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Analysis of Indian Banking Sector with Reference to Efficiency

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Abstract

This study examines the performance of Indian commercial banks for the period 2011-2013. Study has utilized the mathematical programming based non parametric technique i.e Data Envelopment Analysis (DEA) to evaluate the relative efficiency of various Decision Making Units. DEA technique is used to evaluate the technical efficiency scores using CCR (Charnes, Cooper and Rhodes) model and pure technical efficiency scores using BCC (Banker, Charnes and Cooper) model, which are popular among all other methods. The objective of this paper is to evaluate the extent of technical efficiency in 46 commercial banks operating in India. The study categorizes the most efficient banks which act as benchmarks for other banks. The results show that only 10 of the 46 banks are found to be efficient and thus, defined the efficient frontier.

Keywords: *DEA, Efficiency, Banks, India, Technical Efficiency.*

INTRODUCTION

Due to increasing competition between private, foreign and public sector banks, the effectiveness of the management by implementation of the strategic planned policy plays a vital role to retain the existing customers and become customer centric to attract new customers. This is only possible by extending quality services with full satisfaction of the customer. The measurement and evaluation of performance is a fundamental aspect of managerial planning and control. The most difficult part of performance measurement is the determination of appropriate measures to provide an overall ranking of performance. Although a ranking can be obtained with a single measure of performance, this is almost always insufficient as it fails to capture the relevant dimensions of performance needed for planning and control, and provides a valid excuse for the claims of underperforming units that the measure does not fully reflect their activities and results The effectiveness of the

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management is measured by results of the institution and utilization of its available resources to fullest extend to produce the maximum output with full satisfaction of its employees. Hence the measurement of the institution performance is critical to evaluate the effectiveness of the management of the institution.

INDIAN BANKING SECTOR

In India, the Reserve Bank of India acts as a regulator and central bank of the country. Banking system has a wide mix, comprising of scheduled and non-scheduled banks, cooperative sector banks, post office saving banks, foreign and exchange banks. As on March 2008, the number of commercial banks is 79 comprise of 28 PSBs, 23 private sector banks and 28 foreign banks. It is evident that public sector banks dominate the commercial banks in India. It has been observed that the market share of public sector banks in terms of investment, advances and assets is near about 70 percent. The Public sector banks are the biggest players in the Indian banking system and they account for 70 percent of the branches of commercial banks in India. As on March 2008, private sector banks accounts for nearly 21.7 percent while foreign banks constitutes 8.41 percent share in total assets of commercial banks. During last few decades, the environment under which Indian banking sector has operated witnessed a remarkable changes. India embarked on a strategy of economic reforms in the wake of a serious balance of payment crisis in 1991(Mohan, Rakesh 2005). In Indian banking sector, the policy makers adopted a cautious approach for introducing reform measures on the recommendation of Narishmam Committee I (1991), Narishmam Committee II (1997) and Verma Committee (1999). The main objective of the banking sector reforms was to improve the efficiency of banks and to promote a diversified and competitive financial system. One of the outcomes of such reforms was the consolidation of the banking industry through mergers and acquisitions. Technological progress and financial deregulation have played an important role in accelerating the process of merger and acquisition in Indian banking industry. Due to technological progress, the scale at which financial services and products are produced has expanded which provide an opportunity for the banks to increase their size and scale of production.

REVIEW OF LITERATURE

Numbers of studies have been conducted in India and abroad to study the various aspects of performance measurement and to examine the efficiency of banks. Berger and Humphrey (1997) in their study provide an extensive review of studies on the efficiency of banking sector. They pointed out that, majority of studies focused on the banking markets of well-developed countries with particular emphasis on the US market. Bhattacharyya et al. (1997) used DEA to measure the productive efficiency of 70 Indian commercial banks in the period 1986-1991. They found that the public sector banks are the most efficient banks as compared to foreign banks and private banks. They also found a temporal decline in the performance of public sector banks. Das (1997) used the cross-section data and DEA to examine the efficiency of 65 major banks for the year 1995. He found that Indian banks were more technically efficient than allocatively efficient. Singh (1990) discussed the trends and changes in the productivity with particular attention on employee and branch productivity in the Indian banking industry. The researcher used seventeen indicators to analyze productivity trends. Banking being service industry, greater attention has been paid to employee productivity. Mukherjee et al. (2002) examined the technical efficiency of 68 Indian commercial banks for the period 1996-1999 and found that public sector banks are more efficient than both private and foreign banks. Ram Mohan and Ray (2004) compared the performance among three categories of banks- public, private and foreign banks- using physical quantities of input and outputs and comparing the revenue maximization efficiency of banks during 1992-2000. The findings of the study showed that public sector banks performed better than private sector banks but not

differently from foreign banks. All these studies have compared the efficiency of public, private and foreign banks by using a common frontier and such comparisons are not justified on the ground that public, private and foreign banks are operated under different legal and regulatory frameworks. The pace of bank mergers and acquisitions is increasing all over the world and it has given rise to an extensive economic research. Today, there is quite an abundance literature available on the subject of bank mergers. Berger et.al (1999) provided a comprehensive review of studies evaluating mergers and acquisitions in banking industry.

Also there have been several studies conducted on the impact of mergers on the efficiency of banks. The studies that have been conducted to analyze the impact of mergers and acquisitions on bank performance can be classified as ex-ante studies and ex-post studies. Ex-ante studies assess the effect of merger on bank performance by analyzing the stock market reaction to merger announcement. Ex–ante studies are also called the event studies as the announcement of merger is considered as an event in the stock price history of the merging entity. Ex-post studies, on the other hand assets the effect of merger on banks' performance by comparing, pre and post merger performance of banks. This comparison can be made by using either traditional financial ratio analysis or by econometric and frontier analysis. There is voluminous literature on mergers and acquisitions in developed economies like US but there is dearth of literature in developing economies like India and other Asian countries. The literature suggests that there is mixed empirical evidence regarding the impact of mergers and acquisitions on the efficiency and performance of banks. Cost efficiency gains from merger may be arise from the fact that merged banks gain access to cost saving technologies or spread their fixed cost over a larger base, thus reducing average cost. Chakrabarti and Chawla (2005) evaluated the relative efficiency of Indian banks using DEA during the period 1990-2002. They utilized two models to specify input-output vectors and labeled those models as quantity and value approaches. The results of the study suggested that on the value basis, the foreign banks, as a group, have been considerably more efficient than all other bank groups, followed by the Indian private banks. However, from the quantity perspective, private banks seem to be doing the best while the foreign banks are the worst performers. The authors attributed this to the general policy of foreign banks to cherry-pick more profitable businesses rather than offering banking services to a wider section. Further, PSBs have, in comparison, lagged behind their private counterparts in terms of performance.

Ketkar and Ketkar (2008) studied the impact of reforms and liberalization on efficiency and profitability of 62 Indian commercial banks. The analysis is confined to the period spanning for 1997-2004. A non-parametric Data Envelopment Analysis approach has been employed to estimate the efficiency scores for individual banks under the two input-output specifications. It has been observed that the efficiency scores of all banks in general have improved regardless of their ownership during the period of reforms under both specifications. Further, the nationalized banks have registered the strongest gains. These gains in efficiency have shown an improvement in bank profitability. Kumar (2008) examined relationship between efficiency and profitability using the cross-sectional data for 27 PSBs operating in India during the financial year 2004/05. The technique of DEA has been deployed to compute the technical efficiency scores for individual banks. It has been found that the banks affiliated with SBI group outperform the banks in the nationalized banks group in terms of operating efficiency. The analysis of efficiency- profitability matrix reveals that Andhra Bank and Corporation Bank appeared as an ideal benchmarks for the laggards on the efficiency and profitability dimensions. Further, the resource utilization in 48 percent banks is not functioning well and features the presence of considerable waste of resources.

THE PARAMETRIC METHOD

Data Envelopment Analysis

Data Envelopment Analysis (DEA) sometimes also referred as frontier analysis was first introduced in the Operations Research by Charnes, Cooper and Rhodes in 1978 under the assumption of constant returns to scale when all DMU's are operating at an optimal scale. DEA has grown into a powerful quantitative, analytical tool for measuring and evaluating performance and its efficiency. Data Envelopment Analysis is extended application of Linear Programming where the frontier is assembled on a piecewise basis from the Decision-making units (DMUs). It involves the use of Linear Programming methods, it is a non –parametric method of measuring the efficiency of a decision- making Unit (DMU) such as a firm or a public sector agency with multiple inputs and multiple outputs in the absence of market prices, Where DMU are non-market agencies or homogeneous units like schools, hospitals and courts which produce identifiable and measurable outputs from measurable inputs. It was first introduced in the Operations Research Literature by Charnes, Cooper and Rhodes in (EJOR, 1978). The original CCR model was applicable only technologies characterised by Constant returns to scale globally and Banker, Charnes and Cooper (BCC) in (Management Science, 1984) extended the CCR model for technologies that exhibit variable returns to scale. However, in practical situation many factors like imperfect competition, regulatory and legal framework put constraints on DMU' s not to be operating at optimal scale. As a result, the use of CRS specification when some DMU are not operating at optimal scale will result in measures of technical efficiency, which are confounded by scale efficiencies (Philip, 1999). In past years, mythological contributions from a large number of researchers accumulated into a significant volume of literature around the CCR-BCC models and as a result the generic approach of DEA emerged as a result oriented alternative to regression analysis for efficiency measurement.

DEA computes the efficiency of banks on the basis of estimated piecewise linear frontier made up by a set of efficient banks. The banks that lie on the frontier are treated as best practice banks and obtain efficiency score equal to one whereas the banks that do not lie on the frontier are relatively inefficient and their efficiency score lie in the range of zero and one. The DEA approach decomposed the CE (cost efficiency) into its two different components, TE (technical efficiency) and AE (allocative efficiency). Technical efficiency reflects the ability of a firm to maximize output from a given set of inputs whereas allocative efficiency reflects the ability of the firm to use these inputs in optimal proportions, given their respective prices where the cost of production is minimum. Technical efficiency implies that there is no waste in using inputs to produce specific quantity of output. A firm is said to be technically efficient when it cannot increases any output or decreases any input without reducing the quantities of other outputs or inputs. Combining these two measures provides a measure of cost efficiency. A firm is said to be cost efficient when it is both allocative as well as technically efficient. Following Farell et al. (1957), this paper has used the input price vector to specify and obtain a measure of cost efficiency (CE) for each bank by solving this envelopment form of linear programming.

Mathematically, when evaluating the efficiency of the DMU, we solve for the following linear programming problem (LPP):

Maximize $u^T y_i / v^T x_i$

Subject to:

$u^T y_j / v^T x_j \leq 1, \quad j = 1,2.....n, \quad u,v \geq 0$..... (1)

Where u is the ($sx1$) vector of output weights and v is the ($mx1$) vector of input weights. T denotes the matrix transpose operator. Thus, u and v are chosen to maximize the efficiency measure of the DMU i subject to the constraints that the efficiency levels of all units must be less than or equal to 1.

The above problem has an infinite number of solutions. To generate a unique solution, the following constraint is imposed: =1. The problem of maximization then becomes a problem of minimization:

Minimize $v^T x_i$

Subject to:

$$u^T y_i = 1$$

$$u^T y_j - v^T x_j \leq 0, \quad j = 1,2.....n, \quad u,v \geq 0..... \quad ..(2)$$

The duality problem to equation (2) can be written as follows:

Maximize $\varnothing i$

Subject to:

$$\varnothing_i y_i \leq \lambda^T y,$$

$$x_i \geq \lambda^T x, \lambda \geq 0$$

Where λ is a ($nx1$) vector and $\varnothing_{ir}$ is a scalar. We search for all linear combinations of input vectors in current practices. We then compute the maximal proportional output vector that can be produced by these linear combinations.

METHODOLOGY

In banking literature, parametric and non-parametric approaches are frequently used for the estimation of bank efficiency. In this paper we have used non-parametric approaches i.e. DEA to measure the effectiveness of managerial efficiency of Indian commercial banks. The sample period for the study is 2011-13.

In the present context, our DMUs are Banks. The sample size is 46 further we have clusters the banks into small, medium and large banks based on their profitability. Large banks are those whose profitability are more than 1000 cr., medium banks are between 300- 1000 cr and small banks below 300 cr.

Technical efficiency score is total weighted sum of output divided by the total weighted sum of inputs. In this model, the efficiency is measured by the ratio of weighted outputs to weighted inputs thus the efficiency of the banks will be measured as to how efficiently they are able to utilize their inputs.

Research questions which need to be addressed are: (i) What is the efficiency of Individual banks? (ii) Which of the efficient banks can serve as role models for the inefficient ones ? The present study tries to provide the solutions of these questions and, thus, aim to enrich the existing literature. The main objective of the paper is to measure the operating efficiency of Indian banks operating in the financial year 2011- 2013.

SAMPLING DATA

This paper has used secondary data of commercial banks in India for the period 2011-13. The sample contained the public and private sector banks that have operated in India during 2011-13.The required data have been taken from the "Statistical Tables Relating to Commercial Banks in India" an annual publication of Reserve Bank of India.

SELECTION OF THE VARIABLES

It has been found by various researchers that in banking efficiency studies, the selection of input and output variables plays very important role in efficiency scores of banks. At the same time, it is a debatable and critical task to define bank input and output variables. There is considerable disagreement among researchers about the constituents of inputs and outputs of the banking industry. Mainly two different approaches have been appeared in the literature regarding the measurement of inputs and outputs of banks. These approaches are the production approach and intermediation approach. The production approach views bank as using purchased funds to produce deposit and various categories of bank assets. This approach treated loans and deposits as outputs and measured in terms of the number of accounts and transactions serviced during a particular period. A shortcoming of this approach is that it considers only operating costs and excludes the interest expenses. This approach is less common in the empirical literature due to the no availability of data on the number of accounts and transactions. Moreover, the intermediation approach views banks as

financial intermediaries that collect funds from units in surplus and then transform these resources into loans and other investments.

The production approach might be more suitable for branch level efficiency studies whereas intermediation approach is well suitable for measuring bank level efficiency. This is because, at the branch level investment decisions are mostly not under the control of branches whereas at the bank level motive of management will be to reduce total cost and not just non –interest expenses. In banking literature, researches have given priority to intermediation approach. For the purpose of present paper, modified version of intermediation approach is used for the selection of input and output variables. The selected input variables are: No of employees, Equity funds, Operating Expenses (Operating expense consists of salaries paid to employees, research and development costs, legal fees, accountant fees, bank charges etc).

The output variables used for the estimation of efficiency are

1) Non-interest income (Bank and creditor income derived primarily from fees. Examples of non-interest income include deposit and transaction fees, insufficient funds (NSF) fees, annual fees, monthly account service charges; inactivity fees, check and deposit slip fees, etc. institutions charge fees).
2) Interest spread income (measured as the difference between interest earned and Interest expended).
3) Advances (a loan made by a bank; to be repaid with interest on or before a fixed date, for income addition)
4) Net profit (the difference between the revenue that is generated from a bank's assets and the expenses associated with paying out its liabilities. A typical bank's assets Consist of All forms of personal and commercial loans, mortgages and securities. The Liabilities are, of course, the customer deposits) and
5) Deposits (The term Bank Deposit refers to an amount of money in cash or check form or Sent via a wire transfer that is placed into a bank account).

In order to obtain effectiveness of the management these variables plays a crucial role how efficiently management is utilizing its resources to maximize the efficiency of the institution.

7. ANALYSIS, FINDINGS AND RESULTS

In this section, we have classified banks into 03 categories in Table 1 as follows:

Table 1: Banks Classification

Large Banks		Medium Banks				Small Banks			
Sr	Banks name	Sr	Banks name	Sr	Banks name	Sr	Banks name	Sr	Banks name
1	Axis Bank	1	Allahabad Bank	13	Oriental Bank of Comm.	1	Bank of Rajasthan	13	State Bank of Indore
2	Bank of Baroda	2	Andhra Bank	14	Punjab and Sind Bank	2	Catholic Syrian Bank	14	Tamilnad Mercantile Bank
3	Bank of India	3	Bank of Maharashtra	15	SBBJ	3	City Union Bank	15	Yes Bank
4	Canara Bank	4	Central Bank of India	16	State Bank of Hyderabad	4	Development Credit Bank	16	South Indian Bank
5	HDFC Bank	5	Corporation Bank	17	State Bank of Mysore	5	Dhanalakshmi Bank		
6	ICICI Bank	6	Dena Bank	18	State Bank of Patiala	6	IndusInd Bank		

7	Indian Overseas Bank	7	Federal Bank	19	State Bank of Travancore	7	Karnataka Bank		
8	Punjab National Bank	8	IDBI Bank Ltd.	20	Syndicate Bank	8	Karur Vysya Bank		
9	State Bank of India	9	Indian Bank	21	UCO Bank	9	Lakshmi Vilas Bank		
10	Union Bank of India	10	ING Vysya Bank	22	United Bank of India	10	Nainital Bank		
		11	Jammu & Kashmir Bank	23	Vijaya Bank	11	Ratnakar Bank		
		12	Kotak Mahindra Bank			12	SBI Comm. & Intl. Bank		

It was observed that 10 banks are large banks, 23 medium and 16 are small banks based on the profitability. The profitability results from the effective management of resources available. The optimum utilization of available resources results in the profitability of the organization. By giving the maximum outputs from the fixed inputs available.

The CCR and BCC scores of each bank are listed in Table 2. We used the input oriented models in measuring efficiency.

Table 2: CCR (TE) and BCC (PTE) Scores

DEA Estimate Efficiency 2011-2013						
Sr	**Sr**	**DMU**	**EFF**	**CAT**	**2011-2012**	**2012- 2013**
1	21	AXIS	TE	L	1.00	1.00
		AXIS	PTE	L	1.00	1.00
2	3	BOB	TE	L	1.00	1.00
		BOB	PTE	L	1.00	1.00
3	4	BOI	TE	L	0.88	0.89
		BOI	PTE	L	0.97	0.94
4	6	CAN	TE	L	1.00	0.92
		CAN	PTE	L	1.00	0.93
5	7	CBI	TE	L	0.62	0.70
		CBI	PTE	L	0.69	0.70
6	23	HDFC	TE	L	0.84	0.80
		HDFC	PTE	L	0.91	0.90
7	24	ICICI	TE	L	1.00	1.00
		ICICI	PTE	L	1.00	1.00
8	10	IDBI	TE	L	1.00	1.00
		IDBI	PTE	L	1.00	1.00
9	15	PNB	TE	L	0.98	0.96
		PNB	PTE	L	1.00	1.00
10	43	SBI	TE	L	0.94	1.00
		SBI	PTE	L	1.00	1.00

11	18	UNION	TE	L	0.86	0.87
		UNION	PTE	L	0.88	0.88
12	1	ALB	TE	M	0.85	0.92
		ALB	PTE	M	0.86	0.94
13	2	ANDH	TE	M	0.89	1.00
		ANDH	PTE	M	0.90	1.00
14	5	BOM	TE	M	0.56	0.74
		BOM	PTE	M	0.56	0.74
15	8	CORP	TE	M	1.00	1.00
		CORP	PTE	M	1.00	1.00
16	9	DENA	TE	M	0.79	0.90
		DENA	PTE	M	0.79	0.91
17	11	INDIAN	TE	M	1.00	0.98
		INDIAN	PTE	M	1.00	0.98
18	12	IOB	TE	M	0.77	0.80
		IOB	PTE	M	0.81	0.80
19	13	OBC	TE	M	1.00	0.91
		OBC	PTE	M	1.00	0.92
20	41	SBBJ	TE	M	0.75	0.80
		SBBJ	PTE	M	0.75	0.80
21	42	SBH	TE	M	1.00	1.00
		SBH	PTE	M	1.00	1.00
22	45	SBP	TE	M	0.85	0.87
		SBP	PTE	M	0.85	0.88
23	46	SBT	TE	M	0.89	0.91
		SBT	PTE	M	0.90	0.92
24	16	SYNDI	TE	M	0.79	0.86
		SYNDI	PTE	M	0.83	0.88
25	17	UCO	TE	M	0.91	0.98
		UCO	PTE	M	0.91	0.98
26	19	UBI	TE	M	0.79	0.88
		UBI	PTE	M	0.80	0.88
27	20	VIJAY	TE	M	0.66	0.87
		VIJAY	PTE	M	0.67	0.88
28	28	CATH	TE	S	0.43	0.49
		CATH	PTE	S	0.54	0.64
29	29	CITY	TE	S	1.00	1.00
		CITY	PTE	S	1.00	1.00
30	22	DCB	TE	S	0.53	0.50
		DCB	PTE	S	0.65	0.54

31	30	FEDER	TE	S	0.99	0.96
		FEDER	PTE	S	0.99	0.96
32	25	INDUS	TE	S	0.74	0.81
		INDUS	PTE	S	0.76	0.81
33	31	ING	TE	S	0.70	0.68
		ING	PTE	S	0.71	0.69
34	32	J & K	TE	S	1.00	1.00
		J & K	PTE	S	1.00	1.00
35	33	KARNA	TE	S	0.64	0.73
		KARNA	PTE	S	0.67	0.75
36	34	KARUR	TE	S	0.98	0.92
		KARUR	PTE	S	0.98	0.93
37	26	KOTAK	TE	S	0.72	0.74
		KOTAK	PTE	S	0.73	0.74
38	35	LAKSHMI	TE	S	0.79	0.68
		LAKSHMI	PTE	S	0.82	0.73
39	36	NAINITAL	TE	S	0.97	0.85
		NAINITAL	PTE	S	1.00	1.00
40	14	PSB	TE	S	0.78	0.70
		PSB	PTE	S	0.79	0.70
41	37	RATNA	TE	S	0.46	0.68
		RATNA	PTE	S	0.69	0.79
42	38	SOUTH	TE	S	0.85	0.81
		SOUTH	PTE	S	0.90	0.83
43	44	SBM	TE	S	0.90	0.78
		SBM	PTE	S	0.90	0.78
44	39	TAMIL	TE	S	1.00	1.00
		TAMIL	PTE	S	1.00	1.00
45	40	DHAN	TE	S	0.50	0.34
		DHAN	PTE	S	0.54	0.39
46	27	YES	TE	S	1.00	1.00
		YES	PTE	S	1.00	1.00

The CCR and BCC results in the form of technical efficiency and pure technical efficiency listed in Table 2 show that the AXIS, BOB, CAN, ICICI, IDBI, CORP, SBH, CITY, J&K, TAMIL, YES banks are most efficiient banks during this tenure. They have also maintained their efficiency during both the time periods and therefore have become benchmarks for another banks. It was also found that SBI, Indian can and OBC are also Comes under efficient category but they are not able to maintain it in both the financial years though the difference was very less.

Banks with good scores but less than 1.00 technical efficiency scores are found to be as HDFC, PNB, UNION, ALB, ANDH, DENA, IOB, SBBJ, SBP, SBT, SYNDI, FEDER, INDUS, ING, UCO, UBI, KARUR, KOTAK, LAKSHMI, NAINITAL, PSB, SOUTH, SBM are efficient

enough but less than the benchmarks. Also it was found that VIJAY, CATH, BOM, DCB, KARNA, RATNA, DHAN scored very less. The banks where CCR model based scores i.e. technical efficiency 1 are the best performers and furthermore they are referenced for evaluating inefficient banks and are technically efficient. 10 banks are technically efficient and best performer among the set of 46 banks in both the financial years whereas 12 were efficient in 2011-2012 and 11 in 2012-2013.

The BCC model assumes variable returns to scale (VRS) by considering the sizes of the utilities. This formulation ensures that similar sizes utilities are benchmarked and compared with each other. In this model, 16 banks are accorded efficient status in addition to the 10 CCR efficient banks in 2011-2012 and 14 efficient banks in 2012- 2013. It means that those 10 banks who are maintaining their status of efficient banks in both the years are utilizing the resources most efficiently and also operating at optimum size.

DISCUSSION, CONCLUSION AND POLICY RECOMMENDATIONS

Results of the study indicate that banks with the highest scores are technically efficient and termed as the leaders and the banks performing at average value are moderate performers and the banks with inefficiencies are the laggards which need to be improved by means of restructuring of the banks or merger of the laggards with leaders i.e. with high ranked banks.

REFERENCES

1. Avkiran, N.K. (1999a), "An application reference for data envelopment analysis: helping the novice researcher", *International Journal of Bank Marketing*, 17(5), 206-220
2. Avkiran, N.K. (1999b), "The evidence on efficiency gains: the role of mergers and the benefits to the public", *Journal of Banking & Finance*,23(7), 991-1013
3. Chakrabarti, R., & Chawla, G.,(2005), "Banking efficiency in India Since the reforms: an assessment", *Journal of Banking* Vol 3
4. Charnes, A.; Cooper, W,; and Rhoades, E. 1978. Measuring the efficiency of decision making units. *European Journal of Operation Research* 2: 429-444
5. Kumar, S., (2008), " An analysis of efficiency- profitability Relationship in Indian Public Sector Banks", Global Business Review 9:115-129.
6. Ketkar, K.W. and Ketkar, S.L. ,92008), "Performance and profitability of Indian baks in the Post Liberalization Period", A Paper presented at the 2008 world conference on National Accounts and Economic Perfrormance Measure for Nations, May 13- 17 , Washington DC, JBFSIR Volume 1, Issue 3 (june 2011) ISSN 2231- 4288 Sri Krishna Intrnational Research & Educational Consortium Http:/www.skirec.com60
7. Mukherjee, A., Nath, P. and Pal, M.N. (2002), "Performance benchmarking and strategic homogeneity of Indian banks", *International Journal of Bank Marketing*, 20(3), pp. 122-39.
8. Sathye, M. (2001), 'X-efficiency in Australian Banking: An Empirical Investigation", *Journal of Banking and Finance*, 25, 613-630
9. Sathye, M. (2002), 'Measuring Productivity Changes in Australian Banking: An Application of Malmquist Indices", *Managerial Finance*, 28, pp. 48-59
10. Singh, J.(1990), Productivity in Indian banking, A Ph.D. Thesis submitted to UBS, Punjab University, Chandigarh
11. Sturm, J. and Williams, B. (2002), 'Deregulation, Entry of Foreign Banks and Bank Efficiency in Australia', CESifo Working Paper 816/9. Retrieved 2 March 2006from http://www.CESifo.de