Global Financial Crisis and Banking Sector Efficiency: The Indian Perspective

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Abstract. Banks play a crucial role in developing and least developed economies by facilitating in trade finance. Banks established an important linkage in international trade by guaranteeing international payments and thereby reducing the risk of trade transactions. The Banks in India has witnessed a significant growth, specialization and diversification since the initiation of financial sector reforms in 1991and further slowdown in the economy as a result of global financial crisis in 2008-2009. This study examines the performance of Indian banks using data envelopment analysis.

Though, there are large number of literature have been published on banking efficiency, This is an attempt to investigate the impact of global financial crisis on performance of Indian banking sector. The sole objective of this study is to exhibit, utilizing empirical data, the quantum to which the global financial crisis had an impact on the performance of the Indian banking industry. This study gives a comparative empirical analysis of the technical efficiency of Indian commercial banks during pre and post crisis period covering 2005-2012 using non parametric technique i.e. Data Envelopment Analysis (DEA). This period is consisting of pre and post global crisis period which is characterized by far reaching experience of crisis period (2008-2009) and its impact on the efficiency of the Indian banking sector. Overall, the results reveal that the effect of international financial crisis on the Indian banks has not been significant. Instead, the analysis reveals there is a statistically insignificant improvement in the efficiency of Indian banks' following international financial crisis. Furthermore, the paper shows that the commercial banks have a high degree of resilience and stability.

Keywords: Technical Efficiency, Global Crisis Period, Non Parametric Approach, Data Envelopment Analysis

1 Introduction

Commercial banks play a critical role in development of economy of a country in addition to other duties i.e. finance facilitator and advisor etc in International trade and business in view of the fact that none of the modern economic system can function efficiently and effectively without strong and efficient banking system. The strength of a banking system depends upon the provision of efficient services both for domestic as well as overseas customers. Banks are considered to be the mart of the world, the nerve centre of economies and finance of a nation and

the barometer of its economic perspective and growth (Sharma, 1974). In international trade exporters having limited access to working capital require financing to process or manufacture products before receiving payments. Conversely, importers often need credit to buy raw materials, goods and equipment from overseas. These need of international trade been fulfilled by commercial banks in addition banks provide important international trade Information to exporter and importer (advisory role) .Banks are capable of minimizing Exchange rate fluctuation risk between major traded currencies through a hedging operation by taking a reverse position in the forward market or using options (to buy or to sell) foreign exchange in the futures market, thereafter be able to provide importers and exporters with competitive rates.

After globalization major global economies are passing through a stringent competition and intricate circumstances as bankruptcy of banking and financial institutions causing global crisis. The scenario of the global economy showed deeper signs of stress through falling exports, rising unemployment and thus falling incomes during the past years. The global recession created an unprecedented decline in trade growth in 2009, affecting the capacity of trade to be an effective engine of growth. International trade had been growing up to late 2007, before encountering the recessionary storm. From mid-2008, trade flows contracted sharply, affecting a large part of the OECD countries. Added to this was the banking crisis, with credit drying up completely.

The year 2008-09 was a very crucial year for the financial system of the entire world. The headwinds from domestic and international economic developments posed challenges to the financial sector as it witnessed the greatest global financial crisis in the human history. The financial system and banks of many countries collapsed during the crisis period. Although the direct impact of the subprime crisis both on Indian banks and on the financial sector was almost negligible but still it marginally affected the growth of Indian banking sector.

Following the intensification of the global financial crisis in September 2008, some serious questions were raised about the survival, growth and maintaining the sustainable development. However, amidst all this turmoil, Indian Banking industry has been amongst the few to sustain buoyancy. The development and growth for the Indian banking industry has been phenomenal due to higher pace of credit growth; increasing profitability and productivity similar to banks in market growth, reduction in NPAs and focus on financial inclusion have contributed in making

Indian banking strong and vibrant. Indian banks have begun to revise their growth approach and re-evaluate the prospects on hand to keep the economy rolling. In the globally competitive world, the performance and efficiency of institution is pre condition and enormously significant for survival and existence of the institution. In the wake of global competition, the performance and efficiency of the banks has enthralled focus. This study throws light onto the performance of the public and private sector banks both for pre-recessionary and post–recessionary period.

Data Envelopment Analysis (DEA)

DEA has grown into a powerful quantitative, analytical tool for measuring and evaluating performance and its efficiency. Data Envelopment Analysis (DEA) 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 characterized 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. 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.

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.

$$Efficiency = \frac{Weighted\ Sum\ of\ Outputs}{Weighted\ Sum\ of\ Inputs} = \frac{u_1 y_1 + u_2 y_2 + \cdots + u_n y_n}{v_1 x_1 + v_2 x_2 + \cdots + v_n x_n}$$

Where, u and v are the weights for the outputs, $(y_1, y_2, \ldots\ldots, y_n)$ and inputs, $(x_1, x_2, \ldots\ldots, x_n)$ respectively. The best DMU is assigned an efficiency score of 1 and all other banks are assigned efficiency scores between 0-1 and 0-100 per cent. A bank with a score of less than 1 is deemed to be technically inefficient relative to the efficient banks. The efficiency score indicates the performance of banks that how well they convert inputs into outputs. For example, if a bank has a technical efficiency score of 70 percent, it means that it would have to reduce its inputs by 30 per cent to become as efficient as its reference set i.e., those banks with 100 percent scores..An advantage of DEA is that it does not impose any preconceived structure on the data in determining the efficient firms, i.e. it does not assume a particular production technology or correspondence.DEA is used to generate relative technical efficiency scores by comparing a particular DMU to a virtual technically efficient DMU (or its target) that has the same input-output configuration.

The CCR-model reduces the multiple inputs and multiple outputs of each DMU into a single 'virtual' input and single 'virtual' output. The efficiency measure for a DMU can be calculated as the ratio of the single virtual input and single virtual output, which is to be maximised and forms the objective function of the particular DMU being evaluated. Thus, using notation, it is assumed that there are K inputs and M outputs for each of N firms. For ith firm the data are represented by the column vectors x_i and y_i respectively. The input matrix X is of order K×N and the output matrix Y of order M×N displays the data for all N firms. To obtain a measure of the ratio of all outputs over all inputs for each firm, such as $u^{'} y_i / v^{'} x_i$, where u is an M×1 vector of output weights and v is a K×1 vector of input weights. The optimal weights are obtained by solving the mathematical programming problem:

$$\max_{u,v} u^{'} y_i / v^{'} x_i$$

Subject to the constraints: $u^{'} y_i / v^{'} x_i \leq 1 \quad where\ j = 1, 2, \ldots n,\ and\ u, v \geq 0$

The problem can be derived (Coelli et al., 1998) as:

$$\min_{\theta} \lambda_\theta$$

Subject to the constraints: $-y_i + Y\lambda \geq 0;$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

Where θ is a scalar and λ is a vector of constants of order N×1. This envelopment form involves less number of constraints than the multiplier form (K+M < N+1) and therefore, is generally the preferred form to solve. It yields the optimal solution θ^*, which is the efficiency score for the particular DMU (i^{th} firm). The process is repeated and solved N times, once for each firm in the sample. Then a value of θ is obtained for each firm. The efficiency score obtained will satisfy $\theta \leq 1$. The DMUs having $\theta < 1$ are considered to be inefficient and those DMUs for which $\theta = 1$ are relatively efficient, with their virtual input-output combination points lying on the frontier. Thus, a value of one indicates a fully technically efficient firm, according to the Farrell (1957) definition. Technical efficiency can be decomposed into "pure technical" and "scale" efficiencies. This requires the estimation of two DEA models- one with constant returns to scale (CRS) and the other with variable returns to scale (VRS). If there is a difference in the two technical efficiency scores for a particular bank, then this indicates that the bank has scale inefficiency.

2. Literature Review

A numerous published research studies have explored the impacts of the financial crisis on the bank performance in India. Berger et al. (2010) examined the effect of pre-crisis bank capital ratios on banks' ability to survive financial crises, market shares, and profitability during the crisis. Their finding shows that capital during the financial crisis on bank performance. Kumar and Charles(2012) used the technique of Data Envelopment Analysis (DEA) to examine the performance of Indian banking sector and two major ownership structure within it in terms of technical efficiency, returns-to-scale, and total factor productivity (TFP) change for the entire 15 years of post-liberalization period as well as two sub-periods during period 1996-2010 and found that DEA efficiency scores are robust in the sense that the inclusion of outlier bank does not affect the overall trends of efficiency in the present context. PSBs perform as par with its counterpart private sector banks in terms of efficiency. Further, there is growing tendency of PSBs operating under increasing-returns-to-scale (IRS).

Tarawneh (2006) compared financial performance in the Banking Sector in Oman, the impact of a total of five Omani commercial banks with more than 260 branches were financially analyzed, and simple regression was used to estimate the impact of asset management, operational efficiency, helps banks of all sizes during banking crises; higher capital helped banks to increase their

probability of survival, market shares, and profitability and rest of the others studied the real effects of deterioration in bank health or competition and bank size on the financial performance of these banks. The study found that the bank with higher total capital, deposits, credits, or total assets does not always mean that has better profitability performance.

Mukherjee et al. (2002) made an attempt to explore technical efficiency and benchmark the performance of 68 commercial banks of India using DEA. For this they utilized the data for the period 1996 -99. It has been observed that in India, PSB's are more efficient than both private and foreign banks. Also, the performance of PSB's improved over the sturdy period. Besides this publicly owned banks were rated uniformly in terms of self- appraisal as well as peer- group appraisal.

Xiao (2009) used qualitative and quantitative tools to examine the performance of French banks during 2006– 2008. Finding of their study shows that French banks were not immune but proved relatively elastic to the global financial crisis. (Beltratti and Stulz (2009) studied the bank stock return cross the world during the period from the beginning of July 2007 to the end of December 2008. They find that large banks with more deposit financing at the end of 2006 exhibited significantly higher returns during the crisis. Cornett, McNutt and Tehranian (2010) analyzed the internal corporate governance mechanisms and the performance of US banks before and during the financial crisis. They found that largest banks faced the largest losses during the crisis. Dietrich and Wanzenried (2011) examined how bank-specific characteristics, industry-specific and macroeconomic factors affect the profitability of Swiss commercial banks over the period from 1999 to 2009. Their results provide some evidence that the financial crisis did have a significant impact on banks profitability.

Ashamu and Abiola (2012) analysed the impact of global financial crisis on banking sector in Nigeria, the study revealed that the financial crisis has caused depression of the Nigerian capital market and drop in the quality of part of the credit extended by banks for trading in the capital market, exchange rate risk tightening of liquidity, greater loan-loss provisioning, slower growth rate of banks' balance sheet in response to the crisis and higher provisioning leading to lower profitability among others. Similarly, Kiyota (2009) revealed that the crisis also had little impact on the Sub-Saharan African financial systems because the financial sector in Africa remains shallow, uncompetitive and weakly integrated into the global markets. Despite the fact that money,

currencies, and capital markets had the significant pressures by the crisis, they have continued to function normally, and financial institutions in most countries have been stable without emergency support from monetary authorities. Ree (2011) examines the impact of the global financial crisis that began in late 2007 on banking sectors of Asian low income countries, by exploring bank-level data provided by Bank scope. The paper finds that despite relatively low financial integration, the impact of the crisis on LIC banks, particularly the largest ones, were not insignificant. Impacts were most palpable through a loan-to-cross border funding nexus. Sangeetha (2012) studied effect of global financial crisis on the Omani commercial banks, the analysis reveals that the performance of the banks are influenced by the orientation and strategy of the management. The study reveals that the local commercial banks show a high degree of resilience and stability.

Anouze (2007) examined the efficiency of banks' performance in Gulf Region before, during and after s Financial and Political crisis, the overall result shows that Conventional banks perform well during political crisis, whereas, Islamic banks perform better during the financial crisis. However, this difference is not statistical significant, which means that GCC commercial banks can be equally competitive when it comes to technical efficiency. Also, there is no statistically significant relationship between bank geographical location and it is efficiency score. Moreover, the results confirm that large and small size GCC commercial banks are more efficient than the medium size. Out of the 24 environmental factors included in the study to investigate the relationship between environmental factors (internal and external) and bank performance; only 15 factors are considered to be important in predicating the fully efficient banks. Along the same line Khamis (2010) interprets that "GCC banks were less affected by the crisis than their counterparts in advanced economies, in spite of a series of shocks, there has been no systemic breakdown and the impact on bank profitability has been moderate so far."

Shafique, Faheem and Abdullah (2008) test the impact of global financial crises on the Islamic banking system, the result show Islamic banking system has also affected by the global financial crisis but performance of Islamic banks during global financial crisis is better than conventional banks. Risk in Islamic banks is less than conventional bank because of its interest free nature.

Al-Nessor (2008) reached on the conclusion that the impact of financial crisis will vary from one country to another, depending on the complexity of its economy with the global economy and

that the Gulf states will bemost affected, and the reaction of Arab financial markets has been exaggerated as a result of investors said they have watched the erosion of stock prices in world markets and the withdrawal offoreign investors from the Arab markets. The impact of the U.S. mortgage crisis on Arab banks is limited, and resulted in government intervention to provide liquidity to banks to derive a liquidity crisis.

From the above discussion of the international experience it is evident that the impact of international financial crisis on the efficiency of banks' performance is mixed. While some studies indicate that banks' performance has been affected by global financial crisis (i.e. negative impacts), there are studies which show that the banks' performance was not immune but proved relatively elastic to the global financial crisis. Yet some other studies found that no difference in Bank's financial performance before and after crisis. In this study little effort has been undertaken to study the impact of financial crisis on banking performance in India. To fill the research gap, this study is trying to determine the change in efficiency of commercial banks in pre and post crisis period.

Although, there is large number of researches literature available on banking efficiency, This is an empirical attempt to investigate the impact of global financial crisis on performance of Indian banking Industry. The sole objective of this study is to illustrate, utilizing empirical data, the quantum to which the International financial crisis had an impact on the performance of the Indian banking industry. Hence we have chosen inputs and outputs which affect banking performance to great extent.

3. Research Methodology

In the present context, our DMUs are Banks. The sample size is 46 . Although, there are numerous published researches in banking efficiency, little effort has been undertaken to study the impact of financial crisis on banking performance in India. To fill this research gap, this study is trying to determine the change in efficiency of commercial banks in pre and post crisis period. The software's used to carry out the analysis in the research study are DEA- Solver- LV, SYSTAT 10.2 and MS-EXCEL. DEA solver was developed by Cooper, Seiford and Kaoru Tone (2006).

Inputs and Outputs: DEA modelling allows researchers to select the input & outputs in accordance with a managerial focus. In this paper Inputs are no. of employees, equity funds and operating

expenses and the Outputs are Interest Spread, Non interest income, Advances, Net profit and Deposits.

4. Analysis, Findings and Results

The scores of technical efficiency (te) obtained from CCR(O) DEA output oriented technique are shown in Table 1.

Table 1: DEA Scores of Technical Efficiency of Indian Commercial Banks, 2005-2012

Cat	Bank Group	Bank	Pre crisis period			Crisis period		Pre crisis period			Mean T.E Score
			2005	2006	2007	2008	2009	2010	2011	2012	
Large	Private	AXIS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		HDFC	1.000	1.000	1.000	1.000	0.866	0.881	0.837	0.801	0.923
		ICICI	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	PSBs	BOB	0.825	0.772	0.840	0.899	0.973	0.976	1.000	1.000	0.911
		BOI	0.752	0.802	0.810	0.960	1.000	0.880	0.883	0.895	0.873
		CAN	0.871	0.912	0.902	0.876	0.914	0.969	0.996	0.918	0.920
		CBI	0.709	0.703	0.726	0.862	0.892	0.832	0.617	0.697	0.755
		IDBI	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		PNB	0.716	0.804	0.836	0.883	0.930	0.979	0.980	0.962	0.886
		UNION	0.877	0.908	0.945	1.000	0.923	0.953	0.862	0.875	0.918
		SBI	0.981	0.981	0.806	0.882	0.934	0.856	0.937	1.000	0.922
Medium	PSBs	ALB	0.731	0.861	0.947	0.935	0.875	0.938	0.853	0.925	0.883
		ANDH	0.893	0.799	0.862	0.858	0.793	0.902	0.888	1.000	0.874
		BOM	0.683	0.753	0.727	0.741	0.735	0.732	0.557	0.738	0.708
		CORP	1.000	0.982	1.000	1.000	1.000	1.000	1.000	1.000	0.998
		DENA	0.627	0.852	0.821	0.793	0.783	0.772	0.787	0.902	0.792
		INDIAN	0.741	0.735	0.841	0.862	0.853	0.981	1.000	0.977	0.874
		IOB	0.843	0.864	0.945	0.914	0.819	0.684	0.773	0.796	0.830
		OBC	1.000	0.983	1.000	1.000	1.000	1.000	1.000	0.912	0.987
		SYNDI	0.691	0.732	0.854	0.877	0.859	0.765	0.792	0.860	0.804
		UBI	0.719	0.690	0.769	0.710	0.738	0.787	0.793	0.877	0.760
		UCO	0.740	0.736	0.825	0.833	0.862	0.934	0.909	0.982	0.853
		VIJAYA	0.933	0.848	0.867	0.926	0.794	0.775	0.665	0.875	0.835
		SBBJ	1.000	0.751	0.852	0.801	0.848	0.737	0.751	0.801	0.818
		SBH	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		SBP	1.000	1.000	1.000	0.938	0.974	0.939	0.851	0.871	0.947
		SBT	1.000	0.896	0.904	0.884	0.964	0.826	0.890	0.914	0.910
Small	Private	DCB	0.579	0.409	0.608	0.627	0.508	0.457	0.534	0.504	0.528
		INDUS	1.000	1.000	1.000	0.865	0.765	0.709	0.743	0.806	0.861
		KOTAK	0.682	0.688	0.737	0.878	0.875	0.973	0.722	0.737	0.787

		YES	0.605	1.000	0.844	0.870	1.000	1.000	1.000	1.000	0.915
		CATHO	0.632	0.533	0.593	0.592	0.548	0.474	0.429	0.494	0.537
		CITY	0.932	1.000	1.000	1.000	0.938	0.987	1.000	1.000	0.982
		DHAN	0.570	0.562	0.597	0.592	0.664	0.454	0.495	0.345	0.535
		FED	0.876	0.952	1.000	1.000	1.000	1.000	0.993	0.955	0.972
		ING	1.000	0.715	0.673	0.711	0.695	0.688	0.703	0.677	0.733
		J&K	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		KARN	1.000	1.000	1.000	0.909	0.887	0.779	0.640	0.728	0.868
		KARUR	1.000	1.000	1.000	1.000	1.000	1.000	0.977	0.922	0.987
		LAKSHMI	0.753	0.699	0.770	0.697	0.668	0.692	0.789	0.683	0.719
		NAINI	0.720	0.758	0.969	1.000	1.000	1.000	0.966	0.850	0.908
		RATN	0.605	0.653	0.516	0.859	0.961	0.737	0.456	0.683	0.684
		SOUTH	0.801	0.773	0.867	0.851	0.811	0.838	0.850	0.814	0.826
		TMB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	PSBs	**PSB**	0.551	0.676	0.749	0.786	0.755	0.926	0.784	0.698	0.741
		SBM	1.000	0.978	0.822	0.826	0.817	0.890	0.900	0.777	0.876

Source: ***Authors Calculations***

Amongst the category of large banks, the Axis Bank, ICICI from new Pvt. Banks and IDBI bank of PSBs are found to be the most technically efficient on average (100%) and fully technically efficient throughout the study period. Fully technically efficient means operating at the optimal scale. Banks working at optimal scale means maximizing their outputs for the observed amount of inputs i.e. utilizing the resources optimally. However Axis Bank, It is revealed from the study that ICICI and IDBI Bank consistently operating at most productive scale size throughout the study period.

CBI is found to be the least efficient amongst the large banks. More specifically, it was consistently the least technically efficient in every year from 2005-2012 except 2009 where CBI Bank shows the least average among TE (75.50) large size banks during the study period. Amongst the large Bank BOB managed to later turnaround its performance during 2011-2012 and followed by SBI improve their performance in 2011-2012 with full technical efficiency. The significant improvement adopted by management to optimize the operating expenses can be attributed to major restructuring branch network allocation and proactive approach. Central to this exercise were staff redundancies, branch relocation, additional opening of new Branches, and in some cases, the business process re-engineering of retail product delivery channels,

adoption of the latest technology and opening of the new branches in abroad aimed at improving efficiency and customer service quality.

Amongst the medium sized banks, SBH is found to be most technically efficient (100%) on average TE score throughout the study period followed by CORP and OBC in all the years except 2006 with 99.80% and 98.7 % technical efficiency respectively.

In the medium sized banks, BOM is found most inefficient followed by UBI. ANDH Bank, INDIAN, DENA and UCO demonstrated the greatest improvement in technical efficiency amongst all medium sized banks ANDH bank shown remarkable shift to become fully technically efficient in 2012.INDIAN bank illustrated consistent growth in technical efficiency over the study period 2005-2012 except marginally legged in 2006.

DENA bank jumped from bottom in 2005 after being the least technically efficient medium sized bank (and least technically efficient amongst all PSU banks) at the start of the study period and improvement in technical efficiency. This can be attributed to a restructuring of the bank and expansion in their operations in recent years. It is shown that BOM switched over to optimal scale in the last year of the study period.

Amongst the small sized banks, DCB shows the least technical efficiency on average (52.80%) although it managed the improvement in scale efficiency over the years among the peers. J&K and TMB are the most technical efficient banks and both the banks have consistently maintaining the optimal scale throughout the period. DHAN and CATHO banks noted strong deterioration in technical efficiency over the time. YES bank had also shown improvement in the technical efficiency. This is attributed to restructuring and enlarging their scale of operation. In doing so, the small banks do not have to target the size of their larger competitors as it is feasible for banks to reach optimal scale at different sizes depending on the configuration of their inputs and outputs. KARUR bank was efficient in the beginning and maintains consistent performance throughout the period except last two years where its efficiency started slipping.

5. Impact of Global Financial Crisis on Efficiency Scores

This research study is estranged into three sub periods i.e. Pre global crisis period (2005-2007) Global crisis period, (2008-2009) and post global crisis (2010-2012) to analyse the impact of the global crisis on technical efficiency of Indian Commercial Banks. Annexure 1 displays the score

of technical efficiency of Individual banks and Table 2 illustrates the score of technical efficiency of bank categories wise during these sub-periods.

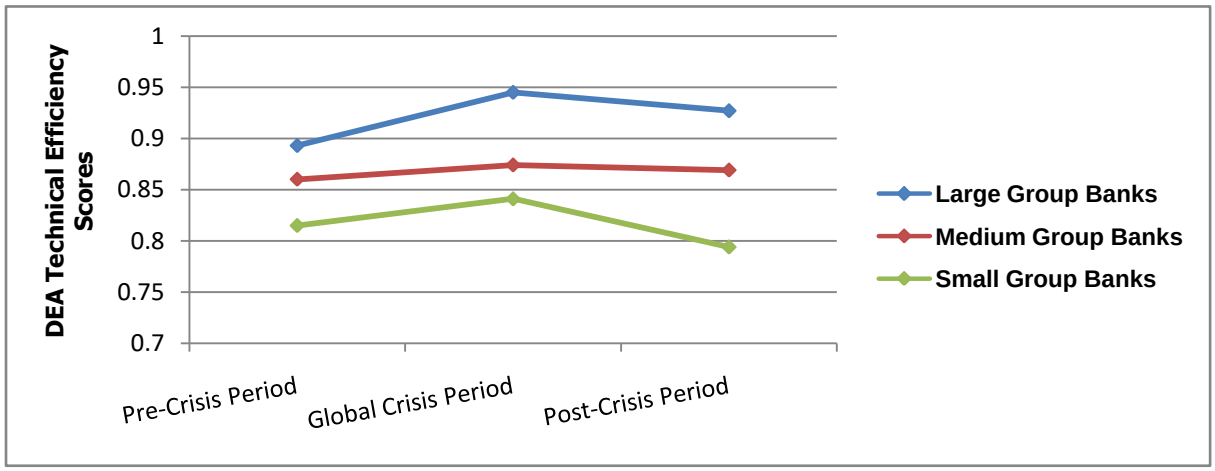
Table 2: Bank category wise DEA Technical Efficiency Scores in sub periods

Banks	Technical Efficiency in Pre-Crisis Period	Technical Efficiency in Crisis Period	Technical Efficiency in Post-Crisis Period
All	0.849	0.877	0.852
Large	0.893	0.945	0.927
Medium	0.860	0.874	0.869
Small	0.815	0.841	0.794

Source: ***Authors Calculations***

It is observed that among the large sized banks HDFC bank was greatly affected. This slippage in efficiency is attributed to exposure and deployment of the funds to International Institutions. The performance of HDFC is declined by 7.18% followed by SBI (1.62%). Later on performance of HDFC bank further beg off to 10% after global crisis (refer Appendix 2). In contrast SBI improved its performance in the post crisis period by (2.53%). In medium banks SBBJ declined (5.24%) followed by SBP (4.60%), ANDH (3.13%), VIJAYA (2.64%), and IOB (2.02%) moreover ANDH bank recovered in post crisis. Figure 1 presents the impact of the global crisis bank category wise.

Figure 1: Impact of Global Crisis on Technical Efficiency (Category wise)



Source : ***Authors Calculations***

It is evident from Figure 1 that there is no significant impact of global crisis on performance of Indian banking sector during the global crisis (2008-2009) conversely there is visible marginal impact on performance of Indian banks in post global crisis period. This is attributed to the headwind stress on the balance sheet of the Indian banking. The small category banks were badly suffered moreover large size banks performance was slightly under pressure. Also it is observed that Medium sized banks were unaffected by global crisis. This is attributed to recent drive of expansions, relocations and restructuring taken by medium sized banks. However large sized banks were suffered owing to the fact of low scale efficiency and small sized banks suffered due to the fact they are working at below the required scale of economy.

6. Conclusion

The large sized banks are found to be the highest technically efficient followed by medium and small banks. This shows that large banks are technically efficient among the all categories of the banks. *It is worth to mention that both the Large and medium sized banks have managed improvements in technical efficiency over time while the small banks have suffered deterioration*. This indicates that there is an increasing disparity between the small banks and their larger competitors.

Small sized banks badly affected by the global crisis followed by the large, however medium size banks illustrate marginal improvement. The results of TE score does not reflect any significant impact of the global crisis on entire Indian banking during crisis 2008-2009 however marginally pressure was observed on TE score in post crisis period.

Finally, results of technical efficiency scores and efficiency index comparison of small medium and large shows similar ups and down trends. Indian banks have also been clustered into leaders, laggards, moderate performer and followers.

The impact of the global crisis during post crisis period was found to be the *maximum* in case of small banks followed by large banks. It is evident from the study that efficiency performance of banking industry as whole has not declined significantly from 2008 to 2012, however growth momentum had been arrested by global financial crisis. This indicates that the *global crisis does not affect much to the Indian banks* that means Indian banks have the *capability to adjust to the changing financial environment attributed to its inherent strength and strong banking regulations.*

7. Suggestions and Recommendations

This study is probably the first attempt to analyze the efficiency of the Indian banking sector using DEA covering global crisis period. Based on the findings, the study implicates with some policy suggestions that would go a long way in improving the performance and efficiency of banks in India.

There is need to frame cluster of the banks based on their common attributes to identify competition, benchmark themselves with respect to competition, compete with better performers, and develop their own strategies to achieve excellence. Each bank in their clusters has to improve within the cluster and once achieved, they should try to re-orient their strategies depending on their long-term vision to move onto a better performing cluster in the next step. This may be possible if the banks adopt strategic changes in size of operations, reframe organisation structure, upgradation and adoption of latest information technology etc.

Leader banks to ascertain benchmark in the areas of customer relationship and embark new definition of customer friendly service, pricing concessions, branch expansions across the boundaries, *Leaders should move beyond seeing the world through IT lenses rather they should view IT and business capabilities in larger social economic and geographical context* Last but not least he leaders should focus on global markets and need to frame strategic team to explore global competition along with service quality.

In addition there is fierce *need of consolidation, reduction in NPAs, strengthening operational system, technology systems,,* Introduction of new banking institutions to enhance competition, further improvement in customer services to achieve wow status and customer delight, strong human resource information system (HRIS), increased focus on financial inclusion and deployment of visionary management may altogether improve the efficiency of banks.

The present supervision and control system in banking sector has improved substantially over the earlier system in terms of speed, coverage, focus and also the tool employed, which is strong enough to regulate the future changes in the Indian banking industry. It is also advised that it maintains vigilance to global front dynamics to predict changes in the pattern of the flow of trade.

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Annexure 1: Technical Efficiency Scores in Sub-periods

Bank Group	Type of Banks	Banks	Technical Efficiency of Pre Crisis Period	Technical Efficiency of Global Crisis Period	Technical Efficiency of Post Global Crisis Period
Large	N Pvt	AXIS	1	1	1
	N Pvt	HDFC	1	0.933	0.84
	N Pvt	ICICI	1	1	1
	Nation	BOB	0.812	0.936	0.992
	Nation	BOI	0.788	0.98	0.886
	Nation	CAN	0.895	0.895	0.961
	Nation	CBI	0.713	0.877	0.715
	Nation	IDBI	1	1	1
	Nation	PNB	0.785	0.907	0.974
	Nation	UNION	0.91	0.962	0.897
	SBI Gp	SBI	0.923	0.908	0.931
Medium	Nation	ALB	0.846	0.905	0.905
	Nation	ANDH	0.851	0.826	0.93
	Nation	BOM	0.721	0.738	0.676
	Nation	CORP	0.994	1	1
	Nation	DENA	0.767	0.788	0.82
	Nation	INDIAN	0.772	0.858	0.986
	Nation	IOB	0.884	0.867	0.751
	Nation	OBC	0.994	1	0.971
	Nation	SYNDI	0.759	0.868	0.806
	Nation	UBI	0.726	0.724	0.819
	Nation	UCO	0.767	0.848	0.942
	Nation	VIJAYA	0.883	0.86	0.772
	SBI Gp	SBBJ	0.868	0.825	0.763
	SBI Gp	SBH	1	1	1
	SBI Gp	SBP	1	0.956	0.887
	SBI Gp	SBT	0.933	0.924	0.877
Small	N Pvt	DCB	0.532	0.568	0.498
	N Pvt	INDUS	1	0.815	0.753
	N Pvt	KOTAK	0.702	0.877	0.811
	N Pvt	YES	0.816	0.935	1
	Nation	PSB	0.659	0.771	0.803
	O Pvt	CATHO	0.586	0.57	0.466
	O Pvt	CITY	0.977	0.969	0.996
	O Pvt	DHAN	0.576	0.628	0.431
	O Pvt	FED	0.943	1	0.983
	O Pvt	ING	0.796	0.703	0.689
	O Pvt	J&K	1	1	1
	O Pvt	KARN	1	0.898	0.716
	O Pvt	KARUR	1	1	0.966
	O Pvt	LAKSHMI	0.741	0.683	0.721

	O Pvt	NAINI	0.816	1	0.939
	O Pvt	RATN	0.591	0.91	0.625
	O Pvt	SOUTH	0.814	0.831	0.834
	O Pvt	TMB	1	1	1
	N Pvt	SBM	0.933	0.822	0.856

Annexure 2: Bank wise impact of the Global Crisis on Technical Efficiency

Bank Group	Type of Banks	Banks	Changes in Technical Efficiency Global Crisis to Pre Crisis	Changes in Technical Efficiency Global Crisis to Post Crisis
Large	N Pvt	AXIS	**0.00%**	**0.00%**
	Nation	BOB	**13.21%**	**5.98%**
	Nation	BOI	**19.59%**	**-9.59%**
	Nation	CAN	**0.00%**	**7.37%**
	Nation	CBI	**18.74%**	**-18.43%**
	N Pvt	HDFC	**-7.18%**	**-10.00%**
	N Pvt	ICICI	**0.00%**	**0.00%**
	Nation	IDBI	**0.00%**	**0.00%**
	Nation	PNB	**13.37%**	**7.41%**
	SBI Gp	SBI	**-1.62%**	**2.53%**
	Nation	**UNION**	**5.36%**	**-6.74%**
Medium	Nation	ALB	**6.48%**	**0.04%**
	Nation	ANDH	**-3.13%**	**12.66%**
	Nation	BOM	**2.30%**	**-8.45%**
	Nation	CORP	**0.60%**	**0.00%**
	Nation	DENA	**2.71%**	**4.10%**
	Nation	INDIAN	**9.93%**	**14.99%**
	Nation	IOB	**-2.02%**	**-13.33%**
	Nation	OBC	**0.57%**	**-2.93%**
	SBI Gp	SBBJ	**-5.24%**	**-7.46%**
	SBI Gp	SBH	**0.00%**	**0.00%**
	SBI Gp	SBP	**-4.60%**	**-7.22%**
	SBI Gp	SBT	**-1.01%**	**-5.12%**
	Nation	SYNDI	**12.56%**	**-7.18%**
	Nation	**UBI**	**-0.28%**	**13.12%**
	Nation	**UCO**	**9.50%**	**11.11%**

	Nation	VIJAYA	**-2.64%**	**-10.27%**
Small	O Pvt	CATHO	**-2.81%**	**-18.30%**
	O Pvt	CITY	**-0.86%**	**2.75%**
	N Pvt	DCB	**6.26%**	**-12.19%**
	O Pvt	DHAN	**8.23%**	**-31.32%**
	O Pvt	FED	**5.73%**	**-1.73%**
	N Pvt	INDUS	**-22.70%**	**-7.65%**
	O Pvt	ING	**-13.23%**	**-1.94%**
	O Pvt	J&K	**0.00%**	**0.00%**
	O Pvt	KARN	**-11.36%**	**-20.30%**
	O Pvt	KARUR	**0.00%**	**-3.37%**
	N Pvt	KOTAK	**19.87%**	**-7.51%**
	O Pvt	LAKSHMI	**-8.52%**	**5.69%**
	O Pvt	NAINI	**18.43%**	**-6.13%**
	Nation	PSB	**14.51%**	**4.17%**
	O Pvt	RATN	**35.02%**	**-31.28%**
	SBI Gp	SBM	**-13.61%**	**4.16%**
	O Pvt	SOUTH	**2.09%**	**0.36%**
	O Pvt	TMB	**0.00%**	**0.00%**
	N Pvt	YES	**12.69%**	**6.95%**