession) together with bad management have forced the Central Bank to take further steps to maintain public confidence and slowed the recovery. Third, interest rates are expected to be able to interact closely with economic activity and inflation.

Jackson and Fethi (2000)\textsuperscript{32} evaluated the technical efficiency of Turkish commercial banks for the year 1998 and used DEA techniques for this purpose. They used value added approach to specify three outputs (loans, demand deposit, and time deposit) and two inputs (number of employees, and non-labour operating expenses) in their study. They employed two stage method. The finding of first stage indicates a progress in average efficiency scores for the banking sector in Turkish commercial


banks during the period of study. Tobit regression indicates that bank size and bank profitability had a positive effect on efficiency, while the impact of capital adequacy ratio, number of branches and state ownership was generally negative.

Limam (2001)\textsuperscript{33} analysed the technical efficiency of GCC banks for the year 1999 and used both parametric and nonparametric techniques for this purpose. He used intermediation approach to specify two outputs (all types of loans provided by banks as well as investments and deposits made by banks) and three inputs (fixed assets, the number of bank employees, and financial capital incorporating deposits, borrowings, and any liabilities not classified under deposits or borrowings) in his study. He found that the banks in Bahrain and Saudi Arabia were more technically efficient than other banks in GCC countries due to the fact that the environment in which banks operated in Bahrain and Saudi Arabia were more conducive to better efficiency. He also found that the larger bank size and higher share of equity capital in assets were associated with higher technical efficiency.

Grigorian and Manole (2002)\textsuperscript{34} examined the efficiency of the commercial banks in transition economies for the period 1995-98 and used DEA technique for this purpose. The sample used in their study included seventeen transition economies (Croatia, Estonia, Slovenia, Bulgaria, and Ukraine, etc.), covering the over 90 percent of the banking sectors during 1995-1998. They used the value added approach to specify two sets outputs (i) revenue, net loans, liquid assets (ii), deposits, net loans and liquid assets,) and three inputs, (labour, fixed assets, and interest expenditure in their study. They found that (i) tighter minimum capital adequacy ratios are associated with stronger revenue generating capacity and more aggressive deposit taking behaviour, (ii) banks in a countries with relatively lax foreign exchange exposure limits are doing better than those in countries with tighter policies, (iii), the single borrower-related limits do not affect the bank performance in significant manner.


Yildirim (2002)\textsuperscript{35} analysed the efficiency of Turkish banks for the period 1988-1999 and used DEA technique for this purpose. He used intermediation approach to specify three outputs (total loans, interest income, and non-interest income) and four inputs (total demand deposits, total time deposits, total interest expense, and total non-interest expense) in his study. He reported that the technical efficiency measure shows a large variation with the absence of sustained efficiency gains. He observed that the efficient banks were more profitable than the inefficient banks and that the size of bank was positively related to the technical and scale inefficiencies. He found that the public sector banks were better than private banks with respect to scale efficiency because of larger loan portfolios in public sector banks. He also found that the instability of the macroeconomic environment had a profound influence on the efficiency measures.

Jemric and Vujcic (2002)\textsuperscript{36} examined the relative efficiency of banks in the Croatia banking system for the period 1995-2000 and used DEA technique for this purpose. They used both operation and intermediation approach to calculate the DEA efficiency score. For the operation approach, they used two outputs (interest and related revenues as well as non-interest revenues) and four inputs (interest and related costs, commissions for services and related costs, labour related administrative costs, and capital-related administrative costs). For the intermediation approach, two outputs (total loans extended and short-term securities issued by official sectors) and three inputs (fixed assets, number of employees, and total deposits received) were employed. They found that the foreign-owned banks were more efficient than their domestic counterparts. New banks were more efficient than the old ones and large banks appeared to be locally efficient while smaller banks were globally efficient. Finally, they concluded that there was a strong equalization in terms of average efficiency in the Croatian banking system during the period of study.

Isik and Hassan (2003)\textsuperscript{37} examined the technical, scale and allocative efficiencies of Turkish commercial banks for the period 1988-1996 and used both

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parametric and non-parametric techniques for this purpose. They used intermediation approach to specify four outputs (short term loans, long term loans, risk adjusted of a balance sheet item and other earning assets) and three inputs (Labour, Capital and Loanable funds) in their study. They found that overall cost and profit efficiencies for the Turkish banks were 72% and 83% respectively, implying that on average, about 40% of bank resources and 20 percent potential of bank profits were wasted during the production of banking services. They also found that the relationship between bank size and efficiency was strongly negative.

Chen, Skully, and Brown (2005)\textsuperscript{38} analysed the impact of bank deregulation on the cost, technical, and allocative efficiency of Chinese banks for the period 1993-2000 and used DEA techniques for this purpose. They used intermediation approach to specify three outputs (loans, deposits, and non-interest income) and four inputs (price of deposits, interest expenses, non-interest expenses, and the price of capital) in their study. They found that the deregulation initiated in 1995 had a positive impact on the efficiency of Chinese banks in the first and second years after deregulation. However, in the third and fourth years of post-deregulation, the efficiency level declined. They also found that large state owned banks and small banks were most efficient than medium sized Chinese banks. Finally, they concluded that the efficiency level of the Chinese banking system improved from the early 1990s until 1996 but deteriorated gradually from 1997 to 2000 due to both international and domestic factors.

Grigorian and Manole (2005)\textsuperscript{39} compared the efficiency scores of banks in Bahrain with other countries (Kuwait, Qatar, the United Arab Emirates, and Singapore) for the period 1997-2002 and used DEA techniques for this purpose. They used intermediation approach to specify three outputs (revenues equating the sum of interest and non-interest income, net loans, and liquid assets, which are the sum of cash and treasure bill holdings) and three inputs (personnel expenditure, fixed assets, and interest expenditures) in their study. They found that Singapore had the highest average in the overall technical efficiency index and that Bahrain appeared to be ahead of the GCC countries, followed by the United Arab Emirates, Qatar, and then

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Kuwait. In terms of scale efficiency index the United Arab Emirates, Bahrain, and Qatar appeared to be at least as strong as Singapore. They did not find significant difference between the efficiency scores for traditional and Islamic banks.

Figueira, Nillis and Parker (2006) examined the relative performance of state owned versus private owned, domestically owned versus foreign owned banks across the 40 African countries for the period 2001-02 and used ratio analysis, parametric and non-parametric techniques for this purpose. They found that in Africa, on average, private owned banks perform better than their state-owned counterparts and foreign banks are more efficient than domestically owned banks.

Alfaraj, Bubshait, and Al-Muhammad (2006) examined the efficiency level of nine Saudi commercial banks for the year 2002 and used DEA technique for this purpose. They used intermediation approach to specify two outputs (net interest income and non-interest income) and two inputs (interest expenses and non-interest expenses) in their study. They compared the technical efficiency scores that they obtained with the world mean efficiency scores, found that the mean efficiency scores of the Saudi commercial banks was higher than the world's mean efficiency scores. They observed that Saudi commercial banks to obtain a higher level of efficiency by continuing to offer new services, such as insurance services, mortgage financing, and Islamic products.

Pasiouras F., Sifodaskalakis E., Zopounidis C. (2007) examined cost efficiency of 16 Greek cooperative banks for the period 2000-2004. They used DEA technique to estimate the technical, allocative and cost efficiency of each bank in the sample. They also used Tobit regression to determine the impact of internal and external factors on banks’ efficiency. They reported that DEA Greek cooperative banks could improve their cost efficiency by 17.7% on average as well as that the dominant source of cost inefficiency is allocative rather than technical. They found that bank size was positively related to all measures of efficiency and GDP per capita had negatively related and significant impact on all measure of efficiency. They also

found that the unemployment rate had negative and significant impact on the technical and cost efficiency although not on allocative efficiency.

Kessy (2007)\textsuperscript{43} analysed the banking efficiency of three East African countries for the period 1994 - 2005 and used DEA techniques for this purpose. His sample consisted of banks in Tanzania, Kenya and Uganda. He used the intermediation approach to specify two outputs (loans and debt securities) and three inputs (fixed capital, labour and deposit) in his study. His results indicate that efficiency of banks had improving all the three countries during the period of study. But banks in Uganda were more efficient than banks in Tanzania and those banks in Tanzania were more efficient than banks in Kenya.

Ariff and Can (2008)\textsuperscript{44} examined the cost and profit efficiency of Chinese banks for the period 19952004 and used DEA technique and Tobit model for this purpose. They used intermediation approach to specify two outputs (total loans and investment) and three inputs (total loanable funds, number of employees and physical capital) in their study. They found that Joint -stock commercial banks on an average were most cost and profit efficient than state-owned commercial banks. They noted concluded that medium size banks were most cost and profit efficient followed by small size banks and large banks had the lowest efficiency scores.

Ariss (2008)\textsuperscript{45} examined the banking efficiency of the Lebanese banking sector for the period 1990-2001 and used the parametric SFA technique for this purpose. She used the intermediation approach to specify three outputs (loans to customers and discounts, liquid assets, and net fees and commissions) and three inputs (unit price of capital, unit cost of funds, and unit price of labour) in her study. She found that the average efficiency level in the banking system improved by about10\% during the period of study and that the efficiency level could increase more by improving competition among banks. She observed positive impact of deregulation on bank efficiency. Finally, she noted that large domestic banks could effectively control the cost level in order to face increasing competition and deregulation.


Erdem, and Erdem, (2008)⁴⁶ evaluated the technical, allocative, and economic efficiency levels of the commercial banks in the Republic of Turkey for the period 1998-2004 and used the non parametric DEA techniques for this purpose. They used intermediation approach to specify one output (profit before tax) and three inputs (number of full-time employees, physical capital, and interest-bearing liabilities) in their study. They reported that six banks appeared to be technically efficient at least once during the period of study. They also reported a decrease in the average efficiency level from 1999 to 2001 (from 0.781 to 0.504), which started to improve after 2001 but barring 2003. Finally, they concluded that the average efficiency level of the banking sector in Turkey was affected by the financial crises Turkey experienced in 2000, 2001, and 2003.

Staub, Souza, Tabak, (2009)⁴⁷ examined the technical and allocative efficiencies in the Brazilian banking system for the period 2000-2007 and used non parametric techniques (DEA) for this purpose. They used the intermediation approach to specify three outputs (total loans net provision of loans, investments, deposits) and three inputs, (operational expenses net of personnel expenses, interest rate expenses) in their study. They found that Brazilian banking inefficiency was high if compared to other countries. They also found that non-performing loans was an important indicator of efficiency level, as well as market share.

Alsarhan (2009)⁴⁸ examined the banking efficiency in the Gulf corporation council countries and used DEA technique and Tobit model for this purpose. He used intermediation approach to specify two outputs (investments and total operating income) and three inputs (deposits, capital and general administration expenses). He employed two stage DEA method in order to calculate the efficiency of the Gulf Cooperation Council (GCC) banking sector. The findings of first stage indicate a progress in average efficiency scores for the banking sector in GCC during the period of study. In addition the results show that the most efficient banks were in Qatar, followed by Bank in Bahrain and UAE. The results of second stage indicate that there

was a positive relationship between efficiency scores and profitability level. Finally, he observed that the Islamic banks associated with higher efficiency score.

Margono, Sharma and Melvin II (2010) 49 examined the cost efficiency, economies of scale technological progress and productivity in Indonesian banks for the period 1993-2000 and used stochastic frontier approach for this purpose. They used intermediation approach to specify two outputs (aggregate loans and total aggregate security) and three inputs (labour, capital and total funds) in their study. They found that the average cost efficiency of the banking sector during the period was 70%. However, there was a marked difference in the cost efficiency before and after the Asian economic crisis. The banking sector cost efficiency was 80% prior to the crisis and 53% after the crisis. The private and foreign banks were more efficient than public-owned banks.

Sufian (2010) 50, investigated the efficiency of the Malaysian and Thailand banking sector over the period 1992-2003 and used DEA and Tobit model for this purpose. The sample he used in his study included 12 and 15 banks which account for more than 80% of Malaysian and 90% of Thailand banking sector total assets respectively. The study used all the three major approaches i.e., intermediate, value added and operating approaches. For the intermediation, he employed two inputs (labour and capital) and two outputs (loan and investments). For value-added approach, he used three inputs (labour, capital, and interest expenses) and three outputs (deposits, loan, and investment). For operational approach, he incorporated two inputs (interest expenses, labour) and two outputs (interest income, non interest income). He found that high degree of inefficiency in the Malaysian and Thailand banking sector, particularly a year after the crisis. The Malaysian banking sector exhibited a higher technical efficiency during the post crisis under the intermediation and value added approach. Thailand banking sector exhibited a lower technical efficiency level during the post crisis period under all the approaches.

Tabak, Fazioy, Cajuciro (2011)\textsuperscript{51}, examined Profit, Cost and Scale efficiency for Latin American banks for the period 2001-2008 and using stochastic frontier analysis. The sample they used in their study included the banking systems in Argentina, Brazil, Chile, Costa Rica, Dominican Republic, Ecuador, El Salvador, Jamaica, Mexico, and Nicaragua, Panama, Paraguay Peru, Uruguay, Venezuela. They employed four outputs (total loans, total deposits, other earning assets, and non-interest income) and two input prices (interest expenses to total deposits, non-interest expenses to total assets). They found that banks are more inefficient in profits than in costs. They also found that the concentration impairs cost efficiency; larger banks have higher performance, but this advantage decreases in concentrated markets. Finally, they concluded that private and foreign banks were the most efficient and the most banks were operating under increasing returns to scale.

Assaf, Barros and Matousek (2011)\textsuperscript{52}analysed the technical the technical efficiency of Saudi banks for the period 1997-2007 and used two-stage DEA bootstrap model. They used intermediation approach to specify three outputs (total customer loans, securities and inter-bank loans) and three inputs (total employee, fixed asset and total deposit) in their study. They found that the average efficiency of Saudi banks has increased since 1999 to reach an average efficiency level of 90.2% in 2007. The lowest performing banks were in Riyadh and Samba. Their average technical efficiency was 86.71% and 84.84 respectively. On average Saudi banks were nearly 9.7% away from their frontier maximum efficiency. They also found that the net profit margin and liquidity coefficient have significant and positive impacts on technical efficiency while the payout ratio has negative impact on the technical efficiency. Finally, they concluded that Saudi banks consistently improved their efficiency since 2004.

Barros, Chen, Liang and Peypocho (2011)\textsuperscript{53} examined the technical efficiency in Chinese banking sector for the period 1998-2008 and used non parametric (DEA) and the inverse B convex model for this purpose. They used two outputs (loans and


securities) and three inputs (number of employees, deposits and total assets) in their study. They found that the Bank of China was less efficient than other banks and it was required to reduce its inputs by 4.79% without changing its outputs in order to reach the efficient production frontier. They also found that the overall efficiency of Chinese banks has improved over time, especially after the entry of China in the World Trade Organization (WTO).

Shyu and Chiang (2012)\textsuperscript{54}, examined the managerial efficiency of bank branches in Taiwan for the period 2007-2008 and used three stage data envelopment analysis technique for this purpose. They employed four inputs variable (number of operational staff, number of business personnel, branch office rent and operating expenses) and two outputs (net fee income and net interest spread income) in their study. They found that average technical, pure technical and scale efficiency of banks branches in 2007 were 0.678, 0.876, 0.751 respectively and average technical, pure technical and scale efficiency of bank branches in 2008 were 0.664, 0.856 and 0.766 respectively. They also found that most of bank branches operate at increasing returns to scale and environmental variables have a significant effect on the level of efficiency.

2.4 Performance of Banks in India

Khusro, Raghavan, Ram and Siddharthan (1971)\textsuperscript{55} examined operational efficiency of Indian commercial banks for the period 1951-1968 and used elasticity approach (bank deposit with respect to advances). They found that Canara Bank, Syndicate Bank, Bank of Maharashtra and Union Bank, had yielded a high coefficient of efficiency. They also found that the top 4 banks such as Canara Bank, Syndicate Bank, Bank of Maharashtra, Union Bank had shown assets growth of more than 20 percent.

Varghese (1983)\textsuperscript{56} examined the profitability of Indian commercial banks for the period 1970 – 1979. He analysed the trend in gross profit, net profit and operating profit (operating income minus operating expenses). He found that the main reasons


for the variation in profit were changes in interest rates, increase in CRR and SLR. He pointed out that best options available for improving profitability are better operating and recovery procedure.

Angadi and Devaraj (1983)\textsuperscript{57} examined productivity and profitability of Indian scheduled commercial banks during the period 1969-1980. They found that foreign bank's productivity and profitability ratios were highest, followed by State Bank group and 14 nationalized banks. They also found that the 14 nationalized banks, which displayed poor performance during the initial years of the period under review, did recover after 1974. Finally, they concluded that since 1977, the performance of these banks have started deteriorating.

Singh (1992)\textsuperscript{58} examined the trend in the productivity of the Indian banking industry since nationalization of 14 major banks in 1969. The state bank of India and its subsidiaries along with the banks nationalized in 1969 were considered for the analysis. He performs cross section and inter temporal analysis to measure the productivity of these banks on the basis of 17 indicators. He concluded that all banks under study showed improvement in their productivity except UCO bank.

Amandeep (1993)\textsuperscript{59} examines the trend in profitability in commercial banks and factors responsible for the erosion of bank profitability. He used trend and ratio analysis for this purpose. He found that the profitability of Indian commercial banks declines mainly due to priority sector lending and rural banking. He also found that social obligation is not the only factor which dragged the bank profitability but there are other factors such as organizational structure, management and overall efficiency of banking operations.

Swami and Subrahmanyam (1993)\textsuperscript{60} developed composite index of performance of public sector banks during the period 1971-73 - 1987-89 using 'taxonomic' method by combining selected indicators of income and expenses. They found that no bank has shown a measure of performance close to the ideal of the

respective groups of banks. Despite several limitations of the ‘taxonomic’ method, their study stressed the usefulness of the method of grouping of banks with similar characteristics and recommended the importance of peer group analysis for better planning and performance budgeting exercise of banks.

Keshari and Paul (1994)\textsuperscript{61}, examined relative efficiency of foreign and domestic banks for the period 1991-1992 and used stochastic frontier approach for this purpose. They used production approach to specify two outputs (Deposit and Advances) and three inputs (labour, capital and material inputs). They found that foreign banks as group was one percent less efficient than domestic banks while the standard deviation of technical efficiency of foreign banks was slightly higher than that of domestic banks.

MurtyRamana (1994)\textsuperscript{62} examined the implication of cash reserve ratio and statutory liquidity ratio on the profitability of public sector banks for the period 1986-92. He concluded that the profitability of the public sector banks declined during the period of the study due to straight credit control measure of the Reserve Bank India.

Salay (1996)\textsuperscript{63} examined the productivity changes in Indian commercial banks for the period 1986 - 1992 and used non parametric techniques (generalized Malmquist productivity index DEA) for this purpose. He used values added approach to specify four outputs (advances, deposits, investments and other income) and two inputs (interest expenses and operating expenses) in his study. He found that the productivity growth in the entire industry during the sample period was 5.5 percent per annum. The productivity change for the public sector banks was a modest 1.2 percent, while private sector banks grew at 2.3 percent per annum. The growth rate for foreign banks was an impressive 15.3 percent annum. The regression analysis indicates that foreign ownership and deregulation had a positive effect on productivity, while the impact of priority sector lending and capital adequacy ratio was generally negative on efficiency.


Noulas and Ketkar (1996)\textsuperscript{64} examined the technical and scale efficiency of Indian public sector banks for the year 1993 and used a non-parametric production frontier approach for this purpose. They used intermediation approach to specify two outputs (investment and advances) and three inputs (labour, capital and funds) in their study. They found that overall technical inefficiency was approximately 3.75 per cent of which only 1.5 per cent was on account of pure technical inefficiency and 2.25 per cent inefficiency was due to scale inefficiencies. The majority of banks were found to operate under increasing returns to scale. They also found that the efficiency of the Indian public sector banks could be further enhanced by increasing the scale of operations.

Batra, A. (1996)\textsuperscript{65} examined the impact of policy constraints on the profitability of Indian scheduled commercial banks for the period 1955 - 1987 and used profit function approach for this purpose. She focused on the importance of loans and advances in the bank's asset portfolio as also of policy variable like SLR and CRR and branch expansion in explaining bank profitability. Her results indicate that loans and advances are the most significant contributory factor in overall assets compositions of banks and branch expansion though making banking acceptable to rural areas has not proved to be remunerative enough.

Bhattacharya, Lovell, Sahay (1997)\textsuperscript{66} examined the productive efficiency of 70 Indian commercial banks for the period 1986-1991 and using the stochastic frontier approach for this purpose. They used advances, deposits and investment as output measure, and interest expenses and operating expenses as resources. They found public-owned banks the most efficient and privately owned banks the least efficient, in utilizing resources at their disposal to deliver financial services to their customers. The average efficiencies over the period were 80.35, 87.40 and 75.37 for, publicly owned, privately owned and foreign owned banks respectively. They also found a temporal improvement in the performance of foreign banks, virtually no trend

in the performance of privately owned banks, and a temporal decline in the performance of publicly-owned Indian banks.

Sharks and Das (1997)\textsuperscript{67} examined the performance of public, private and foreign banks for the period 1994-1995 and using measures of profitability, productivity and financial management. They found that performance of public sector banks were poor as compared to other categories of banks. This was due to their typical organizational cultures, technological development, employment pattern and management skills.

Bhattacharyya, Bhattacharyya and Kumbhakar (1997)\textsuperscript{68} have analysed the productivity growth of Indian public sector banks for the period 1970-1992 and used cost function to measure total factor productivity. They used value added approach to specify five outputs (fixed asset, saving deposits, current deposit, investment, loans and advances) and two inputs (labor and physical capital) in Model I. In a model II number of branches was used as quality/attribute of output while inputs were same as in model I. They found that on average, banks achieved an annual total factor growth of 2% and during the recent deregulation; the growth rate has improved to 7%. They observed that deregulation is likely to boost productivity and technical progress by creating a competitive environment conducive to increases in efficiency.

Athma and Srinivas (1997)\textsuperscript{69} examined the productivity in public private and foreign banks for the period 1982-95. They considered two aspects of banks productivity one aspect of productivity was (deposit +advance) per branch and business per employee and other aspect was cost responsiveness and return on working funds. They found that all three bank groups made efforts to improve their productivity in 1994-95 and recovering their operating cost fully. They noted that efficient operation; prompt recoveries, proper appraisal of credit risk and avoidance of risk investment are the key determinate to profitability in banking.


Das (1997)\textsuperscript{70} estimated the technical, allocative and scale efficiency of public sector banks in various pre-reform and post reform years: 1970, 1978, and 1984, 1990 and 1996 and used non parametric (DEA) technique for this purpose. He employed two outputs (Net Interest Income and interest income) and two inputs (labour and loanable funds) in his study. He found that the State Bank Group, in general, improved in overall efficiency during the period under study. The nationalised banks registered a gradual decline in overall efficiency during the period of study and this is more pronounced after 1990. This poor performance was due to fewer nationalized banks (Indian Bank, United Bank of India, Andhra Bank and Punjab and Sind Bank). Inefficiency was technical in nature, which showed that there is under-utilization or wastage of resources rather than being allocative inefficiency.

Sarkar, Sarkar and Bhaumik (1998)\textsuperscript{71} compared the performance of public, private and foreign banks in India for the period 1993-94 - 1994-95. They use two measures of profitability (return on assets and operating profit ratio) and four efficiency measures namely, net interest margin, operating profit to staff expenses, operating cost ratio and staff expense ratio. The authors attempted these comparisons after controlling for a variety of non-ownership factors that might have an impact on performance, asset size, the proportion of investment in government securities, the proportion of direct credit, the proportion of rural and semi urban branches and the proportion of non interest income to total income. They found that, in comparison between private banks and public sector banks, there was only a weak ownership effect. Traded private banks were superior to public sector banks with respect to profitability measures but not with respect to efficiency measures. Non traded private banks did not significantly differ from the public sector banks in respect of either profitability or efficiency. There was, however, a strong ownership effect between foreign banks and private banks, with the former outperforming the latter with respect to all indicators. The authors conclude that private enterprises may not be unambiguously superior to public enterprise in a developing economy. They ascribe the particular ordering of performance that they found—foreign, traded private, non-


traded private and public-to the link between performance and the market for corporate control. The stronger the link, they suggest, the better performance.

Saveeta and Verma (1999)\textsuperscript{72} have tried to find out the factors influencing profitability of public sector banks in India for the period 1971 - 1995 and using multiple regression analysis. They found that priority sector advances, fixed deposits/current deposits ratio and establishment expenses affected the profitability of public sector banks negatively, and net spread influenced profitability positively and significantly. While high credit deposit ratio influenced profitability positively but not significantly.

Das (1999)\textsuperscript{73} compares the performance among the public sector banks for three years in the post-reform period: 1992, 1995 and 1998 using a decomposition model. He finds a certain convergence in performance. He also notes that that while there is a welcome increase in emphasis on non-interest income, banks have tended to show risk-averse behaviour by opting for risk investments over risk loans.

Das (2000)\textsuperscript{74} examined the efficiency of public sector banks for the year 1998 and used non-parametric (DEA) technique for this purpose. He used intermediate approach to specify three inputs (deposit, borrowings and number of employees) and two outputs (margin and commission, brokerage, exchange, etc.) in his study. He found that banks in the State Bank group are, in general, more efficient than nationalized banks. The inefficiency that existed in public sector banks was more a result of both technical and allocative inefficiency. He observed that most of public sector bank group are faced with somewhat similar level of competition. The problems of poor performing banks still lie in the areas of asset quality, management and congestion of labour. Finally, he suggested that these banks have to develop a quick, systematic and sustainable strategy to clean up their contaminated credit portfolio for their survival and global presence in near and future.

Saha and Ravi Sankar T.S. (2000)\textsuperscript{75} examined the efficiency of the Indian public sector banks for the period 1992-95 and used non parametric (DEA) technique for

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this purpose, DEA analysis was carried out in two stages. In the first stage, they used four inputs variables such as number of branches, number of employees, establishment expenditure and non-establishment expenditure and eight outputs variable, deposits, advances, investment, spread, total income, interest income, non-interest income and working funds. In the second stage, they used four inputs (interest expenditure, establishment expenditure, non-establishment expenditure and fixed assets) and six output variables (deposits, advances, investments, non-interest income, spread and total income). The results of the analysis indicate that, barring few exceptions, the public sector banks have in general improved their efficiency during the period of study. In spite of this there are few banks like United Bank of India, UCO Bank, Syndicate and Central Bank of India continued to be at the lower end of the relative efficiency scales during the study period. On the other hand, it is found that banks like Corporation Banks, Oriental Bank of Commerce, State Bank of India, Canara Bank, State Bank of Hyderabad, Bank of Baroda and Dena Bank have consistently been among the relatively more efficient banks.

Ram Mohan (2002)\textsuperscript{76} examined deregulation and performance of public, private and foreign banks in absolute and relative term for the period 1990-91 - 1999-2000 using ratio analysis. He used four financial ratios for comparison (net profit/total asset, net interest income/total asset, intermediate cost/ total assets and non-performing assets/total assets). He found that the only parameter on which the public sector does not better is the net interest income to total asset and better on the ratio of intermediate costs to total assets. He concluded that performance of public sector banks have improved both in absolute and relative terms during the period of study.

D’ Souza (2002)\textsuperscript{77} has evaluated the performance of public private and foreign bank for the period 1991-2000. The efficiency of the banking system was measured in term of speed / working funds ratio and turnover /employees ratio. With the reference to the spread working funds ratio, the efficiency of the commercial banks as a whole has declined in the post-reform period. The public sector banks have been responsible for this decline in efficiency, as the efficiency of the private and foreign banks has improved during the period of study. Though the turn over/employee ratio has risen in


the public sector banks, the turnover per employee in the private and foreign banks has improved during this decade. However, the analysis revealed that profitability of the public sector banks in late nineties improved relative to that of private and foreign banks.

Chaudhri (2002)\(^{78}\) the examined growth and profitability in public sector banks for the period 1995-2001. It is opined that public sector banks are facing triple jeopardy. First they are losing market share, second their profitability is being squeezed and lastly their balance sheets are not strong enough. Then he concluded that the public sector banks are neither very strong nor very weak but they do not have any further capacity to bear the burden of pursuing government policies.

Das (2002)\(^{79}\) examined the risk and productivity of the Indian public sector banks for the period 1995-96 2000-01 and used DEA technique for this purpose. He considered two models, for the first model, he used three inputs (deposit, borrowing, fixed asset), while an additional input (provisions and contingencies) has been added to define a second model. He used a common set of two outputs for both sets of model bank (credit and investment). He found that higher productivity leads to decrease in credit risk; it has a positive impact on bank capitalization as well. He also found that poor performers are more prone to risk taking than better-performing banking organizations.

Sathye (2003)\(^{80}\) examined the production efficiency scores of Indian scheduled commercial banks for the period 1997-98 and used DEA technique for this purpose. He employed two models and used intermediation approach to specify two outputs (Net-interest income and non-interest income) and two inputs (interest expenses and non-interest expenses) in model A, while in model B he used two outputs (net-loans and non-interest income) and two inputs (deposit and staff number). He found that as per model A, the public sector banks have a higher mean efficiency score as compared to private sector and foreign commercial banks in India. As per model B, they have lower mean efficiency scores than the foreign banks but still higher than private sector commercial banks.


Kumbhakar and Sarkar (2003)\(^\text{81}\) analysed the efficiency of the Indian banking system for the period 1986-2000 and used the stochastic cost frontier analysis for this purpose. They also used a tran’slog specification of the cost frontier to estimate the efficiency of the individual banks. The data sets were related to 27 public sector banks and 23 private sector banks. They found that Indian banks, on average, do exhibit the presence of cost inefficiency in their operations. However, there is a tendency for inefficiencies to decline over time. Finally, they concluded that deregulation in the Indian banking sector resulted in an increase in the cost inefficiency of the Indian banks and a decline in the rate of inefficiency reduction.

Kumar DE (2004)\(^\text{82}\) examined the ownership-liberalization-efficiency issue of the Indian banking Industry using a panel data set for the years 1985 to 1995-96. He estimated time-invariant and time-variant technical efficiency of the banks in the Indian banking industry. He employed two outputs (gross income that is to interest and discount earned plus commission, exchange and brokerage plus other receipts and total earning assets) and three inputs(is labour, capital and loanable fund) in his study. He found that the efficiency of the banking industry has not improved after liberalization and foreign-owned banks as a group has the highest efficiency regardless of the choice of output measure and for more than 70 percent of the banks the hypothesis of time-invariant technical efficiency holds. He also found that in the post liberalization period, technical efficiency has increased for only 14 banks out of 18 banks for which time- invariant model is appropriate. The bank of Tokyo-Mitsubishi has gained most in technical efficiency whereas the Vijay Bank is worst affected in the post liberalisation period. He also reported that among the public sector banks, the State Bank of Indore has gained most in technical efficiency in the post liberalisation era.

Shanmugam and Das (2004)\(^\text{83}\) analysed the technical efficiency of 94 banks belonging to four different ownership groups in India (the State banks of India group, the nationalized banks group, the privately owned domestic group, and the foreign

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banks group) for the period 1992-97 and used parametric (stochastic frontier approach) for this purpose. They employed four outputs (net interest margin, non-interest income, credits, and investments) and four inputs (deposits, borrowings, labour, and fixed assets) in their study. They found that variations in the achievement of efficiency among sample banks and among bank groups in raising non-interest income, investment and credit. Notably, about 50% of the sample banks have technical efficiency (TE) values, which are below average value in all cases, except the investments. Most of them are nationalized and private domestic banks. The results in general indicate that the state bank group and private-foreign group banks perform better than their counter parts.

Ram Mohan and Ray (2004)\(^{84}\) compared performances public and private sector a banks for the period 1992-2000 and used DEA technique for this purpose. They employed three outputs (Loans, investments and other incomes) and two inputs (deposits and operating costs) in their study. They found that Public sector banks were significantly better placed than private sector banks on revenue maximization efficiency but there was no difference between public sector banks & foreign banks. They also found that Public sector banks were significantly better than private banks in respect of technical efficiency but not in respect of allocative efficiency.

Bhaumik and Dimova (2004)\(^{85}\) examined the impact of ownership and competition on banks performance in India for the period 1995-2001 and using regression analysis. They used six measures of profitability and efficiency such as, return on asset, total banking asset, priority sector advance as a percentage of total advances, Government securities as a percentage of total investment, non-interest income as percentage of total income, non-urban branches as percentages of total branches. They found that, the private sector and foreign banks were better performing and hence more efficient, than public sector banks initially. However, after 1998-99, neither ownership nor competitions affect the bank performance significantly. They also found that capital market discipline had no influence on the


performance of banks during the entire period, which makes the rational for privatizing public sector banks in India questionable.

Das, Nag and Ray (2005)\(^6\) examined efficiency of public, private and foreign banks for the period 1997-2003 and used DEA technique for this purpose. They employed four inputs (deposits and other borrowings, number of employees, fixed assets and equity) and three outputs (investments, performing loan assets and other non-interest fee based incomes). The results of the study show that the Indian banks are still not much differentiated in terms of input or output oriented technical efficiency or cost efficiency. However they differ sharply in respect of revenue and profit efficiencies.

Sensarma (2005)\(^7\) examined the cost and profit efficiency of Indian commercial banks for the period 1986-2003 and used stochastic frontier analysis for this purpose. He was used six outputs (fixed, saving, current deposits, loans, investments and branches) and two inputs (labour and capital) in his study. The results of the study indicate that public sector banks have shown higher cost efficiency than private banks, whereas it has been the other way round in the case of profit efficiency. New private and foreign banks exhibit the least efficiency in term of both measures. Moreover, cost efficiency improved during the sample period while profit efficiency underwent a decline. This is however an expected result in an economy undergoing transition and deregulation.

Sensarma (2006)\(^8\) studied the efficiency and productivity of scheduled commercial banks in India for the period 1986 - 2000 and using stochastic frontier approach. He used valued added approach to specify six outputs (fixed deposits, saving deposits, current deposits, investment, loans and advances and number of branches) and two outputs (labour and capital) in his study. He found that the inefficiency in Indian banking industry has decline and total factor productivity has gone up for all bank groups during the period under study. He also found that


deregulation in Indian banking industry has achieved the aim of reducing in intermediate cost and improving the productivity.

Reddy (2006)\textsuperscript{89} examined the productivity growth in regional rural banks for the period 1996 - 2002 and used DEA technique for this purpose. He employed two models. In the first model he employed liquid assets, total advances, and total income as outputs while in the second model he used liquid assets, total advances and total deposits as outputs. Interest and operating expenses were use as inputs in both models. He found that the total productivity growth of rural banks was higher in profitability than service provision during the liberalization period. He also found that banks located in economically developed as well as low banking density regions exhibited had significantly higher productivity growth.

Das and Ghosh (2006)\textsuperscript{90} analysed the performance of Indian commercial banks during the post reform period from 1992 to 2002 and used DEA technique for this purpose. Three different approaches viz., intermediate approach, value added approach and operational approach have been employed in defining inputs and outputs of banks. Under intermediation approach, they employed two outputs (advances and investment) and five inputs (demand deposits, saving deposits, fixed deposits, capital related operating expenses and labour). Under the value added approach, they used five outputs (advances, investments, demand deposits, saving deposits and fixed deposits) and three inputs (labour, capital related operating expenses and interest expenses). Under operational approach, they incorporated two outputs (interest income and non-interest income) and three inputs (interest expenses, employee expenses and capital related operating expenses). The results suggest a large asymmetry between banks regarding their technical efficiency over the years. It is also observed that different approaches of measuring inputs and outputs of bank produced divergent sets of efficiency estimates. However, technical efficiency estimates were found to be higher under value added approach than under intermediation approach. They found that the period after liberalisation did not witness any significant increase in number of efficient banks, while medium-sized public sector banks performed reasonably well and are more likely to operate at


higher levels of technical efficiency. The regression analysis indicates that capital adequacy ratio and ownership had a negative effect on the inefficiency, while, the impact of management quality, size and return on assets was generally positive on inefficiency.

Chatterjee and Sinha (2006) estimated cost efficiency of Indian commercial banks using the Data Envelopment Analysis taking loan as the output indicator. Number of bank branches and borrowed capital were taken as two inputs. The results were for 1996-97, 1998-99, 2000-01 and 2002-03 respectively. The results of the cost minimizing DEA show that mean cost efficiency of the in-sample commercial banks declined in 2002-03 significantly i.e. the banks have diverged from the best practice cost frontier. Further, the in-sample private commercial banks exhibited higher mean cost efficiency than the in-sample public sector commercial banks. The public sector commercial banks lagged behind the private sector commercial banks both in respect of technical efficiency and allocative efficiency. The result may be the outcome of lending aversion behaviour by the public sector commercial banks.

Kumar (2008) examined the relationship between technical efficiency and profitability in the Indian public sector banks for the year 2005 and used non parametric (DEA) technique for this purpose. He employed intermediation approach specify two outputs (spreads and non interest income) and three inputs (physical capital, labour and loanable funds) in his study. His analysis of efficiency-profitability matrix based on the efficiency scores and return on assets reveals that 13 banks that fall in the ‘lucky’ and ‘underdog’ quadrants have the technical efficiency (TE) scores below the industry average. The resources utilization process in these banks features the presence of considerable wastage of resources. The ‘ace’ quadrant contains 9 banks which are flagship units in the industry in terms of both efficiency and profitability. Both Andhra and Corporation Bank appear as an ideal benchmark for the laggards on the efficiency and profitability dimensions of performance evaluation.

Kumar and Gulati (2008) examined the technical, pure technical, and scale efficiencies in Indian public sector banks for the year 2004-05. They used DEA and

logistic regression for this purpose. They employed intermediation approach to specify two outputs (net interest income and non-interest income) and three inputs (physical capital, labour and loanable funds). They found that the level of overall technical efficiency in Indian public sector banking industry was around 88.5 percent and magnitude of technical inefficiency was around 11.5 percent. State Bank of Bikaner and Jaipur, and Corporation Bank have been figured out as the ‘global leader’ of Indian public sector banking Industry. The worst performer banks in the sample have been noticed to be Bank of India, followed by UCO Bank, and Bank of Maharashtra, Union Bank of India, and Canara Bank. They noted that technical inefficiency in the Indian public sector banking Industry was due to the both poor input utilization and failure to operate at the most productive scale size (i.e., scale inefficiency).

Sinha and Chatterjee (2008)\textsuperscript{94} examined the fund – based activities in Indian commercial banks for period 2000-01 2004-05 and used DEA technique for this purpose. They employed two outputs (deposit and advances) and three inputs (labour, net worth, and branch) in their study. The results indicted substantial fluctuations in mean technical efficiency. The mean technical efficiency of the in-sample private and foreign banks were somewhat higher than the in sample public sector banks. Further, most of the in- sample banks exhibited decreasing return returns to scale. In so far as total factor productivity was concerned, the in sample public sector commercial banks exhibited relatively higher relatively higher Malmquist Total factor productivity index than the in-sample private sector banks. Decomposition of the total factor productivity index growth rate into technical efficiency change and technical change components reveals that across the groups the commercial banks exhibited rising technical efficiency but negative technical change.

Das and Ghosh (2009)\textsuperscript{95} examined the cost and profit efficiency of Indian banks during the period 1997-2004 and used DEA technique for this purpose. They used intermediation approach to specify three outputs (loan and advances, investments and other income) and four inputs (deposits, labour, capital and equity) in their study. The results of the study indicate high level cost efficiency and lower


levels of profit efficiency, testifying the importance of the inefficiencies of the revenue side of banking activity. The decomposition of profit efficiency suggested that a large portion of outlay was lost due to allocative inefficiency. The regression analysis indicates that public ownership, share in total deposits of all banks, capital to risk-weighted assets ratio had a positive effect on efficiency, while the impact of proportion of term deposits in total deposits, the proportion of current deposits in total deposits and private ownership was generally negative.

Ray and Das (2010) 96 examined the cost and profit efficiency of Indian banks during the period 1996-97 - 2002-03 and used DEA technique for this purpose. They used an asset approach to specify four inputs (funds, labour, capital and quasi-fixed inputs) and three outputs (investments, earning advances and other income) in their study. The results show considerable variation in average levels of profit efficiency across various ownership categories of banks. In general, state owned banks were found to be more efficient than their private counterparts. Further, efficiency tends to be low among the small banks (assets up to Rs. 50 billion), indicating that at the existing scale of operations, these banks were found to be far below the efficient frontier. The nonparametric kernel density analysis corroborates that the shape of the efficiency distribution was mostly determined by the state owned banks.

Tabak and Tecles (2010) 97 examined cost and profit efficiencies of the Indian banking sector for the period 2000-06 and using Bayesian stochastic frontier approach. They employed two different models. In the first model they used four outputs, (loan, other earning assets, deposits and off-balance sheet items) and three inputs (price of fund, the price of labour, the price of capital). In the second model outputs variables did not include off-balance-sheet data in which input variable were same as in the first model. They found that public sector banks were most efficient, followed by private and foreign banks. They also found that foreign banks have largely improved their efficiency, outperforming the domestic banks in the last years of the sample. Finally, they observed that an off-balance sheet activity significantly improves profit efficiency levels.

Kaur and Kaur (2010)\(^98\) examined the impact of mergers on the cost efficiency of Indian commercial banks for the period 1990-1991 - 2007-2008 and DEA technique for this purpose. They used intermediate approach to specify three outputs (advances, non-interest income and spread) and three inputs (labour, loanable funds and physical capital) in their study. They found that over the entire study period average cost efficiency of public sector banks was 73.4 percent and that of private sector banks was 76.3 percent. Overall, results indicate that mergers led to a higher level of cost efficiencies for merging banks. The strong banks should not be merged weak banks, as it will have an adverse effect upon the asset quality of the stronger banks. Finally, they suggested strong banks should be merged with strong banks to compete with foreign banks and to enter into the global financial market.

Zhao, Casu and Ferrari (2010)\(^99\) examined the impact of a deregulation-prudential re-regulation framework on the characteristics of the competitive behaviour, cost structure and on the ownership-cost efficiency relationship of Indian commercial banks for the period 1992-2004 and used cost frontier and partial adjustment model for this purpose. They used intermediation approach to specify three outputs (performing loans, other earning assets and fee-based income) and two inputs (total loanable funds and non-interest operating cost). Results indicate that Indian commercial banks changed both their input mix and output composition to accommodate the changes in the regulatory environment. Pure technology worsen at the initial stages of the reforms, possibly due to the rigid cost structure inherited from the pre-reform period but improves after 1996 as market participants adjust and take advantage of the new opportunities.

Sanyal and Shankar (2011)\(^100\) investigated the effect of ownership and competition on Indian banks productivity for the period 1992- 2004 and used DEA technique for this purpose. They used loans plus deposits as a measure of output and three inputs labour, capital and intermediate input. They found that private banks dominate the public and foreign banks both in terms of productivity level and


productivity growth. They also found that competition has a positive on productivity for old Indian private banks only. All other banks were hurt by competition. They also found that impact of competition had positive only for private sector banks, while all other banks were hurt by competition.

Dwivedi and Charyulu, (2011)\(^{101}\) examined the efficiency of the Indian banking industry in the post-reform era for the period 2005-2010 and used DEA technique for this purpose. They used intermediation approach to specify two outputs (loans/advances and non interest income) and three inputs (no of branches, total operating expenses and deposit) in their study. The estimated mean technical efficiency of all banks under DEA-CRS model was 95.6 percent in 2005 which move up to 97.9 percent in 2010. They also found that national banks, new private banks and foreign banks have shown high efficiency over the study period than remaining banks. The units under state-owned banks, total-public sector banks and old private banks have improved their efficiency in the recent times when compared to 2005 status. The scheduled commercial banks together improved their efficiency continuously up to 2007-08 and after that there was a slight decline in the last two subsequent years.

Kumar (2012)\(^{102}\) analysed the trend of cost efficiency in the Indian public sector banks during the post-deregulation period from 1992/1993 to 2007/2008 and used DEA technique for this purpose. He used intermediation approach to specify two outputs (net-interest income and non-interest income) and three inputs (physical capital, labour, and loan able funds) in his study. The results indicate that deregulation has had a positive impact on the cost efficiency of Indian public sector banking industry over the period of study. Further, technical efficiency of Indian public sector banks followed an uptrend, while allocative efficiency followed a path of deceleration. The author also noted that in Indian public sector banking industry, the cost inefficiency was mainly driven by technical inefficiency rather than allocative. The convergence analysis shows that the inefficient public sector banks were not only catching-up but also moving ahead of the efficient ones i.e., the banks with the low level of cost efficiency at the beginning of the period was growing more rapidly than the high cost efficient banks.


2.5 Research Gap

From the above review of literature, several observations can be made. We have reviewed 32 studies from the developed countries, 25 studies from the developing countries (excluding India) and 50 studies from India. Most of the studies have used Data Envelopment Analysis (DEA) stochastic frontier approach, and some studies have also used more than one technique. We have observed that different efficiency estimation techniques such as Data Envelopment Analysis (DEA), Free Disposal Hull (FDH), Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and Thick Frontier Approach (TFA) give different efficiency scores. We have also observed that efficiency scores depend upon the selection of input and output variable. Researchers have used capital related operating expenses, labour, deposit, loaned funds, interest expenses, non-interest expenses, total cost, operating expenses, purchased funds and equity, as input variable and advances, investments, interest income, net interest income, net loans, branch number, total deposit, total securities, total off-balance sheet items, earning assets and total revenue as output variable. The deposits have both input and output characteristics. In the literature it has been treated as an input by some authors while other categories of authors treated it as output. We also observed that most of the studies have used intermediation approach in order to select input and output variables following by Berger and Humphrey (1997) according to whom the intermediation approach is best suited for analysis of bank level efficiency, whereas the production approach is well suited for measuring branch level efficiency.

Literature on banking efficiency in the developed and developing countries is dominated by the studies assessing the impact of deregulation and liberalization, comparing efficiency on the basis of ownership and comparison of efficiency across the countries. The majority of these studies are confined to the banking system of the US and other developed countries. Berger and Humphrey (1997) documented a country wise and methodology wise review of the studies on bank efficiency and found that majority of the studies on banking efficiency focused on the banks of the developed countries (about 95% and most of them in the USA). Therefore, they suggested that more research is needed in developing countries.

In recent times, many countries have engaged themselves in the process of deregulation and liberalisation of their banking system with avowed objective of
improving efficiency and performance of banks. The rationale behind introducing deregulatory and liberalization measures like interest rate deregulation, removal of entry barriers for private and foreign banks, etc. in the banking system is that these measures unleash the competitive forces in the system, which in turn compel the banks to bring the output-input combination to the optimal production frontier and induce them to produce financial services at lower cost. This led to the publication of a large number of research works, which explore the efficiency performance of banks in the wake of financial deregulation and liberalization. Nonetheless, there are mixed findings in the literature about whether deregulation helped the banks to improve efficiency or not. Notable studies which reported a positive impact of deregulation on the efficiency and productivity of banks are Alam (2001) for U.S., Isik and Hassan (2002) for Turkey, Chen, Skelly and Brown (2005) for China, Ariss (2008) for Lebanon, etc. In contrast to aforementioned studies, there are studies that reported a negative effect of deregulatory measures on the efficiency and productivity of banks. Some of the studies in this context are Elyasiani and Mehdian (1995), Wheelock and Wilson (1999) for U.S., Harychyk (2006) for polish, Erdem and Erdem (2008) for Turkey etc. Further, we considered some studies which compared efficiency of banks on the basis of ownership pattern within the country and also take into account researches focused on inter-country comparisons. Some of the studies comparing efficiency of the banks on the basis of ownership are Yildirim (2002) for Turkey, Ariff and Can (2008) for china, Tecles and Tabak (2011) for Brazil etc. Studies that compared efficiency of the banks among different countries are Limam (2001) for Gulf Corporation Council, Masdos and Pastor (2001) (OECD) countries Casu and Molyneux (2003) for European countries, etc.

In India, sincere efforts to examine banking efficiency started from 1997. Literature on banking efficiency in India is dominated by the studies assessing the impact of deregulation and liberalization and the studies comparing efficiency of public, private and foreign banks. There are mixed findings in the literature about whether deregulation helped to improve efficiency or not. Notable studies which reported a positive impact of deregulation on the efficiency and productivity of banks are Bhattacharyya et al. (1997a), Bhattacharyya et al. (1997b), Saha and Ravisankar (2000), Ram Mohan (2002), Sathey (2003), Kumbhakar and Sarkar (2003), Shanmugam and Das(2004), Rammohan and Ray(2004), Sensarma (2006),

Our survey of literature on the efficiency of public sector banks in India reveals that efficiency of public sector banks has considerably improved during the post-reform period. But the number of such studies is very small. Many studies on the banking efficiency have compared the efficiency of public, private and foreign banks by using a common frontier. Such comparisons are not justified on the ground that public, private and foreign banks follow different technology and banking practices and are operated under different legal and regulatory frameworks. A Number of Studies on Indian banking have primarily relied on ratio analysis to measure efficiency of financial institution which suffer from several methodological limitations. To alleviate these methodological limitations, this study uses a different methodology to measure the technical efficiency of banks. To our knowledge, no study has attempted to cover sufficiently (21 years) large time span after initiation of reform. Very few studies have compared the performance of public sector banks before and after the global financial crisis. Further, Very limited number of studies on banking have analysed efficiency by decomposing it into components. In this study, I decompose efficiency into three sources- technical efficiency (CRS), pure technical efficiency (VRS) and scale efficiency. Most studies on the efficiency of public sector banks have followed single stage Data Envelopment Analysis. In our analysis, we follow the two-stage approach as suggested by Coelli, Prasad and Battese (1998). This approach involves solving a DEA problem in the first stage analysis. In second stage, the efficiency score measures that are derived from the DEA estimation (first stage) will be used as dependent variable and then regressed upon the environmental variable( capital adequacy ratio, non performing assets, priority sector lending, Management). There are only few studies which have exclusively focused on the efficiency of public sector banks in India. The presents study is a modest attempt to fill the above mentioned research gaps.