Non-Performing Assets of Banks in India: Efficiency in Management

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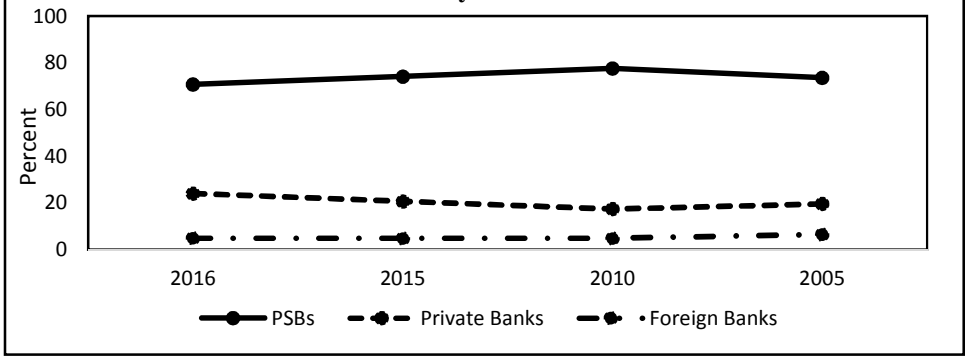
I. Introduction

India is a bank based system and commercial banks play a vital role in financial intermediation in the country and can be observed from the distribution of gross financial savings of the household sector. Gross savings of the household sector accounted for 54.2 percent of the total savings in the country in 2016-17 and the bulk of household savings is in the form of bank deposits. Bank deposits as a percentage of total savings increased from 32 percent in 1991 to a high of 57 percent in 2008-09 and has since declined to 41 percent in 2015-16. A marginal decline, however, has been observed in the growth rate of bank deposits in 2017-18.

Savings held as shares and debentures over this same period have been quite small. Shares and debentures constituted a mere 8 percent of gross financial savings of the household sector in 1990-91 and have since then shown mixed performance. It peaked to 9.62 percent in 2007-08 and has since declined to 2.73 percent in 2015-16. Bank credit to the commercial sector increased by 47 times from Rs. 1654.27 billion in 1990-91 to Rs. 77829.86 billion in 2015-16. Bank credit as a percentage of GDP has almost doubled over this period from 29 percent in 1990-91 to 57 percent in 2015-16. Further, public sector banks dominate India's banking sector and the share of public sector banks and private sector banks can be seen from Figure 1.

Figure 1: Share of Bank Group in Total Credit of the Banking System



Given this pre-dominance of the banking sector in India's financial sector, it is imperative that this sector is financially sound. A sound and healthy banking sector is essential for the efficient working of the financial sector. Financial soundness is captured through a series of indicators/ ratios which cover different aspects such as capital adequacy, asset quality, earnings and profitability, liquidity and sensitivity to market risk. The evolution of these indicators should indicate potential vulnerabilities of the financial/banking sector point out possible weaknesses, thereby functioning as tools of macroeconomic and macro prudential policy analysis (Navajas and Thegeya, 2013). The global financial crisis (GFC) of 2008 has once again brought into focus the importance of detecting early warning signals of potential financial or banking sector crises through the use of financial soundness indicators.

Asset quality is one of the most critical facet in determining the overall condition of a bank. It concerns with the quality of a bank's loan portfolio and its credit administration program. A substantial portion of a bank's assets comprises of loans & carry the greatest amount of risk to their capital. Other items which can impact asset quality are real estate assets, other assets, off-balance sheet items and, to a lesser extent, dues from accounts, and premises and fixed assets. Banks are concerned with the quality of their loans since they provide earnings to a bank. Asset quality concerns with the balance sheet of a bank and more so with the left-hand side of a bank balance sheet.

The problem of stressed assets or non-performing assets (NPAs) is not new for India's banking sector. Since the reforms of 1991, India has had two episodes of NPA problems, one during 1997-2002 and the current one after the global financial crisis of 2008. The problem of NPAs in the current episode started around 2010 and aggravated after 2013. The NPA problem this time over was broad based and coincided with slowing economic growth, extended to the priority sector and more acute in the infrastructure sector like iron and steel,

textiles, mining and aviation. Although the share of NPAs to gross advances was higher in the period 1997-2003, its growth was much higher in the current period (Singh, 2016; Sengupta and Vardhan, 2017). Section II presents the definition and classification of non-performing assets while Section III highlights the focus of the study. Sections IV and V contain the theoretical background and a review of efficiency studies pertaining to banks in India respectively. Section VI discusses the methodology adopted in this study. Sections VII to X discuss the empirical evidence on non-performing assets for banks in India to include bank group level and individual bank level analysis; the results of the efficiency estimates and the determinants of efficiency. Section IX presents the analysis for asset quality and solvency. Section XII examines the relationship between asset quality indicators, solvency and efficiency of banks under the Prompt Corrective Action (PCA) framework and Section XIII contains the conclusions.

II. Non-Performing Assets: Definition and Classification

The terms non-performing assets (NPAs) and non-performingloans (NPLs), are often used interchangeably and, refer to loans that do not meet their stated principal and interest repayments. In other words, these are assets which do not generate income. Non-performing loans, thus, create a problem for asset quality. According to the Reserve Bank of India Prudential Norms, '*an asset, including a leased asset, becomes non-performing when it ceases to generate income for the bank'* (Reserve Bank of India, Master-Circular, 2005).

Prior to 1991, banks in India did not have follow uniform accounting practices for income recognition, classification of assets, provisioning for non-performing assets, and valuation of securities held in a bank's portfolio. Consequently, there was no uniform framework for capital adequacy requirements and very few banks had a capital adequacy ratio of 8 percent.

Prudential norms reflect the regulatory side of banking sector reforms and were introduced following the recommendations of the Committee on Financial System, 1991 (Narasimham Committee I) The Committee recommended the implementation of uniform prudential norms and standards that conformed with the Basel Committee on Banking Supervision. Norms for income recognition, asset classification and provisioning for the loan portfolio in banks were, thus, introduced by the Reserve Bank of India in a gradual manner and became fully operational from March 31, 1996. Assets/ loans were classified into standard, sub-standard and doubtful. Standard assets (loans) required no provisioning. Loans were classified as sub-standard when payments become overdue for a period exceeding two quarters (the international norm was one quarter), sub-standard assets were downgraded to doubtful if they remained in the sub-standard category for two years (international norm was one year). Besides, loans with government guarantees were treated as zero-risk assets and not categorised as non-performing loans despite a payment default. The implementation of the Narasimham Committee I recommendations resulted in strengthening the banking system in the country and the capital adequacy ratio of most banks was higher than the mandated 8 percent by March 1998. Although much of this recapitalisation was through government capital infusion, banks also contributed from their internal reserves and raised capital from the market. The impact was also vindicated by a decline in the ratio of net NPA to total advances from 16.3 percent in 1991-92 to 8.2 percent in 1997-98.

With the objective of reviewing the progress achieved in banking sector reform and closely aligning domestic prudential norms with international best practices, the Committee on Banking Sector Reforms (Narasimham Committee II) was appointed in December 1997. The committee made specific recommendations to improve standards and the capital adequacy ratio for banks was increased to 9 percent (the Committee recommendation was 10 percent) to be attained by March 31, 2000; a risk weight of 2.5 percent was assigned to investments in

government securities along with specifying criteria for classifying non-performing assets (Ahluwalia, 2000).

The definition of NPAs was tightened in phases andthe RBI Master Circular (2005) defines *A Non-performing asset (NPA) is a loan or an advance where;*

(i) interest and/ or instalment of principal remain overdue for a period of more than 90 days in respect of a term loan,

(ii) the account remains 'out of order', in respect of an Overdraft/Cash Credit. (According to the RBI Master circular, an account should be treated as 'out of order' if the outstanding balance remains continuously in excess of the sanctioned limit/drawing power but there are no credits continuously for 90 days as on the date of Balance Sheet or credits are not enough to cover the interest debited during the same period).

(iii) the bill remains overdue for a period of more than 90 days in the case of bills purchased and discounted,

(iv) a loan granted for short duration crops will be treated as NPA, if the instalment of principal or interest thereon remains overdue for two crop seasons.

(v) a loan granted for long duration crops will be treated as NPA, if the instalment of principal or interest thereon remains overdue for one crop season.

The RBI Master Circular, 2014 added the following to aspects to the definition of a NPA

(vi) the amount of liquidity facility remains outstanding for more than 90 days,in respect of a securitisation transaction undertaken in terms of guidelineson securitisation dated February 1, 2006.

(vii) in respect of derivative transactions*, the overdue receivables representingpositive mark-to-market value of a derivative contract, if these remainunpaid for a period of 90 days from the specified due date for payment.*

Besides, according to the Reserve Bank of India guidelines an account may be classified as NPA only if the interest charged during any quarter is not serviced fully within 90 days from the end of the quarter. Banks are required to classify NPAs since March 31, 2005 into three categories, on the basis of the period for which the asset has been non-performing and the extent to which dues can be realised into sub-standard assets, doubtful assets and loss assets. A requirement being that all these '*assets possess well defined credit weaknesses that jeopardise the liquidation of debt and are characterised by the distinct possibility that the banks will sustain some loss, if deficiencies are Not corrected' (Reserve Bank of India, 2005).*

Sub Standard Assets would be those, which have remained NPAs for a period less than or equal to 12 months.

Doubtful Assets are those which have remained in the sub-standard category for a period of 12 months.

Loss Assets are considered uncollectible and of little value that its continuance as a bankable asset is not warranted and even though there may be some salvage or recovery value.

III. Focus of the Study

Given the problem of NPAs started in 2010 and has aggravated since 2013, this study will focus on

(i) Compare the magnitude of the NPA problem for three time periods 2008-10, 2011-13 and 2014-17 at the level of bank groups.

(ii) Quartile analysis of NPAs and comparison at the individual bank level for the periods 2011-13 and 2014-17.

(iii) Analyze and compare the efficiency of performing loans at the individual bank level for two time periods 2011-13 and 2014-17. The ability of a bank to manage its performing or interest earning assets or in other words, a higher efficiency of a

bank in managing its performing assets for a bank would implicitly mean lower Non-performing assets for the bank.

(iv) Identify the determinants of efficiency (univariate approach using rank correlation as well as the Tobit analysis)

(v) Analyze whether there is a relationship between asset quality (GNPAs) and financial soundness (CRAR).

IV. Theoretical Underpinnings

Banks can be viewed as financial intermediaries and /or providers of services and these different views form the basis for different approaches to study the efficiency of banks. Each of these views uses a different set of inputs and outputs as the choice of inputs and outputs in DEA measurement has been a subject of debate and can have an impact on the results. Das and Ghosh (2006) elucidate the commonly discussed approaches in literature to study and measure bank efficiency are the production approach, the intermediation approach, the modern approach and the income based approach. The production and intermediation approach extend the traditional theory of the firm to banks and differ from each other in terms of the specification of banking activities.

The production approach was first discussed by Benston (1965) who pointed that banks are entities that provide services to customers. This approach highlights that banks produce loans and other financial services. The focus of the approach is on studying the number of type of transactions undertaken by a bank or services provided over a given period of time. This approach focuses includes physical variables and/or their costs as only physical inputs are necessary to perform and process transactions and provide advisory services to customers. Hence the input set under this approach often includes physical variables like labour (staff), material or space. Interest costs are excluded from inputs. Outputs are the services provided

to customers and is measured by the number and type of transactions, documents processed or specialized services provided. Given that data on such details is difficult to obtain it is often proxied by the number of deposits and loan accounts.

The intermediation approach views banks as financial intermediaries who transfer funds from one set of agents (depositors) to another set of agents (creditors). Assets created by the bank through loans and advances, securities and investments generate income while deposits of the bank are liabilities where interest has to be paid by the bank. This approach takes into accounting interest costs as well as operating costs. However, there are differing views on whether deposits of a bank should be used as an input or output. This has led to three sub-approaches under the intermediation approach, namely, the asset approach, the user cost approach and the value added approach. The asset approach (Sealey and Lindley, 1977) considers as inputs deposits and other liabilities along with real resources such as labour and capital while loans alone are considered as output. The user cost approach (Hancock, 1985) considers a financial product to be an input or output based on its net contribution to bank revenue. If the financial returns on an asset is greater than the opportunity cost of funds, then it is treated as an output and if the financial returns are lower than the opportunity cost of funds then they are treated as inputs. The value added approach is based on the balance sheet classification of bank activity and those activities that contribute to bank value are treated as outputs (Berger and Humphrey, 1977; Berger, Hanweck and Humphrey, 1987). Under this approach, deposits, loans and investments, contribute to bank value and are hence treated as outputs while labour expenses, capital related operating expenses and interest expenses are treated as inputs.

Berger and Humphrey (1977) have pointed out that the intermediation approach is better suited to examine bank level efficiency while the production approach is more apt for

studying branch level efficiency as at the bank level the focus is often on reducing costs so as to be cost efficient. Processing of transactions takes place at the branch level and hence efficiency in processing the services provided by a bank, the focus of the production approach, is suited for branch level efficiency.

The modern approach (Frexias and Rochet, 1997) takes into account the quality of bank assets and the probability of bank failure in the estimation of costs. This approach seeks to integrate/combine agency costs, some measure of risk and quality of bank services. This approach is best analysed using the CAMELS framework.

The income based or operating approach (Leightner and Lovell, 1998) considers banks to be business entities that generate revenue from costs incurred. Hence, under this approach total revenue (interest and non interest) is considered as output and total expenses (interest and operating) as input.

Most studies in banking efficiency focus on the intermediation approach as data is easily available from the Profit and Loss Account and Balance Sheet of the Bank.

V. Review of Efficiency Studies Relating to Banks in India

An important objective of this study is the analysis and comparison of the efficiency of performing loans of banks in India and examine whether there is any link between asset quality and solvency for a bank. Hence the review of literature has discussed only those studies that have used frontier approaches of Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) to measure bank efficiency in India. This section also contains studies which have analysed bank performance with capital adequacy.

Bhattacharya et al. (1997) examined the productive efficiency of 70 Indian commercial banks in the pre-deregulation era for the period 1986-91. The paper used DEA and SFA models to

measure the efficiency in service provision and found public sector banks to be the most efficient followed by foreign banks and private banks. The paper further observed that although foreign banks were least efficient at the beginning of the period by the end of the period these banks witnessed an improvement in efficiency and that they were as efficient as the public sector banks.

Rajaraman, Bhaumik and Bhatia (1999) discussed the inter-bank variations in NPAs for 1996-97 using regional clustering. The paper studied the impact of region of operation on domestically owned banks. The paper regressed bank-specific net NPAs on bank ownership and regional presence, controlling for bank-specific efficiency and prudential indicators. Regional presence was measured by taking the total number of branches in each state as a percentage of the national total. Under ownership structure, the paper classified banks into four types, namely old private sector banks, new private sector banks, public sector banks and, foreign banks. Foreign banks were further classified into the group of Asian and West Asian origin, banks and another group of other than Asian and West-Asian origin. The paper found significant positive correlation for the cluster comprising three eastern and seven north eastern states while the cluster for southern and northern states showed a significant negative correlation. These findings support those of Demirguc-Kunt and Huizinga on the importance of operating environment for bank efficiency. The paper observed that no major improvement in performing efficiency of domestic banks is possible without prior improvement in the operating environment in difficult regions of the country.

Barr (2000) studied the productive efficiency of the US commercial banks for a 15 year period from 1984-1998 using an input-oriented DEA model. The model was a multiple input-output model and the output variables were earning assets, interest income, and noninterest income and the five input variables were expenditure incurred on salary, premises and fixed

assets, other noninterest expenses, interest expenses, and purchased funds (large dollar deposits). The paper undertook a quartile analysis of efficiency and examined using a t test whether the efficiency scores of best performing banks significantly differed from the worst banks and found that the efficiency scores across quartiles differed significantly. The paper also studied efficiency of banks with respect to size and found that smaller banks were more efficient than larger banks. Further, banks rated as strong on the CAMEL indicators were found to be more efficient than those rated as weak on the CAMEL indicators. The paper concluded that efficient banks had lower expenditure on salary, lower fixed assets levels, lower interest and Non-interest expenses and lesser purchased funds. The paper did not find a consistent relationship between efficiency and interest income. Also, efficiency was positively related to the return on average assets.

Rajaraman and Vashishtha (2002) studied the non-performing loans of 27 public sector banks in India using a fixed effects panel regression framework for a five year period ending 1999-2000. The objective was to examine the variations in non-performing loans among the public sector banks which are a homogeneous group on the criterion of ownership. Two models were estimated with the gross non-performing loans as a percent of gross advances as the dependent variable, one, capital adequacy as an indicator for solvency and the second with operation profits as a percentage of working capital which would reflect operating efficiency as explanatory variables. The paper finds that banks with higher than average NPA's can be grouped into those which have poor operating efficiencies and those which have high NPAs which cannot be explained by operating efficiency and hence with an unexplained intercept shift. The paper observed that Indian Bank and United Bank of India fall under the second category and that recapitalization would not solve the problems and were a case for incentivizing closure whereas closure was not required for UCO Bank.

Kumbhakar and Sarkar (2003) employed a stochastic cost frontier model to analyse the efficiency of public and private sector banks for the period 1986-2000. The paper attested to the prevalence of cost inefficiency among Indian banks and that inefficiencies have declined over time. Further cost efficiency among private banks was higher than the public sector banks.It also found that the decline in inefficiency was slower in the post deregulation period as compared to the pre-deregulation period. Analysis at the individual bank level showed substantial intra-group volatility in efficiency changes among private banks as compared to public banks between the pre and post deregulation period.

Sathye (2003) used data envelopment analysis to measure the productive efficiency of a total of 94 banks comprising of public sector, private sector and foreign banks for 1997-98 in India. The paper estimated two models with different measures of inputs and outputs to measure efficiency. The results obtained indicated that the efficiency score of Indian banks are comparable with those of international banks and that public sector banks were more efficient than private sector banks.

Shanmugam and Das (2004) analysed the efficiency of banks in India for 1992–1999 using stochastic frontier analysis. The data set was an unbalanced panel of 94 banks belonging to four different ownership groups - State Bank group, nationalized banks, private banks and foreign banks. The paper considered four outputs, *viz.,* interest margin, non-interest income, investment and credit and the results indicated that deposits were an important determinant of output and that the observed outputs are less than their potential levels. The paper also found that the technical efficiency of raising interest margin varied widely across bank groups and that reform measures introduced since 1992 had not helped raise interest margins in banks. The paper found efficiency improvement as regards non-interest income, investments and

credits for all bank groups and particularly in the case of private banks along with wide variations among the sample banks.

Ram Mohan and Ray (2004) analysed the revenue and cost efficiency of public, private and foreign banks in India for the year 1999-2000 using data envelopment analysis. The paper found that the variability in revenue efficiency measures (interest spreads and interest spread net of provisions as a ratio of total assets) was higher than the variability in cost efficiency (ratio of intermediation cost to total assets). The output variables considered were loans, investments, and other income and deposits and operating costs were treated as inputs. The paper, further, decomposed revenue efficiency into allocative efficiency and technical efficiency. The paper concluded that PSBs were more efficient than private banks and were at par in efficiency with foreign banks. Further, PSBs outperform private banks in technical efficiency rather than allocative efficiency. Further, to determine the robustness of their findings, the paper compared results of efficiency by removing the State Bank of India and found no major change in the results.

Das et al. (2005) analysed the efficiency of Indian banks using data envelopment analysis for the time period 1997-2003 and observed that not much differentiation existed between input oriented or output oriented technical efficiency and cost efficiency. Indian banks, however, were largely different in terms of revenue and profit efficiency. The paper found that bank size, ownership and listing on the stock exchange had a positive impact on profit and revenue efficiency. The paper also observed that the median efficiency scores of Indian banks and more so of bigger banks had improved during the post reform period.

Sensarma (2005) employed stochastic frontier analysis and estimated bank specific cost and profit efficiency of all scheduled commercial banks in India for 1986-2003. The paper noted

an increase in cost efficiency and a decline in profit efficiency of the banking industry over this period. The paper also found domestic banks to be more efficient than foreign banks.

Das and Ghosh (2006) used data envelopment analysis to study the performance of Indian commercial banks in the post reform period (1992-2002). The paper examined three different approaches – intermediation approach, value added approach and operating approach to determine if efficiency scores varied with changes in inputs and outputs. The paper indicated medium sized public sector banks to operate at higher levels of technical efficiency and pointed that more efficient banks had on an average lower non-performing assets.

Galagedera and Edirisuriya (2005) analysed the technical efficiency of 17 PSBs and 23 private banks using data envelopment analysis and productivity growth using the Malmquist Index from 1995 to 2002. Efficiency was examined using the intermediation approach with two inputs (total deposits and total operating expenses) and for two outputs (loans and other earning assets). Under the CRS – DEA model, the average efficiency of all banks under the CRS-DEA model showed a mixed trend, an increase from 0.84 in 1995 to 0.95 in 1997 and followed by a decline until 1999 (to 0.927). A slight improvement in average efficiency was seen till 2002 (0.94.3). Analysis of technical efficiency for each bank group separately showed both bank groups had similar efficiency scores of 0.924 for this period whereas the managerial efficiency of PSBs (0.98) was higher than that of private banks (0.95). The analysis of productivity change for all banks indicated that there has been no significant productivity growth during the sample period. In terms of bank groups, the paper observed little difference in the performance of public sector banks and private banks which can be attributed to the no TPF growth in private banks and a modest growth in public sector banks.

Sensarma (2006) employed a stochastic frontier model to estimate the cost efficiency of Indian banks using the value added approach to model bank behaviour. The paper compared

the performance of foreign and the new private sector banks with public sector banks for two types of models, Model 1 - without bank group dummies (which provided a common frontier for the entire banking sector relative to which the inefficiencies are estimated) and Model 2 - with the bank group dummies (which created a frontier specific to each bank group). The output vector consisted of value of fixed deposits, saving deposits, current deposits, investments, loans and advances and the number of branches (as a proxy for quality of services or size of bank transactions) while the dependent variable was the total operating cost. The coefficients for fixed deposits as well as branches was positive as was the cost elasticity of output. The paper, further, carried out the generalized likelihood ratio test to test for bank level inefficiency effects and observed that there were significant inefficiencies for both models. The analysis of cost efficiency concluded that new private sector banks performed better as compared to the public sector banks and foreign banks. The paper estimated the total factor productivity for all bank groups and the composite TFP measure showed a sustained rise in the overall performance in the banking industry for both Model 1 and Model 2 suggesting thereby that the ownership effect is Not very strong. The TFP of public sector banks increased the highest followed by new private sector banks and foreign banks.

Ray (2007) evaluated the size and scale efficiency of Indian banks for 2007-2013.The paper employed a modified version of the intermediation approach, with borrowed funds, labour and equity as inputs and credit, investments and other income as the outputs. The paper used the Most Productive Scale Size (MPSS) as a benchmark for largeness of a bank which can be applied to the input bundle of any bank with diminishing returns to scale. If a bank's input mix needed to be scaled down in order to achieve MPSS, then it was termed "too large". In suchcircumstances, it would be considered optimal to break up the firm into smaller input bundles. However if the combined output of the smaller input bundles is lower than the

combined input bundle, then the firm cannot be broken up. Such a firm would notbe scale efficient but is size efficient. The results of the paper indicated that the State Bank of India could be broken down into more than 25 smaller banks to achieve size efficiency; Canara Bank was also found to be too large and consequently could be broken into at least 10 banks; Punjab National Bank was not size inefficient for the first two years of study but was later found to be too large and hence estimated to be broken into 5-11 banks over the years. The paper, likewise, has highlighted the large size of various banks in India and found 25 percent of the Indian banks to be too large and hence suggested that banks be broken into smaller banks in order to achieve higher technical efficiency.

Sensarma (2008) studied the effects of deregulation on the banking sector using profit-based measures of performance for a panel comprising of 83 Indian banks for the period 1986 to 2005 using stochastic frontier analysis. The paper differentiated between the private, public, new private and foreign banks in order to get a clearer picture of the impact of the deregulations and increased competition on each bank group. The paper observed that profit efficiency had declined over time and de-regulation had no impact on this decline. However, there are significant ownership effects in deregulation and that post deregulation profit efficiency of public banks declined, while that of private banks increased. Further, the impact of bank size on efficiency revealed that profit efficiency of banks increased with size. The paper also measured profit productivity and observed a fall in the average profit productivity which is associated with a downward shift in the profit frontier. The decline in profit productivity was the highest for public sector banks (100 in 1986 to 24 in 2005) followed by foreign (100 to 29.1) and new private banks (100 to 89). The paper attributed the fall in profit efficiency and profit productivity could be on account of increased competition in the industry.

Mahesh and Bhide (2008) examined the impact of financial sector reforms on the efficiency of commercial banks and used stochastic frontier analysis to estimate bank specific cost, profit and advance efficiencies for the period 1985-2004. The results indicated that competition had significantly impacted all three measures of efficiency measures. While loan efficiency had not improved much, cost and profit efficiencies displayed variations for different bank groups' post- deregulation.

Zhao (2008) examined the impact of banking reforms on the performance of Indian commercial banks using a balanced panel from 1992 to 2004. The paper estimated the Malmquist index of total factor productivity change to find the impact of the reforms on the risk taking capacities of banks in the framework of the intermediation approach. Earning assets, performing loans (a proxy for quality of risk management) and fee-based income were considered as output and total operating cost as input. Given a small sample size, as a robustness check, the paper further considered two additional input specifications viz. the monetary stock of fixed assets and the number of employees while the other was interest payment, other operating costs and personnel costs. The paper investigated the risk taking behaviour of the market participants by considering another model that used total loans instead of performing loans keeping all other outputs same. The DEA model was estimated for the overall period as well as for the following two sub-periods, viz. 1992-97 and 1998-2004 and it was observed that the average technical (CRS) efficiency of foreign banks declined from 0.82 to 0.80 while that of private banks (0.71 to 0.78) and public sector banks (0.74 to 0.80) increased between the periods. Further, the pure technical (VRS) efficiency of foreign banks remained approx. the same (0.86-0.87), of private banks rose from 0.76 to 0.83 and of public banks rose from 0.85 to 0.90. Finally, scale efficiency of foreign banks declined from 0.96 to 0.91, of the new private banks rose from 0.95to 0.94 and of the public banks rose from 0.90 to 0.93. An analysis of returns to scale showed that in 10 of the 12 years

under consideration, more than 95 percent public sector banks and more than 50 percent private banks exhibited decreasing returns to scale which could be attributed to overstaffing and over-branching whereas in most years, more than 50 percent foreign banks operated at increasing returns to scale. The results of the Malmquist index indicated that the banking sector experienced an average annual total factor productivity growth of 5.1 percent over the entire sample periodwas due to technological progress (4.3 percent on average) as change in technical efficiency was relatively low.

Kumar and Gulati (2010) analysed trends in cost efficiency for public sector banks in India for the period 1992-93 to 2007-08 and also examined whether convergence was obtained in cost, technical and allocative efficiency of banks. The results pointed to the positive impact of deregulation on cost efficiency of banks. Besides, the technical efficiency of the industry showed an upward trend whereas the allocative efficiency indicated a declining trend. The paper also pinpointed that the cost inefficiency of banks in India was more on account of technical inefficiency rather than allocative inefficiency. The paper observed strong alpha and beta convergence in cost efficiency for public sector banks in India.

Bhattacharya and Pal (2011) analysed the effects of financial sector reforms on the technical efficiency of Indian commercial banks from 1989-2009. The results highlighted that banks were operating at an average efficiency of 64 percent during the sample period and an efficiency decline was observed in both public and private sector banks for large part of the post reform period. Further, public sector banks displayed higher efficiency levels as compared to private sector and foreign banks. The paper also found a negative impact of capital adequacy ratios and no significant impact of the number of bank branches on efficiency.

Ray (2014) studied the overall cost efficiency of the network of a single large public sector bank within Calcutta, India using data of 193 branches in 2012. The objective was to find the optimal number of branches in an area that could provide maximum service at minimum cost. Credit, deposits and other non-interest income were treated as outputs while labour and capital were used as inputs. The paper found a wide variation in the credit-deposit ratio between branches i.e. some branches had deposits of Rs. 2000 per Rs. 100 credit while some branches had deposits of Rs. 100 per Rs. 700 credit. The paper divided branches into 4 groups to ensure homogeneity based on credit-deposit ratios as group 1 where the ratio was below 13.75 percent; group 2 (between 13.75 and 18.5 percent); group 3 (between 18.5 and 25 percent) and group 4 had a ratio greater than above 25 percent. There was no major variation in the average cost efficiency for groups 1 to 3 (around 0.70) while the cost efficiency of group 4 was found to be low (0.554). Further the paper also measured the difference between the actual cost and the potential minimum cost and found that the costs of group 1 banks can be reduced by 13 percent while that of group 4 banks can be more than 50percent, if cost efficiency was to be achieved. Further, if all bank branches were to be cost efficient than the overall cost efficiency would reduce by 35 percent. Another important finding of the paper was that the optimal number of branches across groups 1, 2 and 4 be smaller than the actual number of existing branches indicating significant over branching. The number of branches in group 3 is near to the optimal number of branches. The paper also decomposed the overall efficiency into cost efficiency and branching efficiency and pointed out that saving could come from restructuring of the network primarily through consolidation of branches.

Tabak and Tecles (2014) compared the economic efficiency of Indian banks for the period 1998-2012 using both the frontier methods – Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). The analysis of efficiency revealed lower average

efficiency scores and higher volatility in the DEA model as compared to the SFA model and notes that this could be due to the fact that DEA model does not separate inefficiency from the random error. Further, no increasing trend of economic efficiency of banks in the period of study was seen in both models and that the positive impact of financial reforms on the banking system had dissipated by 2000. Also, there was a statistically significant correlation between the efficiency scores from the DEA and SFA models.

Bhatia and Mahendru (2015) compared the efficiency of PSBs for two periods 1990-91 to 2000-01 (reform period) and 2001-02 to 2011-12 (post-reform period) using a two stage DEA model. The paper used the intermediation approach taking four inputs namely deposits, borrowings, interest expenses, and operating expenses and three outputs namely investments, advances, and total income. The paper observed an increase in the mean technical efficiency of banks from 0.977 in the reform period to 0.986 in the post-reform era for the CRS-DEA model, from 0.988to 0.994 for the VRS-DEA model and in scale efficiency from 0.989 to 0.992. The paper attributes the lower efficiency in the reform period to the lack of preparedness of PSBs to reforms, slow technological up-gradation and management inefficiencies. The analysis, further, observed that PSBs had high average efficiency accompanied by small average variation in efficiency. The paper estimated a Tobit model to identify the determinants of efficiency in stage two of the DEA model (CRS as well as VRS) using the CAMEL framework and found that the debt to equity ratio, non-performing assets to net advances, the ratio of total investments to total advances and operating expenses to total expenses, ratio of liquid assets to total assets had a negative and statistically significant impact on the technical efficiency Further, although capital adequacy ratio, ratio of government securities to total investments and return on assets had a positive impact on efficiency it was not statistically significant. The size of a bank, captured by the log of its total assets, had a negative and significant impact on bank efficiency. The paper concluded

that PSBs adapted to reforms which led to a substantial improvement in the CAMEL indicators.

VI. Methodology

The analysis of bank performance, traditionally, employed the method of financial ratio analysis. Sherman and Gold (1985) and Yeh (1986), however, pointed out that the ratio approach however, may not be the best method to assess performance as financial ratios tend to aggregate several aspects of performance and do not necessarily reflect long term performance as also the financial ratios approach can be misleading as it depends on an arbitrary benchmark ratio. Sherman and Gold (1985) were the first to apply frontier methods to banking efficiency analysis. Recent studies on performance/efficiency measurement have applied frontier methods and the extensively used methods are the non-parametric Data Envelopment Analysis (DEA) and the parametric Stochastic Frontier Analysis (Sathye, 2003).The parametric approach requires the specification of a functional form whereas the Non parametric DEA uses mathematical programming. Seiford and Thrall (1990) write *'that the kind of mathematical programming procedure used by DEA for efficient frontier estimation is comparatively robust'*. The mathematical formulations of the DEA models can be converted to simpler formulations which are easier to estimate using the linear programming (LP) procedure to estimate relative efficiency in decision making units (DMUs) and can be used to calculate the best practice production frontier for firms (Ali and Seiford, 1993). A main property of DEA is that it does not require any a priori assumptions about the functional form and the distribution of the error term (Coelli et.al, 2005).

Efficiency of a DMU, in this case a bank, can be defined as the ability with which it can convert inputs to outputs and is calculated as the ratio of outputs to inputs. Efficiency can also be defined as the ratio of minimum inputs that would have to be required to the actual

inputs employed to produce a given level of output. Efficiency measures always lie between 0 and 1.

Data Envelopment Analysis

The DEA method allows for the generalization of the single output/input technical efficiency measure to multiple outputs/inputs by constructing a relative efficiency measure. DEA models can be estimated either under constant returns to scale or variable returns to scale. The Constant Returns to Scale (CRS) efficiency is obtained by solving the Charnes, Cooper, and Rhodes (CCR) model. The CRS model estimates gross efficiency of a DMU which is a composite of technical and scale efficiency. The efficiency of transforming inputs into output denotes technical efficiency while scale efficiency estimates that most productive scale size where the scale at which efficiency is 100 percent. The Banker, Charnes and Cooper (BCC) model measures the Variable Returns to Scale (VRS) efficiency. This model takes into consideration the variation in efficiency with respect to the scale of operation and therefore measures pure technical efficiency. The use of the VRS DEA model allows technical efficiency to be decomposed into pure technical efficiency and scale efficiency. The scale efficiency of a DMU can be computed as the ratio of its CRS to VRS efficiency. The CRS efficiency of a firm is always less than or equal to its VRS efficiency. Thus, other things being equal, the VRS model gives the highest efficiency score while the CRS model gives the lowest score. The focus in DEA models on variable returns is mainly to ascertain whether a DMU exhibits decreasing, increasing or constant returns to scale rather than to quantify the degree of returns to scale (Fukuyama, 2000).

DEA models can be expressed either as output-oriented (maximization) or input-oriented (minimisation) models. The output-oriented DEA model seeks to maximize output production for a given level of resources whereas the input-oriented envelopment model aims

to produce the observed output with minimum inputs. Thus, the dual of the output maximizing DEA model is the input oriented envelopment model and vice-versa (Ramanathan, 2003). In other words, an input oriented DEA model is one where the output of the firm is treated as a given or as an assigned task and the efficiency of the firm is determined by the maximal reduction (equi-proportionate) in all inputs without compromising the feasibility of the target output.

Consider an industry producing 'm' outputs from 'n' inputs. An input-output bundle (x, y) is considered feasible when the output bundle 'y' can be produced from the input bundle 'x'. The technology faced by the firms in the industry can be described by the production possibility set.

$$T = \{(x, y): y \text{ can be produced from } x\} \quad (1)$$

In the single output case, the production function will take the following form:

$$f(x) = \max y: (x, y) \in T \quad (2)$$

In the multiple output case, frontier of the production possibility set is the production correspondence F (x, y) = 1.

Suppose that (x^j, y^j) is a feasible input-output bundle observed for firm j (j = 1, 2,…, N). The production possibility set satisfying the assumptions of convexity and free disposability for such bundles is

$$\begin{aligned} &S = \{(x, y) : x \geq \sum_{j=1}^{N} \lambda_j x^j \\ &y \leq \sum_{j=1}^{N} \lambda_j y^j \\ &\sum_{j=1}^{N} \lambda_j = 1 \\ &\lambda_j \geq 0 (j = 1,2...N) \end{aligned} \quad (3)$$

The set S is also known as the free disposal convex hull of the observed input-output bundles. Different measures of efficiency of a firm can be obtained from using set S as the reference technology such as output oriented technical efficiency, input oriented technical efficiency, cost efficiency, and profit efficiency.

An input oriented CRS –DEA model of efficiency for a firm (here a bank) can be expressed as (used in the study):

$$Min\ x_j \qquad (4)$$
$$subject\ to$$
$$Y\lambda_j \geq y_j$$
$$X\lambda_j \leq x_j$$
$$\lambda_j \geq 0$$

where, x_j is the vector of inputs and $y_j$is the output of firm (here a bank) j. Solving the above equation helps obtain the minimum inputs and a comparison of minimum to actual inputs which would provide an estimate of input efficiency.

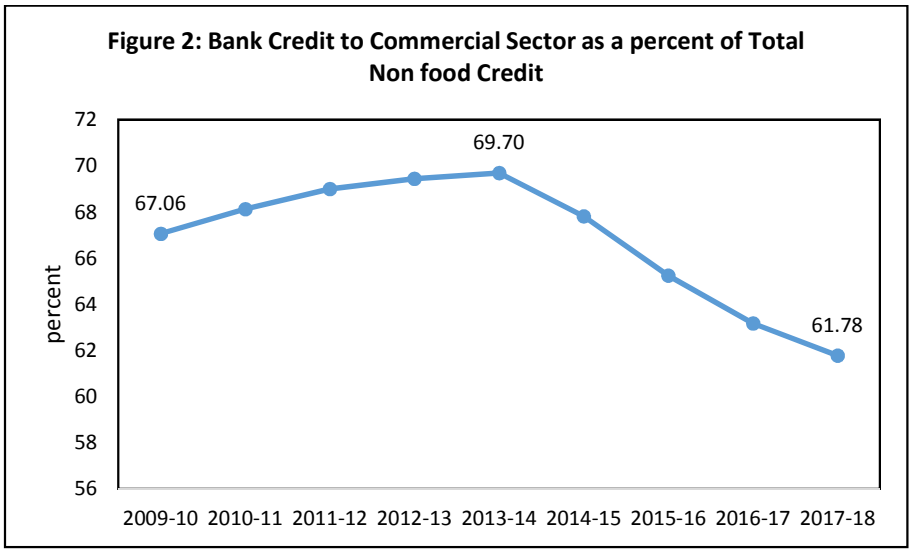
The measure of technical inefficiency obtained from the input oriented DEA models corresponds to Farell's input based measure of technical inefficiency. The estimates of efficiency obtained from the input oriented and output oriented measures would be similar under the CRS model but are unequal for the VRS model as the CRS DEA model is only appropriate when all firms are operating at optimal scale. However, due to imperfect competition or constraints on finance, firms may not operate at the optimal scale and hence an input-oriented variable return to scale may be used to calculate technical efficiency. Further, the choice of orientation (input or output) is dependent on which quantities (inputs or outputs) the firm/DMU has most control over and are the unit's primary decision variables (Coelli, et.al, 2005). Coelli and Perelman (1999) point out that the choice of orientation has only a minor influence on the scores obtained. Coelli et.al (2005, p.181) also note that *'the output and input oriented DEA models will estimate exactly the same frontier and therefore*

by definition, identify the same set of firms as being efficient. It is only the inefficiency measures associated with the inefficient firms that may differ between the two methods'.

VII. *Non-Performing Assets: Some Stylized Facts*

The asset quality of banks, in general, and of PSBs in particular has seen a decline in recent years. This decline can be attributed partly to what is now known as the *Twin Balance Sheet Challenge,* where the difficult financial position of some large corporate houses had an impact on the balance sheets of PSBs (Economic Survey, 2016). Another related reason is the aggressive lending strategy adopted by banks in the period 2008-12. This period saw a substantial increase in bank credit to the commercial sector. Figure 2 highlights this increase and the subsequent decline. The percentage of bank credit to the commercial as a percentage of total non-food credit increased from 67.06 percent in 2009-10 to 69.70 percent in 2013-14 and has shown a decline since then and stands at 61.78 percent as of end March 2018. Other reasons for rising NPAs could be the poor monitoring of loan accounts and/or the exposure of a bank to risky/sensitive sector lending.

The aggressive lending strategy adopted by banks coupled with the global financial crises (GFC) and the consequent twin balance sheet problem provided the rationale for the analysis to be divided into three sub-periods: 2008-10 when bank credit was high and NPAs were low; 2011-13 – the start of the second episode of the NPA crises after 2010; and the period 2014-17 when the asset quality review was implemented.

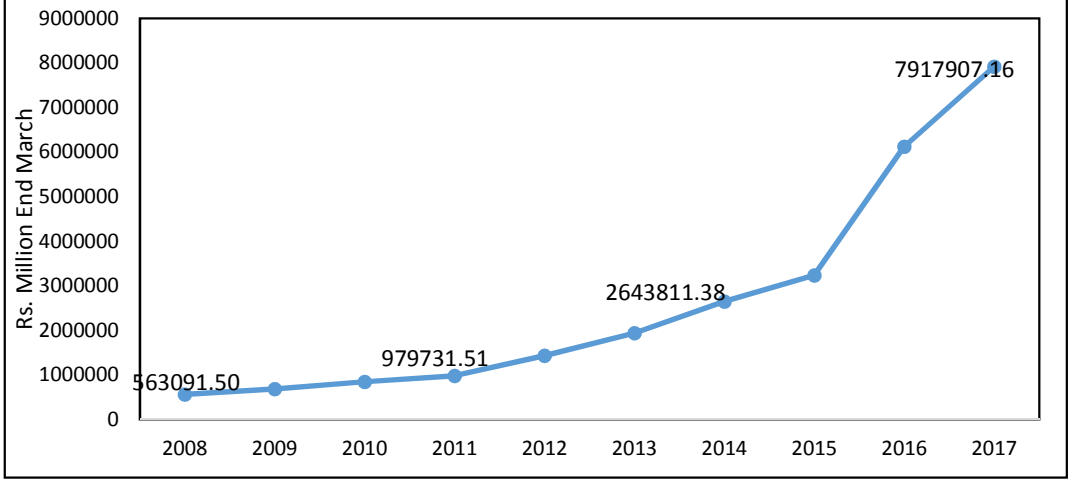


The NPA crises facing the banking sector in India can be inferred by looking at the magnitude and its increase over the period 2008-17.The total size of the banking sector GNPAs as of end March 2017 was Rs. 7.91 million (an increase of 14.10 times) from Rs.0.56 million as of end March 2008. A decomposition of the increase in GNPAs of SCBs indicates that GNPAs increased by 1.50 times during 2008-10, 3.30 times during 2011-15 and 2.40 times during 2015-17. Figure 3 plots the GNPAs of Scheduled Commercial Banks (SCBs) for the period since 2008 (after the GFC) and it can be observed that the increase has been higher after 2010 while a significant increase is seen after 2015. This inflection observed in 2015 may be attributed to the Asset Quality Review that banks were asked to undertake by the Reserve Bank of India. Further, as of end March 2017, GNPAs of the PSBs constituted nearly 86 percent of all GNPAs (Table 1).

Table 1: Gross Non-Performing Assets: Bank Groups (Rs. Million)

Bank Group	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Nationalised Banks	249743	265431	363948	442711	696245	1022272	1484572	2049595	4179878	5069213
State Bank Group	154780	184139	235325	303928	482144	627785	798165	735085	1219686	1778106
Public Sector Banks	404523	449570	599273	746639	1178389	1650057	2282737	2784679	5399564	6847320
Private Banks	129974	169266	176400	182406	187678	210705	245424	341062	561857	932092
Foreign Banks	28594	64445	71336	50687	62966	79771	115650	107610	158052	136291
ALL SCBs	563092	683282	847008	979732	1429033	1940533	2643811	3233352	6119473	7917907

Figure 3: GNPAs: Scheduled Commercial Banks



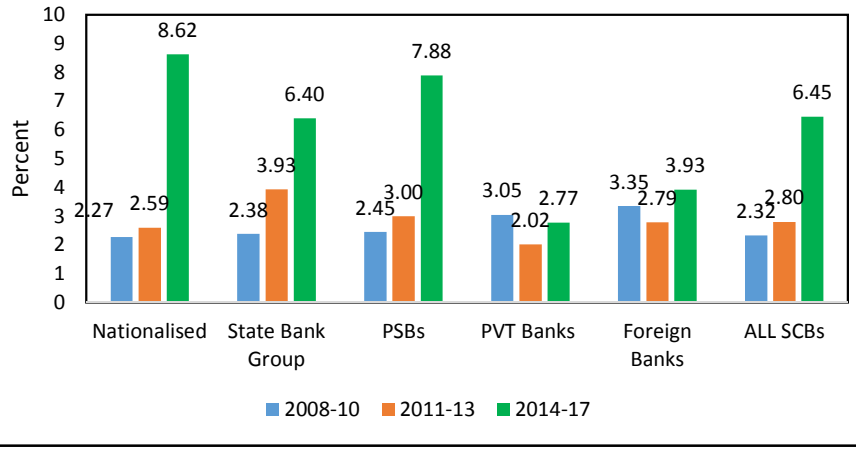
Since GNPAs represent the non-performing assets of a bank, it would be of interest to examine the proportion of bank loans that are non-performing as a ratio of the gross loans/advances. Table 2 and Figure 2 present a bank group wise profile of GNPAs as a percentage of gross advances.

Table 2: GNPAs as a percent of Gross Advances

	2008-10	2011-13	2014-17
Nationalised Banks	2.27	2.59	8.62
State Bank Group	2.38	3.93	6.40
Public Sector Banks	2.45	3.00	7.88
Private Banks	3.05	2.02	2.77
Foreign Banks	3.35	2.79	3.93
ALL SCBs	2.32	2.80	6.45

It can be observed that GNPAs as a percentage of gross advances of SCBs has increased by 2.78 times over the period 2008-10 to 2014-17. The increase has been much higher for PSBs (3.22 times) as where a decline is observed for the privates sector banks from 3.05 to 2.77 percent over the same period. It is also of interest to note that during 2008-10 private banks and foreign banks had a higher percentage of GNPAs compared to the PSBs. The GNPAs as a percentage of gross loans of PSBs have shown an increase whereas that of private sector and foreign banks showed a decline in 2011-13 followed by an increase during 2014-17. Within the PSBs, the increase was higher for nationalised banks (3.80 times) as compared to the State Bank group (2.68 times) for the period 2008-10 to 2014-17.

Figure 4: GNPA as a percent of Gross Advances: Bank Groups



A deeper analysis of GNPAs for the years 2014-17 (Table 3) for the bank groups reveals that GNPAs as a percent of gross advances were much higher in 2016 and 2017 and can be attributed to the Asset Quality Review (AQR) implemented by the Reserve Bank of India during August- November 2015-16.

Table 3: GNPAs as a percent of Gross Advances: 2014 to 2017

Year	SCBs	PSBs	Private Banks
Mar 2014	3.93	4.47	1.83
Mar 2015	4.38	5.09	2.15
Mar 2016	7.75	9.65	2.90
Mar 2017	9.76	12.32	4.10

The AQR was basically an exercise to ensure that banks recognize and identify NPAs. The AQR was conducted by the Reserve Bank of India with a focus to clean bank balance sheets. The AQR was a more stringent inspection of bank books wherein most large borrower accounts were inspected to determine if banks had classified their assets according to prudential norms. Such an exercise became necessary as the Reserve Bank of India realised that banks were resorting to ever greening of accounts and deliberately deferring bad loan classification and the consequent provisioning by asking for forbearance. The AQR severely impacted the performance of banks as several large banks reported losses and it has been reported that about 200 accounts were identified which banks were asked to consider as non-performing. Further, banks were given two quarters October-December 2015 and January-March 2016 to finish asset classification. As a consequence, banks reported losses in both quarters and some banks for the full financial year. Saha (2016) writes that almost all public sector banks were affected and that large banks such as Bank of Baroda (Rs.3230crore), Punjab National Bank (Rs.5367 crore), IDBI Bank (Rs.1376 crore) reported huge losses. Further, Saha (2016) also pointed out that among the new private banks ICICI Bank and Axis Bank were severely affected while the impact on HDFC Bank was small as it had no large exposure to infrastructure projects. Besides, a report in The Times of India, July 31, 2018 pointed that of the 200 companies identified for defaulting on loan payments, most were from the power sector.

A glimpse into the sectoral composition (priority and non-priority sector) of GNPAs for PSBs and private banks shows that PSBs had a substantially higher level of priority sector GNPAs as compared to the private banks in 2013. Since 2013 there has, however, been a steady decline in priority sector GNPAs for both public and private sector banks accompanied by an increasing profile of non priority sector GNPAs (Table 4).

Table 4: Sectoral GNPAs: Priority &Non Priority Sector

Year	PSBs Priority	PSBs Non Priority	Private Banks Priority	Private Banks Non Priority
2013	42.90	57.10	26.00	74.00
2014	36.54	63.46	26.62	73.38
2015	35.66	64.34	22.84	77.16
2016	25.50	74.50	20.96	79.04
2017	24.07	75.93	18.00	82.00

Table 5: Priority Sector GNPAs - Details

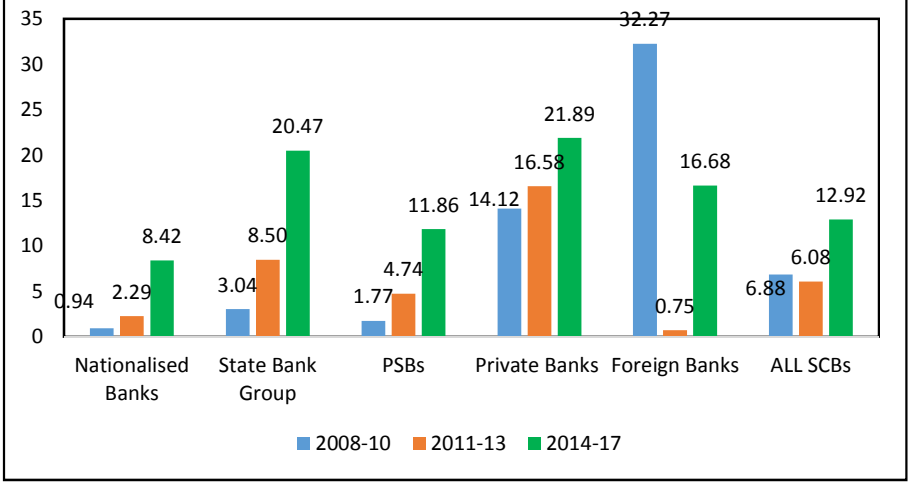
Sector	March 13	March 14	March 16	March 17
Agriculture	4.7	4.4	8.6	8.3
Medium & Small Enterprises	5.1	5.2	12.5	11.3
Other Priority Sector	3.0	3.0	3.7	3.7
As a percent of Total GNPAs Source: RBI, Annual Report (various issues).				

A further analysis of priority sector GNPAs since March 2013 (Table 5) showed that within the priority sector GNPAs of the Medium and Small Enterprises (MSME) sector has been high and rest of the priority sector. Besides, the GNPAs of the agricultural sector increased by 1.76 times while that of the MSME sector increased by 2.21 times.

Non-Performing Assets: Write Offs and Recovery

Figure 5 presents the write offs of loans by banks at the level of bank groups and it can be observed the write offs as a percent of GNPAs have been increasing and have been higher for private banks compared to public sector banks and within the public sector banks write offs have been higher for the State Bank group than for nationalised banks.

Figure 5: Write offs as a percent of GNPAs: Bank Group Wise



The recovery of NPAs has usually been undertaken by the following three channels, namely, Lok Adalats, Debt Recovery Tribunals and the SARFAESI Act (Table 6). Table 6 highlights the decline in recovery of NPAs from 47.5 percent in 2012-13 to 30.1 percent in 2015-16 and a marginal increase to 35 percent in 2016-17. Although, the extent of recovery is quite low, the SARFAESI Act channel has shown higher recovery as compared to the DRT and Lok Adalats.

Table 6: Recovery of NPAs

Year	LokAdalats	DRTs	SARFAESI Act
2012-13			
Amount involved	66	310	681
Amount recovered	4 (6.1)	44 (14.2)	185 (27.2)
2013-14			
Amount involved	232	553	953
Amount recovered	14 (6.0)	53 (0.6)	253 (26.6)
2014-15			
Amount involved	310	604	1568
Amount recovered	10 (3.2)	42 (7.0)	256 (16.3)
2015-16			
Amount involved	720	693	801
Amount recovered	32 (4.4)	64 (9.2)	132 (16.5)
2016-17			
Amount involved	1058	671	1131
Amount recovered	38 (4.0)	164 (24.0)	76 (7.0)
Note: Amount in INR Billion. Figures in parentheses are percentage of recovery. Source: Reserve Bank of India, Annual Reports (various issues).			

VIII. GNPAs: Bank Level Analysis

The analysis of GNPA at the individual bank level has focused 27 banks and includes all the public sector banks (PSBs) and the six major new private sector banks viz. Axis Bank, HDFC Bank, ICICI Bank, IndusInd Bank, Kotak Mahindra Bank and Yes Bank. Figures 6 and 7 graph the GNPAs as a percent of gross advances for individual banks for 2011-13 and 2014-17 respectively and it is obvious that GNPAs as a ratio of gross advances were much higher in 2014-17 than in 2011-13. Appendix I contains the year wise and bank wise details of GNPAs as a percent of gross advances.

Figure 6: GNPAs as a percent of Gross Advances: 2011-13

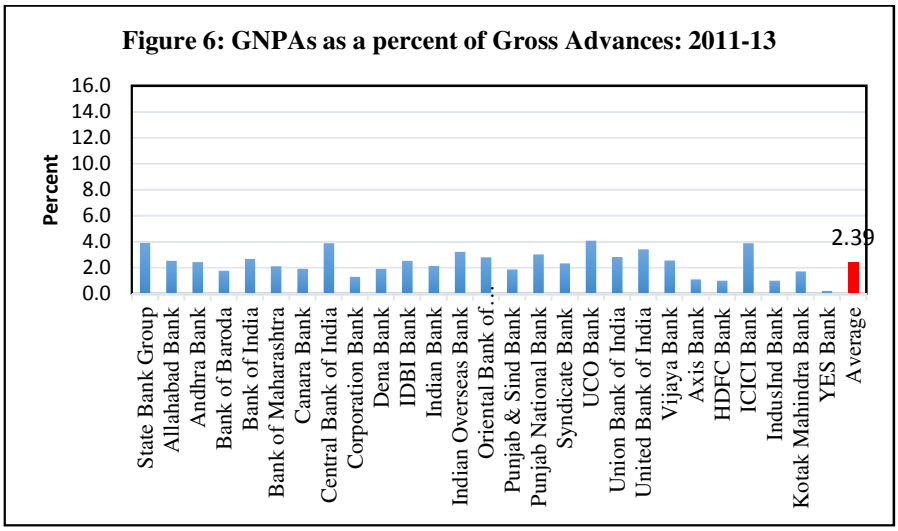
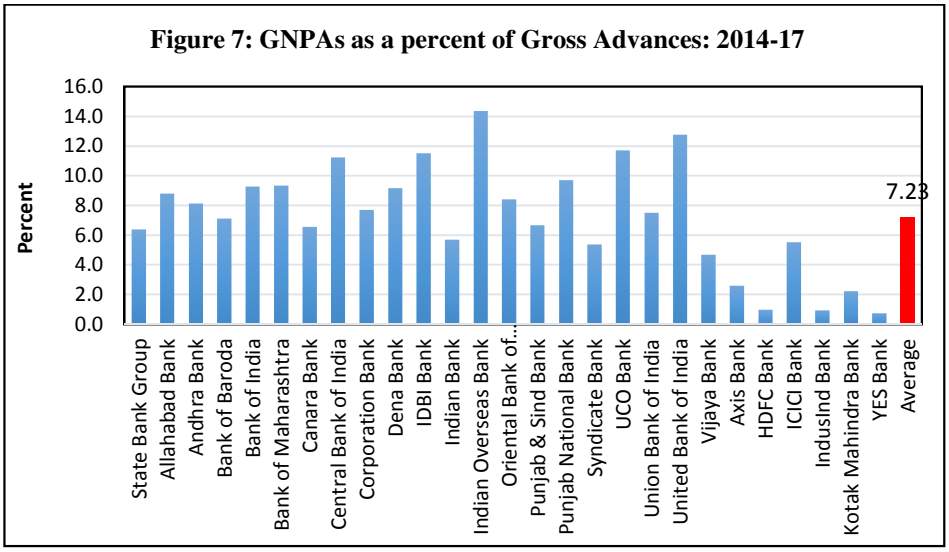


Figure 7: GNPAs as a percent of Gross Advances: 2014-17



A quartile analysis of the ratio of GNPA to gross advances at the individual bank level was undertaken which helped identify the best and worst performing banks during 2011-13 and 2014-17 and the results are in Table 7.

The results of Table 7 show that the range (difference between minimum and maximum GNPAs) for GNPAs as a percent of Gross Advances of banks during 2011-13 was 3.87 which increased by 3.52 times to 13.62 during 2014-17. Banks in the first quartile were the best performers as they had the smallest ratio while banks in the fourth quartile were the worst performers as they had the highest percent of GNPA to gross advances. It can be seen

that most of the new private sector banks considered in the study excluding ICICI Bank are among the best performing banks on the asset quality indicator while ICICI Bank featured among the worst performers in 2011-13. The country's largest bank the State Bank group was also among the worst performers during 2011-13. Interestingly, most of the banks with the highest percentage of GNPA to gross loans are PSBs and several are common to both periods under study viz. Punjab National Bank, Indian Overseas Bank, United Bank of India and UCO Bank.

A quartile rank difference was computed to understand if there has been any movement in bank performance (measured by GNPAs as a percent of gross loans) measured as a movement from one quartile to another during the two periods under consideration, namely, 2011-13 and 2014-17. Table 8 displays the quartile ranks of the various PSBs and the six major new private sector banks in 2011-13 and 2014-17 as also the change in ranks over the period. A negative rank difference would imply that the bank has moved to a lower quartile rank while a positive rank difference would imply that the bank has moved up to a higher quartile. A zero rank would indicate no change in the quartile position and a bank has continued to be in the same quartile in both periods 2001-13 and 2014-17.

Table 7: GNPA as a percent of Gross Advances: Banks with the Highest and Lowest Ratios

	2011-13	**2014-17**
Minimum	0.22 (Yes Bank)	0.75 (Yes Bank)
Maximum	4.09 (UCO Bank)	14.37 (Indian Overseas Bank)
Best Performers (First Quartile)	Yes Bank , IndusInd Bank, HDFC Bank, Axis Bank, Corporation Bank, Kotak Mahindra Bank, Bank of Baroda	Yes Bank, IndusInd Bank, HDFC Bank, Axis Bank, Kotak Mahindra Bank, Vijaya Bank, Syndicate Bank
Worst Performers (Fourth Quartile)	Punjab National Bank, Indian Overseas Bank, United Bank of India, ICICI Bank, State Bank Group, UCO	Punjab National Bank, Indian Overseas Bank, United Bank of India, UCO, Central Bank of India, IDBI Bank, Bank of Maharashtra

It can be observed from Tables 7 and 8 that GNPAs as a percentage of gross loans were higher in 2014-17 compared to 2011-13 for all banks. The quartile rank difference gives us a glimpse into individual bank performance on this important parameter on financial health of banks.Six banks – State Bank group (2 quartiles), Syndicate Bank, UCO Bank, Union Bank of India, Vijaya Bank (2 quartiles) and ICICI Bank (2 quartiles) witnessed an improvement in terms of quartile ranks. Likewise, six banks – Andhra Bank, Bank of Baroda, Bank of Maharashtra (2 quartiles), Corporation Bank (2 quartiles), Dena Bank, and IDBI Bank saw worsened quartile performance between 2011-13 and 2014-17.The remaining 15 of the 27 banks (Allahabad Bank, Bank of India, Canara Bank, Central Bank of India, Indian Bank, Indian Overseas Bank, Oriental Bank of Commerce, Punjab & Sind Bank, Punjab National Bank, United Bank of India and Axis Bank have continued to remain in the same quartile. Further as can be observed from Tables 7 and 8, the average level of GNPAs as well as GNPAs of individual banks as a percentage of gross advances has increased in 2014-17 as compared to 2011-13.

The quartile rank movements or the inter quartile shifts of banks from their positions in 2011-13 to their new quartile positions in 2014-16 indicates that five banks (State Bank group, Syndicate Bank, Union Bank of India, Vijaya Bank, ICICI Bank)have shown an improvement; six banks (Andhra Bank, Bank of Baroda, Bank of Maharashtra, Corporation Bank, Dena Bank, IDBI Bank) have shown a worsening and the remaining sixteen banks have continued to be static and in the same quartile indicating no shift in quartile ranks (Table 8).

Table 8: Quartile Positions of Banks: 2011-13 and 2014-17

Bank Name	GNPA/ Gross Advances	Quartile Rank 2011-13	GNPA/ Gross Advances	Quartile Rank 2014-17	Rank Difference	Times Increase
State Bank Group	3.93	4	6.40	2	2	1.63
Allahabad Bank	2.53	3	8.81	3	0	3.49
Andhra Bank	2.44	2	8.14	3	-1	3.33
Bank of Baroda	1.79	1	7.12	2	-1	3.98
Bank of India	2.69	3	9.27	3	0	3.44
Bank of Maharashtra	2.11	2	9.34	4	-2	4.43
Canara Bank	1.93	2	6.55	2	0	3.39
Central Bank of India	3.90	4	11.24	4	0	2.88
Corporation Bank	1.30	1	7.72	3	-2	5.93
Dena Bank	1.92	2	9.18	3	-1	4.77
IDBI	2.53	3	11.52	4	-1	4.56
Indian Bank	2.14	2	5.70	2	0	2.67
Indian Overseas Bank	3.22	4	14.37	4	0	4.46
Oriental Bank of Commerce	2.81	3	8.42	3	0	2.99
Punjab & Sind Bank	1.88	2	6.67	2	0	3.55
Punjab National Bank	3.05	4	9.72	4	0	3.19
Syndicate Bank	2.34	2	5.38	1	1	2.30
UCO Bank	4.09	4	11.71	4	0	2.86
Union Bank of India	2.83	3	7.52	2	1	2.66
United Bank of India	3.43	4	12.78	4	0	3.73
Vijaya Bank	2.58	3	4.69	1	2	1.82
Axis Bank	1.13	1	2.58	1	0	2.28
HDFC Bank	1.02	1	0.98	1	0	0.97
ICICI Bank	3.89	4	5.53	2	2	1.42
IndusInd Bank	1.01	1	0.94	1	0	0.93
Kotak Mahindra Bank	1.73	1	2.22	1	0	1.28
YES Bank	0.22	1	0.75	1	0	3.45

IX. Data Envelopment Analysis: Results

The DEA model estimated in this section has employed the value based approach and has used variables from a bank's balance sheet of a bank (assets & liabilities). According to this approach, banks create value by acquiring deposits from customers and giving loans. The model measures the efficiency with which banks are able to manage their performing assets (in other words, assets which earn interest) which in turn may provide insights into their ability in managing their non-performing assets. The argument being that if a bank exhibits high efficiency in managing its performing or interest earning assets then implicitly it would mean lower non-performing assets for the bank. This reasoning is that NPAs are created ex-post variable reflect the failure to judge to credit risk. Hence a single output and three inputs, input oriented CRS-DEA model was estimated to measure bank level efficiency for two time periods 2011-13 and 2014-17 to measure the efficiency of banks in managing their portfolio of performing assets. The output variable, thus, was the performing loans of a bank while the input variables were: expenditure on salary, operating expenses of a bank and expenditure incurred on fixed assets.The efficiency of performing loans was analyzed and compared for all the PSBs and the six major new private sector banks for two time periods 2011-13 and 2014-17. It can be seen that average/ mean efficiency of banks in managing their portfolio of performing assets has remained constant at 0.96 in both time periods. Further, the number of banks with the maximum efficiency score of 1 is only lower by one bank in the period 2014-17.It is worth noting that Corporation Bank, Punjab & Sind Bank and Vijaya Bank were among the most efficient banks in both the time periods. IDBI Bank had an efficiency score of 1 in 2011-13 but not in 2014-17. (Table 9 and Appendix I). The mean efficiency scores obtained compare well with the efficiency scores observed in literature and to mention a few -Das, Nag and Ray (2005), Das and Ghosh (2006), Bhatia and Mahendru (2015), Zhao (2008) for different time spans.

Table 9: Summary of Efficiency Estimates: DEA Model

	2011-13	2014-17
Mean Efficiency	0.9627	0.9605
Minimum Efficiency	0.8747	0.8854
Maximum Efficiency	1	1
No. of Banks with E=1	5	4
Banks with efficiency score 1	Corporation Bank Punjab & Sind Bank Vijaya Bank IDBI Bank YES Bank	Corporation Bank Punjab & Sind Bank Vijaya Bank, YES Bank
No. of Banks with efficiency lower than mean	15	13
Source: Author Calculations		

Likewise, the number of banks with an efficiency score lower than the mean efficiency score were marginally fewer in 2014-17 (13 banks) compared to 2011-13 (15 banks). The twelve banks which had an efficiency score lower than the mean efficiency in both time periods (2011-13 and 2014-17) are State Bank group, Allahabad Bank, Bank of Baroda, Bank of India, Bank of Maharashtra, Canara Bank, Central Bank of India, Indian Bank, Indian Overseas Bank, Punjab National Bank, Syndicate Bank and Union Bank of India.

Table 10: Range of Efficiency Scores of Banks

	2011-13		2014-17	
Efficiency Range	No. of Banks	Percentage	No. of Banks	Percentage
0.8<= E 0.9	1	3.70	1	3.70
0.9<= E <1	21	77.80	22	81.50
E ==1	5	18.50	4	14.80

A deeper analysis into the distribution of efficiency scores obtained by banks during 2011-13 and 2014-17 shows that the State Bank group was sole bank to have an efficiency score below 0.9 in both periods while there is no major difference in the number of banks with an efficiency score between 0.9 and 1 in the two periods (Table 10 and Appendix I). These

results indicates that the level of efficiency of bank performance on performing loans has seen no major difference between the two periods under consideration.

IX.1 Super Efficiency

A decomposition of the efficiency scores of the efficient DMUs has been undertaken using the super efficiency approach of Anderson and Peterson (1993). Table 11 presents the scores of efficiency and super efficiency for only the efficient DMUs (or banks that have an efficiency score of 1). An analysis of super efficiency scores showed that all banks had feasible solutions and revealed that the efficiency score of 1 actually ranged between the maximum of 1.0375 and minimum of 1 during 2011-13 and between 1.0549 and 1 during 2014-17.Interestingly, the banks which were the most efficient (an efficiency score of 1) on their performing loans were the same in 2011-13 and 2014-17 with the exception of IDBI Bank. IDBI Bank had an efficiency score of 1 in 2011-13 and 0.9876 in 2014-17 (see Appendix I).

Table 11: Decomposition of Super Efficiency Scores

	2011-13		*2014-17*	
Bank	***Efficiency Score***	***Super Efficiency Score***	***Efficiency Score***	***Super Efficiency Score***
Corporation Bank	1	1.0026	1	1.0182
IDBI Bank	1	1.0063	--	--
Punjab & Sind Bank	1	1.0375	1	1.0148
Vijaya Bank	1	1.0057	1	1.0083
YES Bank	1	1.0201	1	1.0549

IX.2 Input Slacks

Slacks in the DEA models represent the additional increase in outputs and/or a decrease in inputs needed for a unit to become efficient.Slacks, therefore, exist only for those DMUs which are identified as inefficient and represent only theleftover portions of inefficiencies;

implying that after proportional reductions in inputs or increases in outputs, a DMU cannot reach the efficiency frontier. Slacks are needed to push the DMU to the frontier (target). Input slacks refer to the overutilization of inputs to produce a given level of output. A DMU (in our case a bank) can reduce its expenditure on a given input by the amount of the slack without reducing its performance with respect to performing loans. Slacks, thus, are indicative of the potential areas of improvement and suggest an input-output mix which can improve efficiency (Ozcan, 2014; Zhu, 2014).

Table 12: Mean Input Slacks Values and the Number of Banks Using Slacks

Slacks	2011-13	2014-17
Salary Expenditure	0.01	0
Operating Expenditure	0.08	0.11
Expenditure – Fixed Assets	0.21	0.22
Number of Banks that used zero slack	7 banks	9 banks
Number of Banks that used at least one slack	20 bank	18 banks

Table 12 indicates that the mean value of the input slack was the highest on expenditure incurred on fixed assets and the least on salary expenditure in both time periods. Further, 7 banks did not use their input slacks during 2011-13 while 20 banks used at least one input slack. Of the 7 banks, 5 banks had an efficiency score of 1 and hence had no slack and the other two banks(Syndicate Bank and UCO Bank) did not utilise their input slacks (or reduce expenditure incurred on inputs) to improve efficiency. In the period 2014-17, of the 9 banks that did not use the input slack, 4 banks had an efficiency score of 1 and the remaining 5 banks (Andhra Bank, Central Bank of India, Punjab National Bank, Syndicate Bank and United Bank of India) did not utilise their input slacks to move towards efficiency.

X. Determinants of Efficiency

The factors that impact bank efficiency can be studied by looking at the correlations between the efficiency scores and each of these factors. Correlation analysis, however, would be a simplistic representation and a univariate approach to understanding the relationship between efficiency levels of banks and the factors that can determine efficiency. Another way to model the factors that can impact efficiency is by examining a multivariate Tobit model. This study has adopted both methods to understand the factors which influence efficiency. Consequently, the correlation analysis has been undertaken between efficiency scores obtained by a bank from the DEA model and the level of GNPAs, the exposure of a bank to sensitive lending (lending exposure of a bank to capital markets, real estate and commodities), financial soundness captured by the CRAR and the asset size. The results of the correlation analysis are in Table 13 whereas Table 14 contains the results of the Tobit model.

There is some sync between the results obtained from the correlation analysis and the Tobit model. The results of the correlation analysis indicate an inverse and significant relationship between the efficiency scores and the level of GNPAs. The coefficient of the GNPA variable is also negative and significant in both time periods in the Tobit analysis. This clearly indicates that higher the GNPAs lower the efficiency of a bank. A similar inverse and statistically significant correlation is observed, for both time periods, between the efficiency scores and the extent of sensitive lending undertaken by a bank. In the Tobit analysis the relationship is inverse and significant in 2014-17. This implies that higher the exposure of a bank to sensitive lending lower the efficiency. Asset size of a bank also matters is an important determinant of efficiency. Larger the asset size lower the efficiency. The relationship between efficiency scores and CRAR, a measure of financial soundness, is not

statistically significant in the correlation and Tobit analysis implying that efficiency of a bank in managing its performing loans is independent of the capital adequacy ratio. Ownership was a dummy variable which took the value of 1 for public sector banks and 0 for the six new private sector banks to understand if ownership is an important determinant of efficiency. The co-efficient of the ownership variable was not statistically significant in 2011-13 and is marginally significant in 2014-17. Das et.al (2000) observed that ownership had a positive and significant impact on profit and revenue efficiency. The management of a bank (defined as the ratio of operating expenses to total assets) is also an important determinant of efficiency.

Table 13: Spearman's Correlation for the Major Determinants of Efficiency

	2011-13	**2014-17**	
GNPAs &Efficiency	-0.71*** (-4.99)	-0.61*** (-3.89)	
Sensitive Lending & Efficiency	-0.67 (-4.56)	-0.67*** (-4.46)	
GNPAs& Sensitive Lending	0.77*** (6.01)	0.63*** (4.03)	
Asset Size &Efficiency			
Less than 1000 billion (7 banks)	0.16 (0.36)	Less than 2000 billion (9 banks)	-0.38 (-1.07)
1000 – 2000 billion (8 banks)	0.07 (0.18)	2000 – 5000 billion (11 banks)	-0.09 (-0.27)
Greater than 2000 billion (12 banks)	-0.05 (-0.15)	Above 5000 billion (7 banks)	-0.46 (-1.17)

Table 14: Results of the Tobit Model

Variable	2011-13	2014-17
CONSTANT	1.48***	1.54***
OWNERSHIP	-0.008	-0.02*
CRAR	0.00006	-0.001
LSIZE	-0.0220**	-0.03***
MANAGEMENT	-5.76***	-6.89***
LSENSITIVE	0.002	-0.02**
LGNPA	-0.013*	-0.02***
*** - 1% level of significance ** - 5% level of significance * - 10% level of significance		

XI. Asset Quality and Solvency

This section examines the relationship between asset quality, which is (measured by the GNPAs as a ratio of gross advances) and solvency of banks (measured by the CRAR). GNPAs as a ratio of gross advances reflect ex-post the inability to judge credit risk and examining its relationship with the capital adequacy ratio will indicate whether this mis-judgement has had an impact on solvency. The objective being to study whether the increase in GNPAs witnessed has had any impact of the solvency of a bank. The analysis of this section follows the framework adopted by Rajaraman et.al (2002) which indicates that there is no prior expectation that solvency would be a correlate of bank performance with respect to NPAs. The reason for this could be that banks are mandated to maintain the CRAR and that the level of GNPAs should not be high as to affect solvency of a bank.

A correlation analysis was conducted between GNPAs as a ratio of gross advances of a bank and CRAR, this would provide insights on whether asset quality has an impact on bank solvency. The issue of whether the efficiency of a bank on managing its performing assets is correlated with the CRAR of a bank was also examined using the efficiency score obtained by a bank from the DEA model estimated above. The results of the correlation analysis are in

Table 15 and indicate that there is a negative and statistically significant relationship between asset quality and solvency indicating that banks which have high GNPAs as a ratio of gross advances would have lower CRAR.

Table 15: Results of Spearman's Rank Correlation - Asset Quality and Solvency

	2011-13	2014-17
GNPAs as a ratio of gross advances & CRAR	-0.50*** (-2.90)	-0.73*** (-5.30)
CRAR& Efficiency	-0.01 (-0.56)	0.08 (0.41)

However, the correlation between CRAR and the efficiency achieved by a bank in managing its performing loans is not statistically significant implying that efficiency scores have no bearing on the CRAR.

The relationship between asset quality and solvency has also been studied using a fixed effects panel model for all the 27 banks (21 public sector banks and 6 new private sector banks).The fixed effects model assumes that something within the bank may impact the outcome (here GNPAs as a percent of gross advances) variable and which needs to be controlled. A fixed effects panel model was estimated as the focus was on capturing the variations over time of the impact of bank specific changes in GNPA levels, after controlling for an underlying uniform impact of NPAs, on bank specific solvency. Table 16 contains the results of the fixed effects panel estimation. A baseline model for the entire period 2011-17. Time effects were also considered by introducing a dummy variable (D2) in the baseline model. The dummy variable took a value of 0 in 2011-3 and a value of 1 during 2014-17.

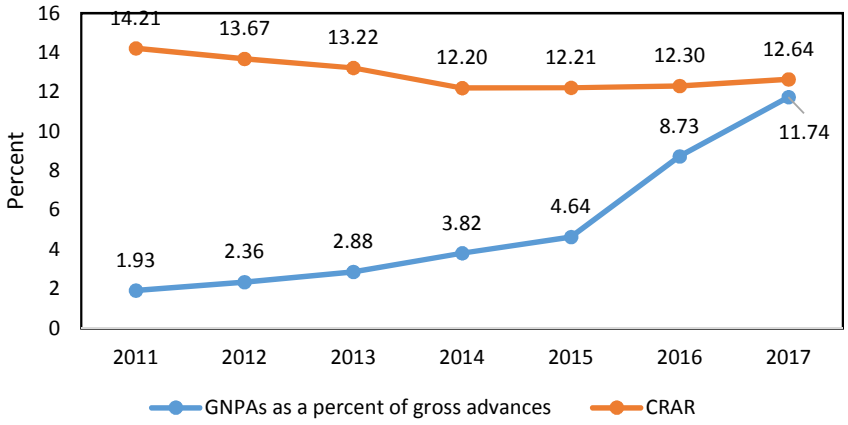
Table 16: Results of Panel Data Estimates
Dependent Variable: GNPAs as a ratio of Gross Advances

All Banks – 2011-17					
Constant	CRAR	D2	Rho	F	No. of Observations
25.61*** (7.31)	-1.58*** (-5.86)	--	0.24	34.34*** (1, 161)	189
6.87* (1.62)	-0.33 (-1.06)	4.40*** (6.54)	0.23	43.02*** (2,160)	189
All Banks – 2011-13					
5.17*** (3.73)	-0.20** (-2.01)	--	0.58	4.04** (1,53)	81
All Banks – 2014-17					
-0.35 (-0.44)	0.61 (0.94)	--	0.52	0.89 (1,80)	108
*** indicates significance at 1% of significance ** indicates significance at 5% of significance * indicates significance at 10% level of significance					

The results indicate an inverse and statistically significant between CRAR and GNPAs as a percent of gross advances in the baseline model implying that as GNPAs decline there will be an improvement in the CRAR. However, when the time effects are introduced in the baseline model, the dummy variable (D2) is statistically significant but the co-efficient of CRAR is not significant. The results of the panel model estimated for 2011-13 point to an inverse and statistically significant relationship between GNPAs as a percent of gross advances and CRAR while for the period 2014-17 the relationship is not statistically significant. A plot of the average values of the two variables for all the banks in the sample supports the results of the panel estimates.

Figure 8 plots the average value of GNPAs as a percent of gross advances and the CRAR of the 27 banks considered in the sample and evident from the graph is the inverse relationship between these GNPAs and CRAR. As GNPAs as a percent of gross advances was increasing the CRAR was declining especially in the period 2011-13. After 2014, the CRAR has stabilised around 12 percent while the GNPAs of banks have shown a marked increase.

Figure 8: GNPAs as a percent of Gross Advances and CRAR: 2011-17



XII. Prompt Corrective Action Framework

Prompt Corrective Action (PCA) refers to the action initiated by the Reserve Bank of India when the financial condition of a bank worsens and is below certain limits (trigger points) on three major financial indicators viz. the net NPA ratio, the CRAR, Return on Assets and leverage ratio. Policy guidelines for such corrective actions were initiated by the Reserve Bank of India in 2002 and later revised in 2014 and 2017. The provisions of the revised PCA framework of 2017 were effective from April 1, 2017 based on the financial health of a bank on the above specified indicators and was applicable to all banks operating in India. The breach of any risk threshold would result in the activation of the PCA Framework for a bank.

Although the PCA framework is applicable to all banks operating in the country, it is worth noting that the 11 banks under this framework are public sector banks, namely, Allahabad Bank, Bank of India, Bank of Maharashtra, Central Bank of India, Corporation Bank, Dena Bank, IDBI Bank Ltd., Indian Overseas Bank, Oriental Bank of Commerce, UCO Bank and United Bank of India under the PCA framework in 2017. This section concentrates on the performance of banks with respect to two asset quality indicators - GNPAs as a percent of Gross Advances (this indicator has been represented in terms of times increase/decrease between 2011 and 2017) and the NNPA ratio (as of end March

2017), and CRAR(as of end March 2017) for banks under the PCA framework. Table 17 presents the performance on each of these indicators. It can be observed that each of these banks has seen a more than 10 times increase in GNPAs as a percent of Gross Advances between 2011 and 2017. All the banks under this framework were at varying Risk Threshold levels, 2 banks at Risk Threshold 1, 6 banks at Risk Threshold 2 and 3 banks at Risk Threshold 3.The Net NPA ratio for 9 of the 11 banks under this framework was at Risk Threshold 2 as of end March 2017.

All banks considered in the sample, not just those under the PCA framework, had witnessed a decline in CRAR between 2011 and 2017 but the decline in CRAR for most banks under the PCA framework was greater than 2 percentage points.It is worth noting that no bank (under the PCA framework or otherwise) had a CRAR below the trigger level either in 2014 (below 9 percent and above 6 percent) or 2017 (below 10.25 percent and above 7.75 percent). Appendix III contains the details of these indicators for all banks.

Table 17: Asset Quality Indicators, CRAR and Efficiency Scores of Banks under the PCA Framework

Bank	GNPA as a percent of Gross Advances (Times Increase/Decrease)	NNPA Ratio	Percentage Change in CRAR	Efficiency Score (DEA Model) 2014-17
Allahabad Bank	11.96	9.19	-1.51	0.9523
Bank of India	11.94	7.13	-0.03	0.9505
Bank of Maharashtra	15.49	12.26	-2.17	0.9605
Central Bank of India	17.70	10.68	-0.70	0.9213
Corporation Bank	11.23	8.54	-2.79	1.0000
Dena Bank	15.51	11.03	-2.02	0.9748
IDBI Bank Ltd.	21.68	14.08	-2.94	0.9876
Indian Overseas Bank	22.23	14.79	-4.06	0.9400
Oriental Bank of Commerce	12.49	9.33	-2.59	0.9725
UCO Bank	15.65	9.29	-2.78	0.9806
United Bank of India	14.02	10.28	-1.91	0.9609
Average Efficiency Score				0.9620
Source: Author Calculations				

Given that the NPA profile of these banks is high, it would be of interest to examine if they also display lower than average efficiency in managing their performing loans? So the efficiency scores obtained from the DEA model were juxtaposed with the asset quality

indicators and a glance at Table 17 indicates that 6 of the 11 under the PCA framework in 2017 had an efficiency score lower than the mean efficiency score obtained for the 27 banks in the sample. Interestingly, Corporation Bank (Risk Threshold 1) had an efficiency score of 1 and IDBI Bank Ltd. (Risk Threshold 3) had an efficiency score of 0.9876. Of the 6 banks at Risk threshold 2, 3 banks had higher than average efficiency and three had lower than average efficiency. Hence, one can infer that there is no clear relationship between the efficiency score obtained by the bank from a model which estimates how well it manages its performing assets and the GNPA profile of a bank under the PCA framework.

IX. Conclusions

The current NPA crises facing banks in India is much larger and more widespread than the previous one and the total size of the banking sector GNPAs as of end March 2018 stood at Rs. 12.1 million. The significant increase observed after 2015 could be on account of the implementation of the Asset Quality Review which made banks recognize and report stressed assets.

The public sector banks accounted for nearly 88.17 percent of the banking sector GNPAs and GNPAs as a percentage of gross loans of PSBs have shown an increase whereas that of private sector and foreign banks showed a decline in 2011-13 followed by an increase during 2014-17. A sector wise decomposition of GNPAs shows an increase in the profile of non priority sector for both public and private sector banks since 2013. Further, write-offs as a percent of total GNPAs have been increasing and have been higher for the private banks as compared to the public sector banks. A bank level quartile analysis of GNPAs as a ratio of gross advances shows that the new private sector banks considered in the study with the exception of ICICI Bank were among the best performing banks whereas public sector banks featured in the worst performing quartile. Banks that had the highest percentage of GNPAs to

gross advances and common to both periods of analysis viz. 2011-13 and 2014-17 are Punjab National Bank, Indian Overseas Bank, United Bank of India and UCO Bank.

The mean efficiency score of a bank in managing its performing loans (obtained from an input oriented DEA model) remained constant around 0.96 (0.9627 in 2011-13 and 0.9605 2014-17) and scores compare well with efficiency scores observed in literature. The efficiency analysis also helped identify the twelve banks (all in the public sector) that had an efficiency score lower than the mean efficiency in both time periods *viz.*2011-13 and 2014-17. Also, slack was the highest on expenditure incurred on fixed assets and the least on salary expenditure. Further, efficiency of banks was impacted by the level of GNPAs, extent of sensitive lending, asset size and ownership. Besides, a significant relationship exists between asset quality and solvency but one cannot establish a clear relationship between efficiency score obtained by a bank and solvency.

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Appendix I

Bank wise GNPAs as a percent of Gross Advances: 2011 -2017

Bank	2011	2012	2013	2014	2015	2016	2017	Average 2011-13	Average 2014-17
State Bank Group	3.06	4.19	4.55	5.10	4.39	6.60	9.52	3.93	6.40
Allahabad Bank	1.76	1.85	3.97	5.85	5.58	10.10	13.72	2.53	8.81
Andhra Bank	1.39	2.16	3.78	5.44	5.46	8.75	12.91	2.44	8.14
Bank of Baroda	1.38	1.55	2.43	2.99	3.80	10.56	11.15	1.79	7.12
Bank of India	2.26	2.60	3.22	3.47	5.52	13.89	14.20	2.69	9.27
Bank of Maharashtra	2.50	2.31	1.51	3.22	6.49	9.66	18.00	2.11	9.34
Canara Bank	1.49	1.73	2.58	2.51	3.95	9.74	10.00	1.93	6.55
Central Bank of India	1.85	4.93	4.92	6.49	6.30	12.62	19.55	3.90	11.24
Corporation Bank	0.91	1.27	1.73	3.46	4.90	10.36	12.14	1.30	7.72
Dena Bank	1.88	1.69	2.21	3.37	5.57	10.40	17.39	1.92	9.18
IDBI Bank	1.77	2.52	3.29	5.04	6.09	11.52	23.45	2.53	11.52
Indian Bank	0.98	2.05	3.38	3.73	4.51	6.84	7.73	2.14	5.70
Indian Overseas Bank	2.76	2.79	4.12	5.13	8.69	18.68	24.99	3.22	14.37
Oriental Bank of Commerce	2.00	3.20	3.24	4.04	5.28	9.87	14.49	2.81	8.42
Punjab & Sind Bank	1.00	1.65	2.99	4.46	4.83	6.62	10.80	1.88	6.67
Punjab National Bank	1.81	2.97	4.36	5.41	6.75	13.54	13.20	3.05	9.72
Syndicate Bank	2.43	2.57	2.02	2.65	3.18	6.87	8.82	2.34	5.38
UCO Bank	3.18	3.54	5.56	4.43	6.97	16.61	18.83	4.09	11.71
Union Bank of India	2.40	3.06	3.03	4.17	5.10	9.04	11.77	2.83	7.52
United Bank of India	2.53	3.45	4.30	10.82	9.82	13.92	16.56	3.43	12.78
Vijaya Bank	2.58	2.97	2.20	2.44	2.82	6.77	6.75	2.58	4.69
Axis Bank	1.12	1.06	1.22	1.37	1.46	1.80	5.70	1.13	2.58
HDFC Bank	1.06	1.02	0.97	0.99	0.94	0.95	1.06	1.02	0.98
ICICI Bank	4.64	3.73	3.31	3.10	3.90	6.02	9.08	3.89	5.53
IndusInd Bank	1.02	0.99	1.03	1.13	0.82	0.88	0.93	1.01	0.94
Kotak Mahindra Bank	2.06	1.57	1.56	2.00	1.87	2.39	2.63	1.73	2.22
YES Bank	0.23	0.22	0.20	0.31	0.41	0.76	1.53	0.22	0.75
Average	1.93	2.36	2.88	3.82	4.64	8.73	11.74	2.39	7.23

Appendix II

Efficiency Scores of Individual Banks

Bank Name	2011-13	2014-17	Bank Name	2011-13	2014-17
State Bank Group	0.8747	0.8854	Punjab & Sind Bank	1	1
Allahabad Bank	0.9512	0.9523	Punjab National Bank	0.9217	0.9328
Andhra Bank	0.9894	0.9727	Syndicate Bank	0.9587	0.97
Bank of Baroda	0.9465	0.9496	UCO Bank	0.9931	0.9806
Bank of India	0.9505	0.9505	Union Bank Of India	0.9464	0.9528
Bank of Maharashtra	0.9559	0.9605	United Bank Of India	0.9838	0.9609
Canara Bank	0.9401	0.9434	Vijaya Bank	1	1
Central Bank of India	0.9327	0.9213	Axis Bank	0.9508	0.9653
Corporation Bank	1	1	HDFC Bank	0.9147	0.9445
Dena Bank	0.9989	0.9748	ICICI Bank	0.9264	0.9439
IDBI Bank Ltd.	1	0.9876	IndusInd Bank	0.9827	0.984
Indian Bank	0.9524	0.9638	Kotak Mahindra Bank	0.9289	0.9657
Indian Overseas Bank	0.9519	0.94	YES Bank	1	1
Oriental Bank of Commerce	0.9696	0.9725	**Average**	**0.9600**	**0.9620**

Appendix III

Change in GNPAs as a percent of Gross Advances and CRAR

(All banks from 2011 to 2017)

Bank		GNPA as a percent of Gross Advances	CRAR
State Bank Group		6.46	-1.34
Allahabad Bank	pca	11.96	-1.51
Andhra Bank		11.52	-2.00
Bank of Baroda		9.77	-2.28
Bank of India	pca	11.94	-0.03
Bank of Maharashtra	pca	15.49	-2.17
Canara Bank		8.52	-2.52
Central Bank of India	pca	17.70	-0.70
Corporation Bank	pca	11.23	-2.79
Dena Bank	pca	15.51	-2.02
IDBI	pca	21.68	-2.94
Indian Bank		6.74	0.08
Indian Overseas Bank	pca	22.23	-4.06
Oriental Bank of Commerce	pca	12.49	-2.59
Punjab & Sind Bank		9.80	-1.89
Punjab National Bank		11.39	-0.76
Syndicate Bank		6.39	-1.01
UCO Bank	pca	15.65	-2.78
Union Bank of India		9.37	-1.16
United Bank of India	pca	14.02	-1.91
Vijaya Bank		4.17	-1.15
Axis Bank		4.58	2.30
HDFC Bank		0.00	-1.67
ICICI Bank		4.44	-2.15
IndusInd Bank		-0.08	-0.58
Kotak Mahindra Bank		0.57	-3.15
YES Bank		1.29	0.50
Average		**9.81**	**-1.57**
pca indicates bank under PCA Framework			

Appendix IV

Prompt Corrective Action Framework

The PCA Framework: Areas, Indicators and Triggers, 2014

The PCA framework is applicable only to commercial banks and not extended to co-operative banks, non-banking financial companies (NBFCs) and FMIs.The trigger points along with structured and discretionary actions that could be taken by the Reserve Bank are described below:

Area & Indicator	Risk Threshold	Action to be Initiated by RBI
Capital CRAR	less than 9%, but equal or more than 6%	bank to submit capital restoration plan; restrictions on RWA expansion, entering into new lines of business, accessing/renewing costly deposits and CDs, and making dividend payments; order recapitalisation; restrictions on borrowing from inter-bank market, reduction of stake in subsidiaries, reducing its exposure to sensitive sectors like capital market, real estate or investment in non-SLR securities, etc.
	CRAR less than 6%, but equal or more than 3%	in addition to actions in hitting the first trigger point, RBI could take steps to bring in new Management/ Board, appoint consultants for business/ organizational restructuring, take steps to change ownership, and also take steps to merge the bank if it fails to submit recapitalization plan.
	CRAR less than 3%	in addition to actions in hitting the first and second trigger points, more close monitoring; steps to merge/amalgamate/liquidate the bank or impose moratorium on the bank if its CRAR does not improve beyond 3% within one year or within such extended period as agreed to
Asset Quality Net NPAs	over 10% but less than 15%	special drive to reduce NPAs and contain generation of fresh NPAs; review loan policy and take steps to strengthen credit appraisal skills, follow-up of advances and suit-filed/decreed debts, put in place proper credit-risk management policies; reduce loan concentration; restrictions in entering new lines of business, making dividend payments and increasing its stake in subsidiaries.
	15% and above	In addition to actions on hitting the above trigger point, bank's Board is called for discussion on corrective plan of action.
Profitability Return on Assets	less than 0.25%	restrictions on accessing/renewing costly deposits and CDs, entering into new lines of business, bank's borrowings from inter-bank

		market, making dividend payments and expanding its staff; steps to increase fee-based income; contain administrative expenses; special drive to reduce NPAs and contain generation of fresh NPAs; and restrictions on incurring any capital expenditure other than for technological upgradation and for some emergency situations.
Source: Reserve Bank of India, Circular, 2014.		

PCA Matrix: Areas, Indicators and Risk Thresholds Indicator, 2017

The PCA framework would apply without exception to all banks operating in India including small banks and foreign banks operating through branches or subsidiaries based on breach of risk thresholds of identified indicators.

	Indicator	Risk Threshold 1	Risk Threshold 2	Risk Threshold 3
Area				
Capital *(Breach of either CRAR or CET 1 ratio to trigger PCA)*	CRAR- Minimum regulatory prescription for capital to risk assets ratio + applicable capital conservation buffer(CCB) current minimum RBI prescription of 10.25% (9% minimum total capital plus 1.25%* of CCB as on March 31, 2017) **<u>And/ Or</u>** Regulatory pre-specified trigger of Common Equity Tier 1 (CET 1_{min}) + applicable capital conservation buffer(CCB) current minimum RBI prescription of 6.75% (5.5% plus 1.25%* of CCB as on March 31, 2017) **Breach of <u>either CRAR or CET 1</u> ratio to trigger PCA**	upto 250 bps below Indicator <10.25% but >=7.75% upto 162.50 bps below Indicator <6.75% but >= 5.125%	more than 250 bps but not exceeding 400 bps below Indicator <7.75% but >=6.25% more than 162.50 bps below but not exceeding 312.50 bps below Indicator <5.125% but >=3.625%	- - In excess of 312.50 bps below Indicator <3.625%

Asset Quality	Net Non-performing advances (NNPA) ratio	>=6.0% but <9.0%	>=9.0% but < 12.0%	>=12.0%
Profitability	Return on assets (ROA)	Negative ROA for two consecutive years	Negative ROA for three consecutive years	Negative ROA for four consecutive years
Leverage	Tier 1 Leverage ratio[4]	<=4.0% but > = 3.5% (leverage is over 25 times the Tier 1 capital)	< 3.5% (leverage is over 28.6 times the Tier 1 capital)	

[1]CET 1 ratio – the percentage of core equity capital, net of regulatory adjustments, to total risk weighted assets as defined in RBI Basel III guidelines

[2]NNPA ratio – the percentage of net NPAs to net advances

[3]ROA – the percentage of profit after tax to average total assets

[4] Tier 1 Leverage ratio – the percentage of the capital measure to the exposure measure as defined in RBI guidelines on leverage ratio.

Source: Reserve Bank of India Circular, 2017.