EFFICIENCY EVALUATION OF BANKING SECTOR IN INDIA BASED ON DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Banks deal with people's most liquid asset (cash), and run a country's economy. The banking system in India is significantly different from that of other nations because of the country's unique economic, social and geographic characteristics. India has a large population and land size, a diverse culture, and extreme disparities in income, which are marked among its regions. There are high levels of illiteracy among a large percentage of its population but, at the same time, the country has a large reservoir of managerial and technologically advanced talents. Between about 30 and 35 percent of the population resides in metro and urban cities and the rest is spread in several semi-urban and rural centers. The country's economic policy framework combines socialistic and capitalistic features with a heavy bias towards public sector investment. However, the last couple of decades have witnessed continuous change in regulation, technology and competition in the global financial services industry. Rising cost-income ratios and declining profitability reflect increased competitive pressure. To assess the stability of the banking system, it is therefore crucial to benchmark the performance of banks operating in India. An efficient banking system contributes in an extensive way to higher economic growth in any country. Thus, studies of banking efficiency are very important for policy makers, industry leaders and many others who are reliant on the banking sector.

This paper investigates the technical efficiency of major representatives of Indian commercial banks. For this purpose, the data envelopment analysis (DEA) model was used with four input variables (viz. Deposits, Interest expenses, Operating expenses, Assets) and four output variables advances & loans, investments, net interest income, and non-interest income. DEA is a nonparametric method of measuring the efficiency of a Decision Making Unit (DMU) such as a firm, a public sector unit (Bank in this case), first introduced in the operations research by Charnes, Cooper and Rhodes (CCR) (European Journal of Operational Research [EJOR], 1978). DEA is a technique of determining efficiency of DMU's based on multiple inputs and multiple outputs.

Keywords: Data Envelopment Analysis, Technical Efficiency, Decision Making Unit CRR model.

INTRODUCTION:

India has a long history of both public and private banking. Modern banking in India began in the 18th century, with the foundation of the English Agency House in Calcutta and Bombay. In the first half of the 19th century, three Presidency banks were established. After the 1860 introduction of limited liability, private banks began to appear, and foreign banks entered the market. The beginning of the 20th century saw the introduction of joint stock banks. In 1935, the presidency banks were merged together to form the Imperial Bank of India, which was subsequently renamed the State Bank of India. Also that year, India's central bank, the Reserve Bank of India (RBI), began its operation. Following independence, the RBI was given broad regulatory authority over commercial banks in India. In 1959, the State Bank of India acquired the state-owned banks of eight former princely states. Thus, by July 1969, approximately 31 percent of scheduled bank branches throughout India were government controlled, as part of the State Bank of India. The Indian Banks development strategy was in many ways a socialist one, and the government felt that banks in private hands did not lend enough to those who needed it most. In July 1969, the government nationalized all banks whose nationwide deposits were greater than Rs. 500 million, resulting in the nationalization of 54 percent more of the branches in India, and bringing the total number of branches under government control to 84 percent.

Wide-ranging reforms covering industry, trade, taxation, external sector, banking and financial markets have been carried out in the Indian economy since mid-1991. A couple of decades of economic and financial sector reforms have strengthened the fundamentals of the Indian economy and transformed the operating environment for banks and financial institutions in the country. The sustained and gradual pace of reforms has helped avoid any crisis and has actually fuelled growth. The most significant achievement of the financial sector reforms has been the marked improvement in the financial health of commercial banks in terms of capital adequacy, profitability and asset quality as also greater attention to risk management. Further, deregulation has opened up new opportunities for banks to increase revenues by diversifying into investment banking, insurance, credit cards, depository services, mortgage financing, securitization, and so on. At the same time, liberalization has brought greater competition among banks, both domestic and foreign, as well as competition from mutual funds, NBFC's, and other financial institutions. Increasing competition is squeezing profitability and forcing banks to work efficiently on Shrinking spreads. Because banks still play an important role in the financial market, it is important to evaluate whether banks operate efficiently. In order to compete with other financial institutions, banks must increase their levels of efficiency.

LITERATURE REVIEW:

There have been several studies analyzing bank efficiency in India. In some studies, bank efficiency was measured by a number of financial indicators and compared over various categories of banks. Sarkar et al. (1998) compared public, private and foreign banks in India to find the effect of ownership type on different efficiency measures. Rammohan (2002, 2003) also used financial measures for comparing operational performance of different categories of banks over a period of time. However, most of the studies which look at the efficiency of Indian commercial banks concentrate on cost, profit, income or revenue efficiencies, using DEA as a technique of analysis. While few studies concentrate on the efficiency of only public sector banks, others look at the relationship between ownership and efficiency.

Bhattacharya et al (1997) used DEA to measure the productive efficiency of Indian commercial banks in the late 1980's to early 1990's and to study the impact of policy of liberalizing measures taken in 1980's on the performance of various categories of banks. They found that the Indian public sector banks were the best performing banks, as the banking sector was overwhelmingly dominated by the Indian

public sector banks, while the new private sector banks were yet to emerge fully in the Indian banking scenario.

Sathye (2001) studied the relative efficiency of Indian banks in the late 1990's and compared the efficiency of Indian banks with that of the banks in other countries. He found that the public sector banks have a higher mean efficiency score as compared to the private sector banks in India, but found mixed results when comparing public sector banks and foreign commercial banks in India. He also found that most banks on the efficient frontier are foreignowned.

Kumbhakar and Sarkar (2003) found evidence on Indian banks that while private sector banks have improved their performance mainly due to the freedom to expand output, public sector banks have not responded well to the deregulation measures.

Rammohan and Ray (2004) compared the revenue maximizing efficiency of public, private and foreign banks in India, using physical quantities of inputs and outputs in the 1990's, using deposits and operating costs as inputs, and loans, investments and other income as outputs. They found that public sector banks were significantly better than private sector banks on revenue maximization efficiency, but between public sector banks and foreign banks the difference in efficiency was not significant.

Shanmugam and Das (2004) studied banking efficiency using stochastic frontier production function model during the reform period, 1992-1999. The study considers four input variables (viz. deposits, borrowings, labor and fixed assets) and four output variables (viz. net interest income, non interest income, credits and investments). They found that deposits are dominant in producing all outputs and the technical efficiency of raising interest margin is varied across the banks. In particular, they found that the reform measures that had been introduced since 1992 have not helped the banks in raising their interest margin. Also, in general, they found that private/foreign banks performed better than public banks.

Das et al (2004) analyzed the efficiency of Indian banks using data envelopment analysis using four input measures (viz. borrowed funds (i.e. deposits and other borrowings), number of employees, fixed assets and equity), and three output measures (investments, performing loan assets and other non-interest fee based incomes), and found that, despite liberalization measures aimed at strengthening and improving the operational efficiency of the financial system, Indian banks were still not much differentiated in terms of input- or output-oriented technical efficiency and cost efficiency; however, they found that there were significant differences in terms of revenue and profit efficiencies. They also found that bank size, ownership, and the fact of its being listed on the stock exchange had a positive impact on the average profit efficiency and to some extent revenue efficiency scores. Also, they found that there was a general improvement in efficiency during the post-reform period.

Sanjeev (2006) studied efficiency of private, public, and foreign banks operating in India during the period 1997-2001 using data envelopment analysis. He also studied if any relationship can be established between the efficiency and non-performing assets in the banks. He found that the there is an increase in the efficiency in the post-reform period, and that non-performing assets and efficiency are negatively related.

Kumar and Gulati (2007) studied the technical efficiency of public sector banks in India using two data envelopment analysis models, viz. the CCR model and Andersen and Petersen's super-efficiency models were used. The analysis was performed on a cross-section of twenty seven public sector banks in the year 2004-05. The results show that the technical efficiency scores range from 0.632 to 1, with an average of 0.885. Thus, the overall level of technical inefficiency in Indian public sector banking industry has been found to be around 11.5%. Finally, foreign banks are found to be more cost-efficient but less profit-efficient relative to domestically owned private banks and state-owned banks. The banks affiliated with SBI group were found to outperform the nationalized banks in terms of operating efficiency.

METHODOLOGY:

This research analyses the efficiency of 5 public and 5 private sector banks on the DEA analysis.The banks are selected on the basis of Purposive sampling technique based on the values of deposits and advances. The banks are :

Public sector Banks	Private sector Banks
State bank of India	ICICI Bank
Punjab National Bank	HDFC Bank
Canara Bank	Axis Bank
Bank of Baroda	Jammu & Kashmir Bank
Bank of India	Federal Bank

The efficiency scores would be based on the CCR model of DEA.

Data Envelopment Analysis (DEA), occasionally called frontier analysis, is a performance measurement technique which can be used for analyzing the relative efficiency of productive units, having the same multiple inputs and multiple outputs. It is a non-parametric analytic technique which allows us to compare the relative efficiency of units as benchmark and by measuring the inefficiencies in input combinations in other units relative to the benchmark. One of the earliest studies on DEA is 57 International Research Journal of Finance and Economics - Issue 18 (2008) the study of Farrell (1957) who attempted to measure the technical efficiency of production in single input and single output case. DEA was originally developed by Charnes, Cooper and Rhodes (1978) with the assumption of constant return to scale (CRS) in attempt to propose a model that generalizes the single-input, single output measure of a DMU to a multiple inputs, multiple outputs setting. Thus DMU is an entity that uses input to produce output. DEA was extended by Banker, Charnes and Cooper (1984) to include variable return to scale (VRS). Up to now the DEA measure has been used to evaluate and compare educational departments, health care, agricultural production, banking, armed forces, sports, market research, transportation and many other applications.

DEA is a deterministic methodology for examining the relative efficiency, based on the data of selected inputs and outputs of a number of entities called decision–making units (DMUs). From the set of available data, DEA identifies relative efficient DMUs (which are used as reference points) which define the efficiency frontier and evaluate the inefficient of other DMUs which lie below that frontier. DEA is an alternative analytic technique to regression analysis. Regression analysis approach is characterized as a central tendency approach and it evaluates DMUs relative to an average. In contrast, DEA is an extreme point method and compares each DMU with the only best DMU. The main advantage of DEA is that, unlike regression analysis, it does not require an assumption of a functional form relating inputs to outputs. Instead, it constructs the best production function solely on the basis of observed data; hence statistical tests for significance of the parameters are not necessary. Despite the existence of several DEA models, this study utilizes CCR-Model which is an output-oriented model where DMUs deemed to produce the highest possible amount of output with the given amount of input.

CCR-MODEL:

CCR-Model is introduced by Charnes, Cooper and Rhodes (1978). This model measures the efficiency of each DMU which obtained as a maximum of a ratio of total sum of weighted outputs to total sum of weighted inputs. Consequently, the efficiency can be defined as follow.

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{}$$

Weighted sum of inputs

The weights for the ratio are determined by the restriction that the similar ratios for every DMU have to be less than or equal to unity, thus reducing multiple inputs and outputs to a single "virtual" input and single "virtual" output without requiring pre-assigned weights. Therefore, the efficiency score is a function of the weights of the "virtual" input-output combination. Suppose that there are n DMUs, each with m inputs and s outputs, relative efficiency score of a given DMU0 is obtained by solving the following linear programming model.

$$\max h_0(u,v) = \frac{\sum_{r=1}^{s} v_r y_{r0}}{\sum_{i=1}^{m} u_i x_{i0}}$$

subject to

$$\frac{\sum_{r=1}^{s} v_r y_{rj}}{\sum_{i=1}^{m} u_i x_{ij}} \le 1 ; j = 1,2,.....,n$$

$$u_i \ge 0 ; i = 1,2,.....,m$$

$$v_r \ge 0 ; r = 1,2,.....,s$$

where

x_{ij} = the amount of input i utilized by the jth DMU

y_{rj} = the amount of output r produced by the jth DMU

u_i = weight given to input i

v_r = weight given to output r

Following the Charnes-Cooper transformation (1962), one can select a representative solution (u,v) for which

$$\sum_{i=1}^{m} u_i x_{i0} = 1$$

Hence, the denominator in the efficiency score h_0 shown above is set equal to one, the transformed linear programming model for DMU_0 can be written as follow.

$$\max z_0 = \sum_{r=1}^{s} v_r y_{r0}$$

subject to

$$\sum_{r=1}^{s} v_r y_{rj} - \sum_{i=1}^{m} u_i x_{ij} \le 0 ; j = 1,2,.....,n$$

$$\sum_{i=1}^{m} u_i x_{i0} = 1$$

$$u_i \ge 0 ; i = 1,2,.....,m$$

$$v_r \ge 0 ; r = 1,2,.....,s$$

The linear programming model shown above will be run n times in identifying the relative efficiency scores of all the DMUs. Each DMU selects input and output weights that maximize its efficiency score. Generally, a DMU is considered to be efficient if it obtain a score of 1.00, implying 100% efficiency; whereas a score of less than 1.00 implies that it is inefficient.

v_r = weight given to output r

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The Inputs and outputs considered for this research are:-

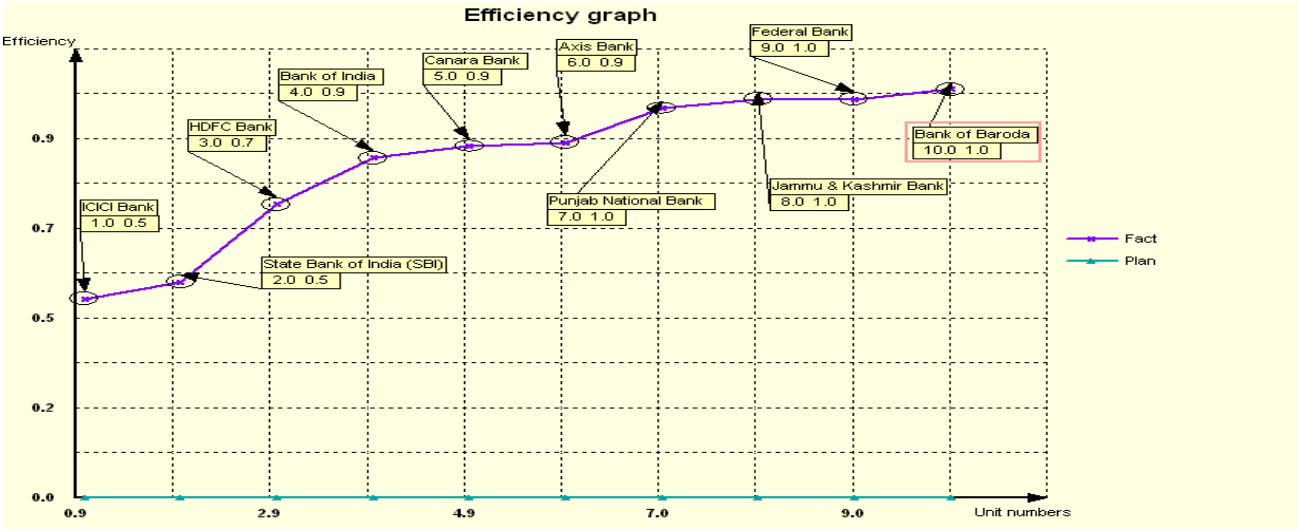
Inputs	Outputs
Deposits	Advances
Interest expenses	Investments
Operating expenses	Interest income
Assets	Non-interest income

Results and Analysis:

The efficiency scores of major banks commercial banks show a great variety and no two banks can be said to have a same trend throughout.

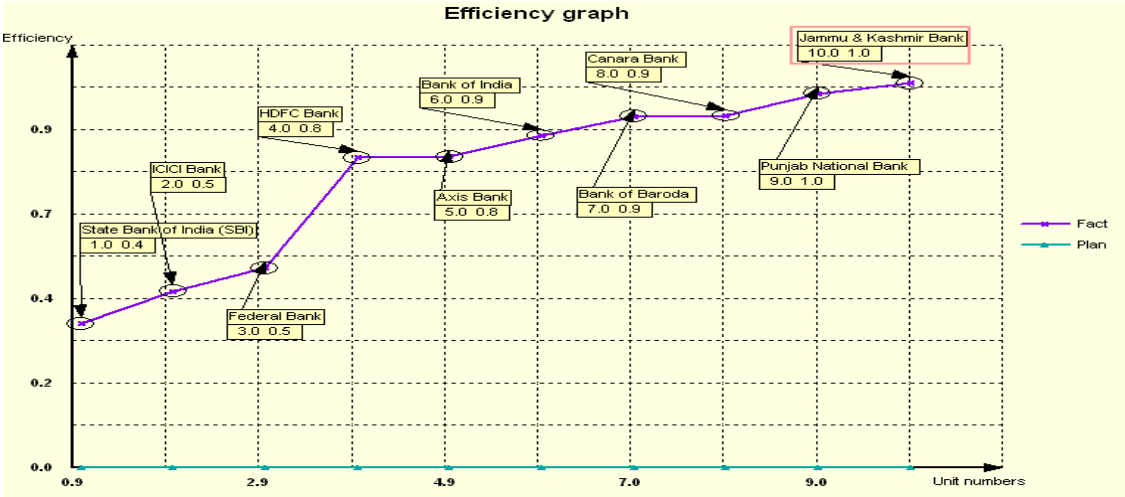
Serial Number	DMU (Banks)	Efficiency 2008	Efficiency 2009	Efficiency 2010
1	ICICI Bank	0.499	0.458	0.617
2	State Bank of India	0.541	0.373	0.293
3	HDFC Bank	0.736	0.806	0.811
4	Bank of India	0.852	0.863	0.999
5	Canara Bank	0.882	0.915	0.884
6	Axis Bank	0.892	0.808	0.734
7	Punjab National Bank	0.978	0.973	1.01
8	Jammu & Kashmir Bank	1	1	1
9	Federal Bank	1	0.519	1
10	Bank of Baroda	1.025	0.914	0.877

Efficiency Graph 2008



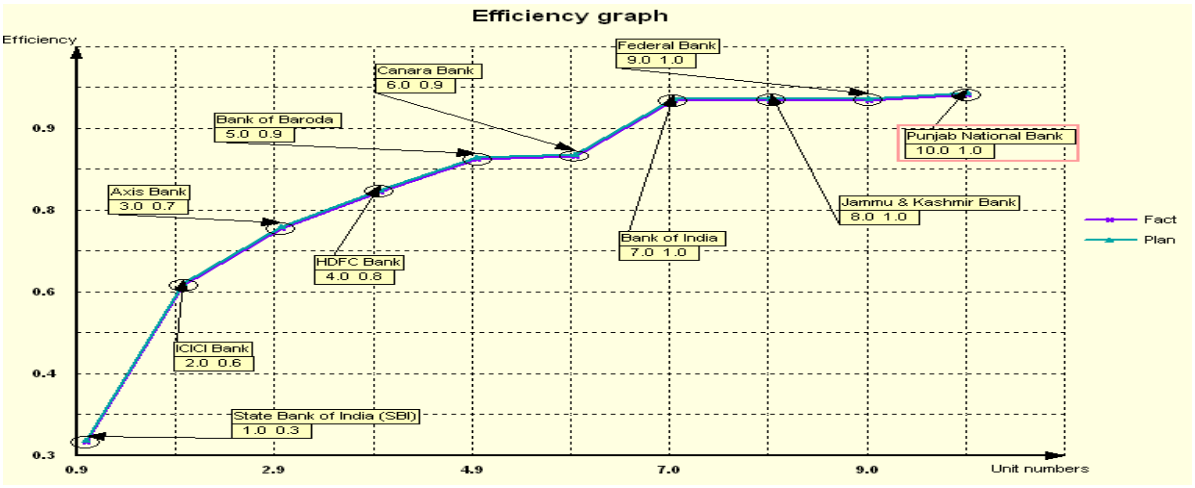
In 2008, banks namely Punjab National Bank, Jammu & Kashmir Bank, Federal Bank, Bank of Baroda showed scores ranging from 0.978 to even 1.025 which are considered to be very good scores and these banks can be called as efficient, and have produced their outputs in an efficient manner. The scores for HDFC bank, Bank of India, Canara bank and Axis bank are in the range of 0.736 to 0.892 which is a satisfactory level, but still have a scope for improvement in the efficiency. Whereas SBI (0.541) and ICICI bank (0.499) face a turmoil situation as the scores depict about being in-efficient.

Efficiency Graph 2009



In 2009, half of the sample size shows a negative trend as compared to 2008. The efficiency of five banks namely State Bank of India, Axis Bank, Federal bank, Bank of Baroda and ICICI has decreased by 2009 and this decrease is significant in banks like Federal bank, Axis bank and SBI. Still the banks like HDFC bank, Bank of India, Axis bank manage to remain in the satisfactory level, whereas the banks like Canara bank (0.915), Punjab National bank (0.973), J & K bank (1.0) and Bank of Baroda continue their efficient performance even in 2009.

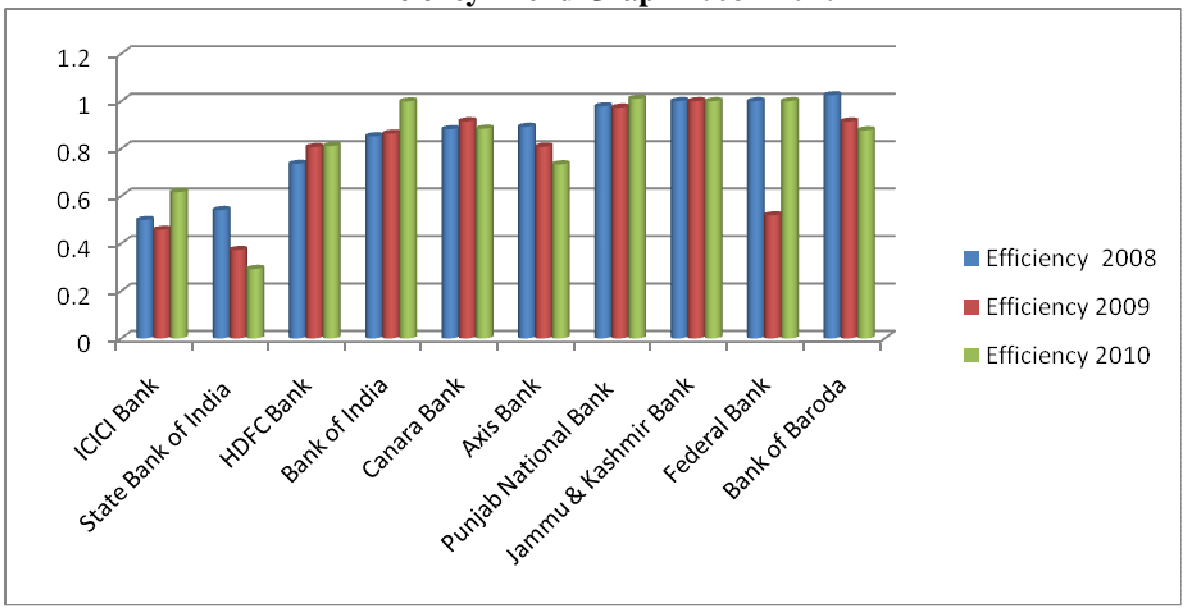
Efficiency Graph 2010



In 2010, SBI, Axis bank and Bank of Baroda continue their poor performance and again show the decreasing trend. Now this should be considered as an alarming signal for bank like SBI with the efficiency scores just 0.293. However, a significant growth can be seen in the efficiency scores of ICICI bank (26%), Bank of India (14%) and Federal bank (49.1%). So, overall 2010 has been comparatively efficient year for most of the banks.

The overall performance of commercial banks can be analysed from the averages of their efficiency scores. 2008 - 0.8405; 2009 - 0.7629; 2010 – 0.8225

Efficiency Trend Graph 2008 - 2010



Considering various factors affecting the efficiency, still it ranges in between satisfactory level. Also, no significant demarcation between the Public and Private sector banks can be made. As even the best perfor4mers and the poor performers have representatives of both the sectors.A point to be noted is that the poor performers are those with high figures of Deposits and Advances. The banks with lower deposits and advances have shown efficiency, whereas banks with huge deposits and advances are not that efficient.

CONCLUSION:

In this research DEA was used to analyse the efficiency of major representatives of commercial banks in India and it can be seen that most of the banks are satisfactorily efficient. The average performance of the banking sector ranges above 80%, which indicates the appropriate conversion of inputs into outputs. The public and the private sector are equally efficient; however the private sector has a margin over the public sector.

There exist banks like Canara bank, Punjab National bank, J & K bank and Bank of Baroda which are very efficient and they have a consistency in their performance. Banks like SBI, ICICI can be a matter of concern as their efficiency scores are below satisfactory level; however ICICI bank has shown a remarkable improvement in the last year. The major factor resulting in the poor performance by these two banks is their huge amounts of deposits, advances and other assets. So here either these banks possess blocked/non-performing assets or are not able to make a set off between the deposits and advances. Being major banks in the country deserve to be paid a better attention of the regulators and the administrators.

The banking sector of India portrays a picture of a developing economy, moving towards being a developed economy through continuous efficiency improvement.

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