

Impact of Global Financial Crisis on the Efficiency of Indian Banking Sector: An Assessment

Abhijit Sinha, Tagar Lal Khan

ABSTRACT

The present study looks into the stability of the banking system in India in the backdrop of the recession that gripped all corners of the world post-2008. When the developed economies like the USA, the UK, European Union, etc. got caught in the whirlwind of the subprime crisis, it was observed that the Indian economy in general and the Indian banking system in particular did not collapse like a pack of cards. The researchers in this paper aim to understand the resilience of the Indian banking system in terms of efficiency. For the purpose, analysis is made by considering the top sixteen banks from the private and public sectors on a data period from 2004-05 to 2011-12. Data Envelopment Approach is applied to compute the efficiency scores in terms of Technical Efficiency (TE), Pure Technical Efficiency (PTE) and Scale Efficiency (SE) for the banks under study. In order to capture the effect of recession on the Indian banking system, a comparison between the average performance score in the pre- and post-2008 (i.e., post-recession) is carried out. 'Wilcoxon Matched-pair Signed-rank' test has been applied to test any significant change in performance of Indian banks on account of global recession. The outcomes of the study clearly show that the global turmoil could not affect the Indian banking industry. This may be possibly due to strong base and good governance of Indian banking system through Reserve Bank of India (RBI) and the stringent measures passed from time to time. The article is an original work carried out by the researchers and the findings are in a similar line as that of Goel and Bajpai (2013).

Keywords: Indian banking, Efficiency, Data Envelopment Analysis, Pre- and post-recession, Wilcoxon Matched-pair Signed-Rank Test

JEL Classification: C14, D24, D61, G210

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INTRODUCTION

The global economic scenario changed since 2008 when the sub-prime mortgage crisis took its shape and gripped the US economy. With time and bad news coming in everyday, the other economies also slowly started getting infected with India being no exception. We have seen reports of several companies vanishing in the USA and hundreds of banks becoming

bankrupt during the period. However, the effect on the Indian economy as a whole and the banking sector in particular revealed that here the condition was much better. The credit goes to the RBI which has put in place sound and strict prudential and regulatory requirements which the banks need to comply with. The same view was reflected in the words of Pawan Kumar Bansal when he said in 2008 that the Indian

market could keep its head held high because of the banking sector. The stability of the banking sector has been proved once again during the period of financial turmoil that affected all corners of the globe.

LITERATURE REVIEW

Akbari, Dahmardehb and Saravani (2012) in their study made an effort to compare the performance of different branches of Bank Refah Kargaran in the Sistan and Baluchistan province using Data Envelopment Approach (DEA) and revealed the existence of wide difference in the performance of the branches, 7 branches attained perfect efficiency under Charnes, Cooper, and Rhodes (CCR) model in contrast to 12 under the Banker, Charnes and Cooper (BCC) assumption. The average performance of the branches under the two assumptions is 68.5% and 78.9%, respectively. Akin, Kilic and Zaim (2009) focused on the efficiency trends in Turkish banking. It covered 31 banks that operated between 2002 and 2007. The analysis was based on the input-oriented CCR model. Results showed that the average score during the period exceeded 80%. The industry showed an increasing trend till 2006 after which it declined. Of the total sample, only 6 banks operated at perfect efficiency level during the period. The scale efficiency (SE) scores revealed that they were lower than the average technical efficiency scores. The results of tobit regression revealed that all the explanatory variables, viz. size, nationality, ownership and publicly listed significantly affected the efficiency level. Of these, the first two factors had a negative effect on the efficiency score. Ataulah, Cockerill and Le (2004) looked into the effect of financial liberalisation on the efficiency of commercial banks in India and Pakistan. Their study period was from 1988 to 1998 which was divided into three sub-periods to capture the effect of reforms on the banking efficiency. The researchers computed the technical efficiency (TE) scores on the basis of loan-

based model and income-based model. They found that in both the countries, scale efficiency (SE) was the major factor in low overall technical efficiency (OTE) and at the same time pointed out that though the efficiency scores were quite low under both the models, there was a sign of improvement. Furthermore, their analysis revealed that the rate of improvement for the private sector exceeded that of the public sector. Moreover, they found that size did not significantly affect efficiency, in contrast to what was inferred in earlier studies.

Bala and Kumar (2011) analysed the efficiency of public sector banks (PSBs) in India. The results with respect to TE under CCR model showed an average of 87% for the 27 PSBs. Of the total sample, only one-third attained a score of one. The range for TE scores for the remaining banks was found to be in the range of 55.3% to 99.9%. Since, several banks attained a score of one, the super-efficiency model was run. The ultimate ranking showed that the top three banks in terms of efficiency were IDBI Bank, Corporation Bank and Indian Bank. Leading banks like the State Bank of India (SBI), Punjab National Bank (PNB) and Canara Bank secured ranks of 10, 8 and 22, respectively. Chhikara and Bhatia (2012) made a study on the efficiency level of 28 foreign banks operating in India considering data for the year 2010-11. They looked into the scores in terms of the three efficiency aspects, viz. technical, pure technical and scale. Fifteen banks were found to be perfectly efficient with a score of 100% on all counts. The mean scores of TE, PTE and SE were found to be 91.0%, 93.8% and 96.9%, respectively. In order to clearly identify the superior banks among those which obtained 100% efficiency score, the Anderson and Peterson's super-efficiency approach was applied. It revealed that Citi Bank, HSBC and Standard Chartered were the top three banks in terms of efficiency. Das and Ghosh (2010) looked into the profit efficiencies of the Indian

commercial banks using DEA during the period 1992-2004 which coincides with the post-reform period. Furthermore, they investigated into the possible factors that affected efficiency. Results of their study revealed that the range of cost efficiency values remained between 85.66% and 96.09%. On the other hand, the profit efficiency figures during the period fell in the range of 40.04% to 70.63%. With reference to the tobit regression results for different models, the determinants were identified. Dhanapal (2012) investigated into the efficiency level of 21 public sector banks covering the data period from 2006–07 to 2010–11. In addition to this, it analysed the determinants of profitability of the sector as a whole. With regard to the second objective, the author found that the most significant factors that affected profitability in a positive way were return on assets and non-performing assets (NPAs) to total assets. On the other hand, NPA to net advances had a significant negative effect on the dependent variable. With regard to the efficiency scores, it was observed that the efficient units were Andhra Bank, Indian Bank, Oriental Bank of Commerce (OBC), Punjab & Sind Bank, Vijaya Bank and IDBI Bank. Furthermore, 50% of the small-sized banks and 66% of the large-sized banks were identified to be efficient. Goel and Bajpai (2013) looked into the effect of global recession on the Indian banking sector. They tested the hypothesis that the effect of recession was not significant. They made their study on the different categories of banks which included the SBI and its associates, nationalised banks, private banks and foreign banks considering data for the period 2006 to 2009. The analysis was made on financial data covering aspects like operating profit to total assets, return on assets, profit per employee, capital adequacy, CASA deposit ratio, business per employee, credit deposit ratio and the investment deposit ratio. The results depicted that the sector was not significantly affected by the slowdown. Gupta, Doshit and Chinubhai (2008) studied 56 banks over

a period of five years from 1999-2003. To determine the relative efficiency level, they considered the asset weighted score. Their analysis revealed that the average efficiency of all banks increased by 2.4% during the period. The SBI group proved to be the most efficient followed by private banks. Hence, the other nationalised banks proved to be the least efficient. In determining the factors that contributed to efficiency of the banks, the significant ones were operating profit per total asset and capital adequacy ratio. Size, NPA level and business per employee were found to have no significant effect on the banks. Gulati (2011) studied the different efficiency aspects of 51 Indian banks using DEA. Both CCR and BCC models were used for computing different efficiency scores. The analysis of results showed that only nine banks were overall technically efficient. Moreover, of these nine, five were private banks which were established after 1996. The TE results showed that the average score was 79.2% with a deviation of 15.5%. In terms of frequency distribution, around 50% of the banks had a score of less than 80%. The second aspect relating to PTE showed an average of 83.4% with a deviation of 15.5%. Of the total sample, 14 banks attained perfect efficiency under VRS assumption. Moreover, of these 14, there were 9 banks which were also efficient under CRS assumption, thereby denoting 100% scale efficiency. The overall scale efficiency result showed an average score of 95.1% with a standard deviation of 6.6%. The results, therefore, showed that scale inefficiency had a low contribution in the overall inefficiency. Since, there were several banks with the same TE score, the researchers applied the super-efficiency model, which showed that the top three banks were ICICI Bank, Yes Bank and HDFC Bank. In the later part of the study, four tests were applied to determine whether there was any significant difference in the efficiency levels between the private and public sector banks. It was found that in all the cases, there was an insignificant difference in the mean levels of TE, PTE and SE

between the two sectors. Furthermore, the tobit regression model showed that the return on assets and off-balance sheet activities were the most important factors affecting efficiency. Hu, J. L, Chen, C. P and Su, Y. Y (2008) extended the available literature and analysed the different efficiency aspects like cost, allocate, overall technical, pure technical and scale using DEA. For the purpose, they computed efficiency scores under both Constant returns to scale (CRS) and Variable returns to scale (VRS) assumptions. The data for 12 banks covered a period from 1996 to 2003. Furthermore, to understand the effect of different factors on inefficiency, the tobit regression was run. Their study revealed that in terms of TE, China Development Bank was the most efficient in three of the eight years. In terms of PTE, the most efficient banks were ABC, BC, CEB all of which were, however, not scale efficient. Similarly, different results relating to cost efficiency were discussed in the research paper. Furthermore, the effect of different environmental variables on efficiency was also discussed. Jackson and Fethi (2000) studied 48 Turkish commercial banks for 1998 using Lovell's value-added approach. The results revealed that the overall mean was 67% in case of VRS assumption. In order to reveal the factors determining TE, tobit regression model was applied. The estimation revealed that whereas both bank size and profitability affected TE positively, capital adequacy affected negatively. Furthermore, though ownership affected efficiency negatively, the effect was insignificant. Kamau (2011) intended to look into the efficiency and productivity aspects of the Kenyan banking sector using data for 40 banks covering the data period from 1997 to 2009. The decision-making units (DMUs) for study included banks of different sizes. In order to meet the objectives, firstly, DEA was applied followed by the use of Malmquist Productivity Index (MPI). Results revealed that the average TE, PTE and SE were 47%, 56% and 84% respectively. However, the overall trend was found to be positive. The results with respect

to bank size showed that the factor was positively related with efficiency. On the other hand, the ownership-based scores revealed that the best and worst scores were attained by the foreign banks and local public banks respectively. The productivity analysis revealed that for the entire industry, the increase in factor productivity was mainly due to change in TE. San, Theng and Heng (2011) made a study to determine the efficiency scores of the domestic and foreign banks of Malaysia during the period 2002–2009. Results showed that most of the banks attained a score of 100% during the period, during which the average PTE of domestic banks was found to be 97.81%. On the other hand, the score of the foreign banks was relatively unstable with wide fluctuations. The average PTE of foreign banks in the study period was 94.92%. The result of the tobit regression analysis showed that capital strength, loan quality and expenses significantly affected efficiency at 1% level. Asset size, on the other hand, significantly affected efficiency at 10% level. Soetanto and Ricky (2011) studied the efficiency of 20 domestic commercial banks in which included 4 state-owned and 16 private-owned banks for the period from 2004 to 2009. The researchers used the intermediation approach for the selection of variables on the input-oriented approach of DEA. Furthermore, in order to capture the effect of different factors affecting efficiency, Tobit regression was applied. Results revealed that the average TE ranged between 80.4% and 92.9% with an average of 89.5% during the period. The average PTE, on the other hand, ranged between 92% and 98% with the overall average of 93.4%. Moreover, they found that in most of the years, TE was supported by PTE rather than SE. With regard to ownership-based efficiency, they revealed that private banks showed lower TE levels though they showed an overall improvement. A study of the efficiency-determining factors showed that asset size, capital strength and liquidity risk were the significant ones.

However, the above articles and research papers showed that their focus was on understanding the different efficiency levels of the financial institutions. In some other research papers, researchers have revealed the operating returns to scale in the industry. Another interesting part in most of the studies is in understanding the determinants of the efficiency levels using tobit regression model. Only one paper looked into the effect on the financial performance parameters due to the global slowdown. It is, therefore, clear that none of the studies aimed to understand the effect recession on the efficiency of the banking industry. As a result, the researchers on identifying the gap concentrated on the pre- and post-efficiency levels in the industry and enquired into the significance of their difference, if any, during the two periods.

OBJECTIVES OF THE STUDY

The present study is made to (i) measure performance of the selected banks in terms of efficiency scores using DEA (TE, PTE, SE), and (ii) to find whether there is any significant change in the efficiency level of the Indian banking sector (TE, PTE, SE) due to global recession.

The following hypotheses are tested:

H₁₀: There is no significant difference in the TE Scores of the banking sector during the pre- and post-recession period.

H₁₁: There is significant difference in the TE Scores of the banking sector during the pre- and post-recession period.

H₂₀: There is no significant difference in the PTE Scores of the banking sector during the pre- and post-recession period.

H₂₁: There is significant difference in the PTE Scores of the banking sector during the pre- and post-recession period.

H₃₀: There is no significant difference in the SE Scores of the banking sector during the pre- and post-recession period.

H₃₁: There is significant difference in the SE Scores of the banking sector during the pre- and post-recession period.

METHODOLOGY AND DATA SOURCE

Purposive sampling is the method applied in the study for choosing the sample. For the purpose of our study, 16 Scheduled commercial banks of India are covered which includes eight each from the public and private sectors (see Table 1). The sample is chosen on the basis of market capitalisation. In other words, the focus is more on the larger-sized banks which represent the industry. Using the data of capitalisation (as on February 25, 2013), the banks that got included in the sample are as follows:

Table 1: Commercial banks chosen as sample

Sl. No.	Private sector banks	% market capitalisation of private sector	Sl. No.	Public sector banks	% market capitalisation of public sector
1.	Axis Bank	More than 90%	9.	Bank of Baroda (BoB)	Almost 80%
2.	Federal Bank		10.	Bank of India (BoI)	
3.	ICICI Bank		11.	Canara Bank	
4.	IndusInd Bank		12.	IDBI Bank	
5.	ING Vysya Bank		13.	OBC	
6.	HDFC Bank		14.	PNB	
7.	Kotak Mahindra Bank		15.	SBI	
8.	Yes Bank		16.	Union Bank	

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For this research purpose, secondary data are collected from the Capitaline Database Package covering the period from 2004-05 to 2011-12 which has been segregated into pre- and post-financial crisis; 2004-05 to 2007-08 as the former and from 2008-09 to 2011-12 as the latter.

Firstly, since the analysis is based on efficiency, the non-parametric methodology of DEA is applied to arrive at the banking efficiency results. In order to compute the scores relating to different efficiency, viz. technical, pure technical and scale, both CCR and BCC models are applied. Secondly, to meet the second objective of understanding the effect of recession on the Indian banking industry, Wilcoxon Matched-Pair Signed-Rank test is applied [David, 2000; Kanji and Gopal, 2000].

DATA ENVELOPMENT APPROACH (DEA)

The DEA is a non-parametric methodology, popularly applied in the financial services industry to calculate the efficiency scores of the different organisations, technically called decision-making units (DMUs), on the basis of certain selected input and output variables. According to the DEA method, a frontier is created through the piecemeal addition of frontiers arrived at separately. The firms which lie on the frontier are considered to be the “best-practice” ones with a score of 100% that set the benchmark for other firms. The other DMUs get values between 0% and 100% depending on their distance from the frontier.

In order to arrive at the score of the banks, in our case, the maximisation linear programming technique is applied since the objective is to maximise outputs.

It is important to note that for the application of DEA:

- The inputs need to be strictly positive, whereas outputs should be non-negative (Sarkis and Weinrach, 2001)

- There should be a significantly positive relationship between the inputs and the outputs which is confirmed through the ‘isotonicity’ test.
- Furthermore, it is important to mention here that result of DEA depends on the selection of inputs and outputs. In this research article, the intermediary approach is used as the basis for selecting the two categories of variables. Moreover, since the number of variables also plays a vital role, the following two thumb rules, given by Cooper *et al.* (2007) is considered in mind:
 - $n \geq p \times q$, where n is the number of DMUs, p is the number of inputs and q is the number of outputs, and
 - $r = 3(p+q)$, where r is the total number of observations.

After a thorough review of literature and considering the above two rules, the following two inputs and outputs are considered:

Input variables: Deposits and Assets

Output variables: Loans and Advances and Investments

Prior to the application of DEA, the nominal data are deflated using GDP Deflators to the base year 2004–05. The deflated variables are named as Deflated Deposits (DEFLDEP), Deflated Assets (DEFLASSE), Deflated Advances (DEFLADV) and Deflated Investments (DEFLINV).

TESTING FOR ISOTONICITY

This test is extremely important before determining the efficiency results because it points to the strength and the sign of the relationship between the inputs and outputs. It is necessary to have a positive, significantly strong relationship between the inputs and outputs. The Pearson’s Correlation Matrix gives the obtained

relationship in this case:

Table 2: Result of Isotonicity Test

		Correlations			
		DEFLDEP	DEFLASS E	DEFLADV	DEFLINV
DEFLDEP	Pearson Correlation	1.000	.755**	.991**	.966**
	Sig. (2-tailed)	.	.000	.000	.000
	N	128	128	128	128
DEFLASSE	Pearson Correlation	.755**	1.000	.772**	.768**
	Sig. (2-tailed)	.000	.	.000	.000
	N	128	128	128	128
DEFLADV	Pearson Correlation	.991**	.772**	1.000	.951**
	Sig. (2-tailed)	.000	.000	.	.000
	N	128	128	128	128
DEFLINV	Pearson Correlation	.966**	.768**	.951**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	128	128	128	128

** Correlation is significant at the 0.01 level (2-tailed).

Source: Calculated by the authors

The above matrix depicts the high positive correlation between the inputs and outputs, all of which are significant at 1% level. Thus, the choice of variables is logically correct; hence, we proceed with DEA.

For the present study, OTE is considered which is computed using the CCR model and for determining pure technical and scale efficiency results, the BCC model is applied.

Empirical Analysis

The following points summarise the results of our study. In the first part, the researchers point to the different efficiency results, following which in the second part, the Wilcoxon Matched-Pair Signed-Rank Test is applied to statistically test the effect of recession on banking industry efficiency. The details of our observations are given in the points below.

EFFICIENCY RESULTS OF THE INDUSTRY

The TE pertains to the OTE attained by the private and public players. PTE, on the other hand, relates to

the efficiency arising out of managerial decisions and sound resource allocation. The SE reflects the extent of utilisation which is computed as shown below:

$$\text{Scale Efficiency} = \frac{\text{Technical Efficiency}_{\text{CCR}}}{\text{Pure Technical Efficiency}_{\text{BCC}}}$$

The charts below summarise the results obtained in the three efficiency forms.

(a) Technical Efficiency

Technical Efficiency Result

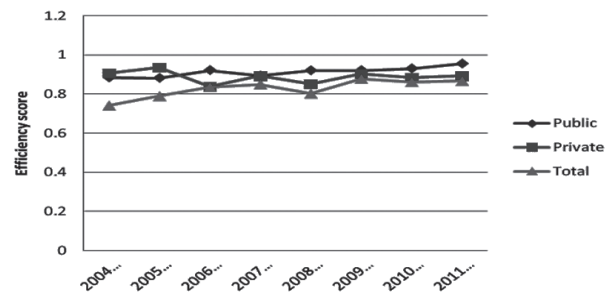


Chart 1: Technical efficiency result summary

Source: Computed by the authors

From Chart 1, we observe that in terms of TE, there is a sign of improvement not only in the industry, but

also in both the sectors. In terms of the industry trend, it is clear that there is a substantial improvement from 74% in 2004–05 to 87% in 2011–12. A good point to be mentioned here is the consistency in improvement of efficiency scores. If we look into the sectoral trend, we observe that the public sector banks reflect greater consistency in comparison to the private sector. The former showed an efficiency improvement from 88% in 2004–05 to almost 95% at the end of the study period. On the other hand, though the trend for the private banks is optimistic, in the initial year of the study period, there was a hiccup when the efficiency declined from 93% in 2005–06 to 83% in the very next year.

(b) Pure Technical Efficiency

This aspect covers one component of the total (or overall) efficiency. It highlights the issues of the organisation in terms of managerial skill and resource allocation soundness.

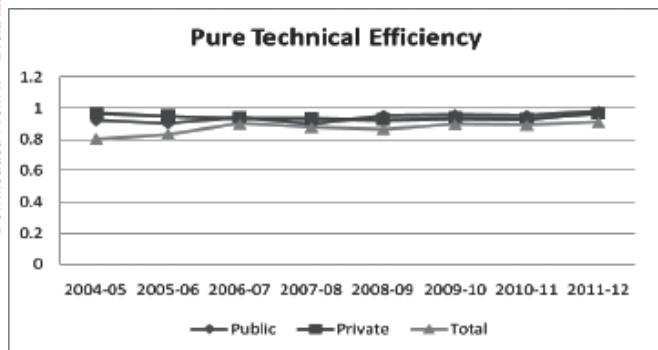


Chart 2: Pure technical efficiency result summary

Source: Computed by the authors

In terms of PTE, as is shown in Chart 2, it is observed that the public sector showed a comfortable average with the score exceeding 90% in all the years. In the second half of the study period, the average exceeded 95%. The performance of the private sector is not far behind with a better average than the public sector in some of the years. The overall sectoral performance showed that it improved drastically from 80.3% in

2004–05 to more than 91% in 2011–12. Hence, the pure technical inefficiency is quite low leaving less scope for improvement.

(c) Scale Efficiency

This is the second component of the total efficiency which throws light on the efficiency in terms of scale utilisation. Higher is the score implies better is the size utilisation and closer it is to the minimum point on the average cost curve. The results of the industry in this aspect are given in Chart 3 below.

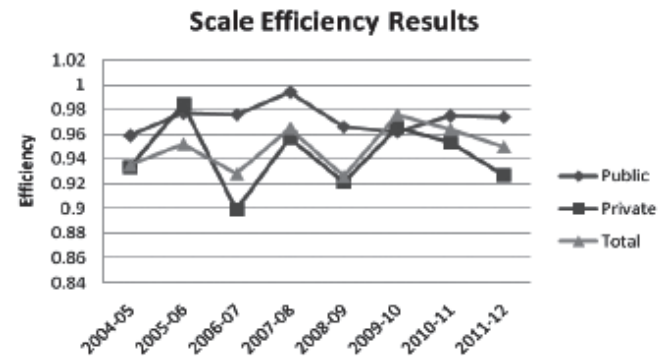


Chart 3: Scale efficiency result summary

Source: Computed by the authors

The efficiency results by applying DEA point to the high scale efficiency; the score exceeded 90% in all years of the study (look at Chart 3). Though the public sector attained a higher average than the private sector, the overall situation is very favourable. In contrast to the other two aspects, it seems that it is showing more fluctuation. The truth is that it is apparently so, but the range is very limited. An observation of the scores suggests that none of the two aspects had a severe down-pulling effect on the OTE. Thus, the situation in the banking industry in totality and the two sectors, in particular, shows that it has shown tremendous strength even in the years following the commencement of the global financial crisis.

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EFFICIENCY SCORES OF THE INDIVIDUAL BANKS

In this sub-section, we concentrate our focus on the results of each of the banks in each year of the study period. The year-wise result of the banks in respect of the three efficiency forms is given in Tables 4 and 5.

Table 4: Efficiency results of public sector banks

Efficiency	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
Bank of Baroda								
TE	0.754	0.770	0.836	0.794	0.935	0.909	0.910	0.895
PTE	0.823	0.812	0.867	0.800	0.969	0.947	0.961	1.00
SE	0.916	0.947	0.964	0.993	0.965	0.960	0.946	0.895
Bank of India								
TE	0.904	0.849	0.915	0.854	0.931	0.916	0.862	0.928
PTE	0.921	0.850	0.958	0.860	0.953	0.951	0.902	0.955
SE	0.981	0.999	0.954	0.993	0.977	0.962	0.955	0.971
Canara Bank								
TE	1.00	1.00	0.791	0.826	0.890	0.894	0.863	0.928
PTE	1.00	1.00	0.795	0.828	0.891	0.906	0.885	0.931
SE	1.00	1.00	0.994	0.997	0.999	0.986	0.975	0.997
IDBI								
TE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PTE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oriental Bank of Commerce								
TE	0.827	0.881	0.978	1.00	0.853	0.862	1.00	0.982
PTE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	0.827	0.881	0.978	1.00	0.853	0.862	1.00	0.982
Punjab National Bank								
TE	0.882	0.792	0.934	0.862	0.933	0.935	0.926	0.973
PTE	0.917	0.801	0.963	0.873	0.961	0.963	0.937	0.974
SE	0.962	0.989	0.969	0.987	0.970	0.970	0.988	0.998
State Bank of India								
TE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PTE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Union Bank of India								
TE	0.707	0.766	0.921	0.817	0.826	0.865	0.885	0.904
PTE	0.607	0.766	0.973	0.834	0.859	0.905	0.943	0.992

SE	0.987	0.998	0.946	0.980	0.962	0.955	0.938	0.948
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Source: Calculated by the authors

Note: TE stands for Technical Efficiency, PTE stands for Pure Technical Efficiency and SE stands for Scale Efficiency.

Table 5: Efficiency results of private sector banks

Bank	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
Axis Bank								
TE	1.00	1.00	0.821	0.807	0.846	0.865	0.795	0.794
PTE	1.00	1.00	1.00	1.00	1.00	1.00	0.983	0.995
SE	1.00	1.00	0.822	0.807	0.846	0.865	0.808	0.797
Federal Bank								
TE	1.00	0.973	0.902	0.944	0.870	0.879	0.893	0.893
PTE	1.00	1.00	1.00	1.00	0.958	0.880	0.907	0.909
SE	1.00	0.974	0.902	0.944	0.908	0.999	0.984	0.982
HDFC Bank								
TE	1.00	0.985	0.717	0.945	0.764	0.856	0.841	0.834
PTE	1.00	1.00	1.00	1.00	0.988	0.909	1.00	1.000
SE	1.00	0.985	0.717	0.945	0.773	0.942	0.841	0.834
ICICI Bank								
TE	0.849	0.967	0.855	0.974	0.941	1.00	1.00	1.00
PTE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	0.849	0.968	0.856	0.975	0.941	1.000	1.00	1.00
IndusInd Bank								
TE	0.686	0.762	0.632	0.709	0.671	0.858	0.760	0.816
PTE	0.850	0.770	0.671	0.712	0.684	0.881	0.765	0.818
SE	0.808	0.990	0.943	0.996	0.981	0.973	0.993	0.998
ING Vysya Bank								
TE	0.717	0.793	0.782	0.756	0.724	0.798	0.780	0.805
PTE	0.850	0.770	0.671	0.712	0.684	0.881	0.765	0.818
SE	0.808	0.955	0.957	0.995	0.924	0.972	0.998	0.805
Kotak Mahindra Bank								
TE	1.00	1.00	1.00	1.00	1.000	0.970	1.000	1.000
PTE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000
SE	1.00	1.00	1.00	1.00	1.00	0.970	1.00	1.00
Yes Bank								
TE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PTE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Calculated by the authors

Note: TE stands for Technical Efficiency, PTE stands for Pure Technical Efficiency and SE stands for Scale Efficiency.

The explanation with respect to the above two tables are given in the following:

TECHNICAL EFFICIENCY

Among the public sector banks, with respect to the overall efficiency, SBI and IDBI Bank proved to be the best performing banks with a perfect score of 100% in all the years. The other two leading banks in terms of performance are OBC and PNB which attained an average score of more than 90%. The overall average considering all the public sector banks is more than 80%.

On the other hand, with regard to the private sector banks, only Yes Bank attained a perfect score of 100% in all the years. Kotak Mahindra Bank almost attained an efficiency level of 100% during the period. The other leading banks in this respect are ICICI Bank and Federal Bank, with their mean score exceeding 90%. Axis Bank and HDFC Bank attained an average score of 87% during the period, thereby implying a scope of improvement to the extent of 13%.

PURE TECHNICAL EFFICIENCY

Using the same Tables 4 and 5, an elaborate discussion about PTE is made. With regard to this efficiency aspect, it is observed that SBI, IDBI Bank and OBC attained a perfect efficiency of 100% in all the years, thereby denoting that there are no other public sector banks which can produce more using the same unit of inputs. Some of the other banks which attained an average score exceeding 90% include PNB, BoI and Canara Bank. The scope of improvement for these three banks is 7.7%, 8.1% and 9.5%, respectively.

ICICI Bank, Yes Bank and Kotak Mahindra Bank, among the private sector banks, lead the race with a relative score of 100% in all the years. Axis Bank attained an average of almost 100%. The other private banks which had an average score of more than 90%

include HDFC Bank and Federal Bank. The overall position of the units is very positive.

SCALE EFFICIENCY SCORES

On the basis of the figures in the above table numbers 4 and 5, an elaborate discussion about scale efficiency is made which measures the efficiency arising out of scale utilisation. A score of 1.00 (or 100%) denotes operation at the lowest point on the average cost curve, i.e. at the constant returns to scale. The score of less than 100% points to operation either at the decreasing or increasing returns to scale.

The scale efficiency score of the two sectors shows that its average exceeded those of the other two efficiency aspects. Among the public sector banks, only SBI and IDBI Bank attained perfect score of 100% during the period. All the other banks in the sector, however, achieved an average exceeding 90%, thereby pointing to a low scope of improvement.

Of the private sector banks, only Yes Bank and Kotak Mahindra Bank attained a mean relative score of 100%, thereby denoting perfect efficiency in all the years during the data period. The other banks with an average score of more than 90% included Federal Bank, IndusInd Bank, ING Vysya Bank and ICICI Bank. The remaining banks had a score between 85% and 90%. Hence, the situation of the overall industry is quite good.

EFFECT OF GLOBAL RECESSION ON THE BANKING INDUSTRY EFFICIENCY

For the second objective of this study, the researchers employed the Wilcoxon Matched-Pair Signed-Rank Test, the details of which are given in Tables 6 and 7. Table 6 summarises the descriptive statistics of the efficiency results in the three categories.

Table 6: Descriptive statistics of the efficiency scores

Descriptive statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
TECH EFF-PRE	16	0.80413528	0.126354256	0.549358	1.000000
PU TECH EFF-PRE	16	0.85453312	0.132778733	0.562578	1.000000
SC EFF-PRE	16	0.94558406	0.078827302	0.683642	1.000000
TECH EFF-POST	16	0.85282645	0.089238609	0.743274	0.997347
PU TEC EFF-POST	16	0.89281061	0.074392299	0.787134	1.000000
SC EFF-POST	16	0.95445311	0.030323015	0.915780	0.997347

Source: Calculated by the authors

The result of the rank sum and Wilcoxon Matched-Pair Signed-Rank Test is presented in Table 7.

Table 7: Rank sum of the efficiency results in the pre- and post-recession period

Ranks				
		N	Mean Rank	Sum of Ranks
TECHPOST - TECHPRE	Negative Ranks	5 ^a	8.00	ΣR- 40.00
	Positive Ranks	11 ^b	8.73	ΣR+ 96.00
	Ties	0 ^c		
	Total	16		
PU TECH POST – PU TEC PRE	Negative Ranks	4 ^d	6.25	ΣR- 25.00
	Positive Ranks	9 ^e	7.33	ΣR+ 66.00
	Ties	3 ^f		
	Total	16		
SC POST – SC PRE	Negative Ranks	10 ^g	8.90	ΣR- 89.00
	Positive Ranks	6 ^h	7.83	ΣR+ 47.00
	Ties	0 ⁱ		
	Total	16		

Note:
 a. TECHPOST < TECHPRE d. PURETECHPOST < PUREPRE g. SCALEPOST < SCALEPRE
 b. TECHPOST > TECHPRE e. PURETECHPOST > PUREPRE h. SCALEPOST > SCALEPRE
 c. TECHPOST = TECHPRE f. PURETECHPOST = PUREPRE i. SCALEPOST = SCALEPRE

Source: Calculated by the authors

Table 8: Wilcoxon Matched-Pair Signed-Rank Test

	TECHPOST - TECHPRE	PURETECHPOST - PUREPRE	SCALEPOST - SCALEPRE
Z	-1.448 ^a	-1.433 ^a	-1.086 ^b
Sig. (1-tailed)	.148	.152	.278
a. Based on negative ranks			
b. Based on positive ranks			

Source: Calculated by the authors

The outcome of Wilcoxon Matched-Pair Signed-Rank Test on the basis of significance level shows that there is no significant change in the average performance of the Indian banks in terms of their TE, PTE and SE as a result of the global financial crisis. In other words, there is no significant statistical difference in the efficiency level between the pre- and post-recessionary period which is similar to the findings by Goel and Bajpai (2013). This is due to the strong foundation of Indian banks and stringent control by the RBI together with the stringent prudential norms imposed by the regulator.

CONCLUDING OBSERVATION

On the basis of the above analysis, we find that the overall strength of the banking industry is at a commendable level, be it any form of efficiency. The industry has proved to be really tough even in the backdrop of the global financial crisis to which India could not remain unscathed. The credit for this resilience goes to the RBI which brings about strict regulations from time to time and also imposes several requirements to be complied with by the banks. This has helped in bringing stability to the industry, thereby leading to no severe impact on the banks even during the period of economic and financial turmoil.

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