# A study on the efficiency evaluation of Indian commercial banks (2014-2018) – A quantitative approach

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***Abstract*-The efficiency evaluation of any bank is of utmost importance for bank management and policymakers. The operational efficiency of any bank can be affected by many risk factors. This study attempted to evaluate the efficiency of Indian banks during the five financial years from 2014-15 to 2018-19. The study attempted to identify the impact of NPAs on the efficiency of Indian commercial banks during these financial years using the data envelopment analysis. The results reveal that the impact of NPAs is statistically significant for all five financial years at a 5% level. The 'Risk efficiency' is measured and it reveals that due to NPAs, the banks experienced 8% input losses and on average 7% of the efficiency deteriorated due to risk inefficiency.**

***Index Terms***
***Efficiency, Indian banks, Nonperforming assets, Data envelopment analysis.***

## I. INTRODUCTION

The main aim of banks is to channel the funds between the depositors and borrowers. Due to this, we can say banks play a predominant role as the financial mediators for the growth of any country's economy. In underdeveloped institutions, banks play the main sources of money lending for the growth of small, and medium enterprises. After the implementation of banking reforms, more private and foreign sector banks started operating in India. The public sector banks channel the funds of different government welfare schemes to the public. These banks are working as mediators between the government and the public. The private and foreign sector banks are mostly working in urban areas with the motto of increasing the deposits and channelling the money to the borrowers with hassles technology towards better banking business.

The changes after the implementation of the reforms led the Indian banking management system truly competitive with a robust system from the financial crisis. Increased competition induces banks to face a risky environment in the financial market. For survival and to increase their share in deposits, loans, advances, and investments, the commercial banks were started introducing the innovative financial products. If these banks fail to promote the financial products and wherever promoted if they fail to get returns as much as the management anticipated, nonperforming assets would tend to increase.

## II. NONPERFORMING ASSETS

The situation of increasing the non-performing assets may decrease the customer's confidence in the banking system. To Bring more transparency about the non-performing assets (NPAs), RBI defined clearly which assets will come under the NPAs by adopting the '90 days' overdue' norms. The following represents the clear definition of NPAs defined by RBI. "A non-performing asset (NPA) is a loan or an advance where

(i) the interest and/or installment of a principal remains overdue for more than 90 days in respect of a term loan
(ii) the account remains 'out of order' for more than 90 days, in respect of an Overdraft/Cash Credit (OD/CC)
(iii) the bills remain overdue for more than 90 days in the case of bills purchased and discounted
(iv) the interest and/or installment of the principal remains overdue for two yield seasons but for a period not exceeding two half years in the case of an advance granted for agricultural purposes, and
(v) any amount to be received remains overdue for more than 90 days in respect of other accounts."

The NPAs were classified into different categories based on the severity of their returns. These are Standard, sub-standard, doubtful, and loss assets. Except for the standard assets all other assets come under the NPAs. After the implementation of the Narasimham Committee reforms in India, there is a decrease in the NPAs ratio until the year 2000. After 2013, due to political interference, and a poor internal risk management system, there is an alarming increase in the NPAs ratios of the Indian banking system. The NPAs will deteriorate the performance of banks by reducing capital due to the provisions for loan losses. It is an asset that ceases the money, in terms of capital and interest. Due to this, the NPAs became one of the key indicator variables in efficiency evaluation.

## III. REVIEW OF LITERATURE

Sherman & Gold (1985) applied the basic data envelopment analysis models to measure the efficiency of bank branches. After that, there were many studies on the efficiency of banks using DEA models. The basic DEA models under constant and variable returns to scales were the most popular models in the literature in measuring the efficiency of banks (Subramanyam et al., 2008, 2020; Grmanová, E., & Ivanová, E, 2018). Several researchers proposed environmental data envelopment analysis models to capture the influence of nonperforming assets. These models capture the impact of NPAs due to internal and external factors. The risk impact is captured by decomposing the overall technical efficiency as risk and scale efficiency (Pastor, 1999; Hafsal et al., 2020). The focal point in DEA is the identification of significant input and output variables. Several researchers studied and proposed different methods for selecting significant input and output variables. The step-wise procedure to be considered as the most popular procedure to identify the significant input and output variables (Subramanyam, 2016, 2020). The present study identified fixed assets and operating expenses as input variables and deposits, investments, and advances as output variables. The net NPAs were considered as an undesirable output variable. This study focused on evaluating the efficiency and the effect of NPAs in Indian banks during the financial years 2014-15 to 2018-19.

## IV. DATA ENVELOPMENT ANALYSIS

Data Envelopment Analysis (DEA) is a recognized non-parametric approach to evaluate the efficiencies of organizational units where multiple inputs and outputs are present. This approach became more popular due to its non-parametric nature. Following Charnes, Cooper, and Rhodes (1978) there were several data envelopment analyses (DEA) methods appearing in the literature on the efficiency of profit and non-profit organizational units (Subramanyam T et.al, 2008; Banker et.al, 2004).

CCR Model: The basic CCR models developed keeping in mind that the organizational units, called Decision Making Units (DMU) are working under constant returns to scale (CRTS).

$$\theta^{CCR} = Min\left\{\lambda : \sum_{j=1}^{n} \lambda_j x_{ij} \leq \lambda x_{i0}; \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0};\ \lambda_j \geq 0\right\}$$

The suffix *i* and *j* represents the input and output variables. Where $i=1,2,\ldots,m$ and $j=1,2,\ldots,n$ respectively. Due to the nature of the NPAs, the variable can be treated as an undesirable output. The effect of NPAs can occur due to internal or external factors. If the variable $y_b$ represents the undesirable output, the DEA model under CRTS can be represented as:

$$\theta^{CCR,NPA} = Min\left\{\lambda : \sum_{j=1}^{n} \lambda_j x_{ij} \leq \lambda x_{i0}; \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}; \sum_{j=1}^{n} \lambda_j y_{bj} \geq y_{b0}; \lambda_j \geq 0\right\}$$

BCC Model: Banker, Charnes and Cooper (BCC) proposed a linear programming problem to capture the scale differences by introduction additional constraint, $\sum_{j=1}^{n} \lambda_j = 1$, into the basic CCR model. The BCC model with NPAs as undesirable output can be represented as:

$$\theta^{BCC,NPA} = Min\left\{\lambda : \sum_{j=1}^{n} \lambda_j x_{ij} \leq \lambda x_{i0}; \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}; \sum_{j=1}^{n} \lambda_j y_{bj} \geq y_{b0};\ \sum_{j=1}^{n} \lambda_j = 1\right\}$$

The efficiency values, $\theta^{BCC,NPA}$ known as the pure technical efficiency. The below multiplicative decomposition is useful to capture the overall effect of NPAs on the banks:

$$\theta^{CCR} = \left[\frac{\theta^{CCR}}{\theta^{CCR,NPA}}\right]\left[\frac{\theta^{CCR,NPA}}{\theta^{BCC,NPA}}\right]\left[\theta^{BCC,NPA}\right]$$

The ratios, $\frac{\theta^{CCR}}{\theta^{CCR,NPA}}$, and $\frac{\theta^{CCR,NPA}}{\theta^{BCC,NPA}}$ represents the risk efficiency due to the NPAs and scale efficiency respectively. The efficiency scores $\theta^{BCC,NPA}$ represents the pure technical efficiencies.

## V. EMPIRICAL ANALYSIS

The efficiency of the banks were evaluated under the assumption that banks are working under the homogeneous environment. The table 1, represents the average efficiency scores of the Indian commercial banks under different environments for the five financial years from FY 2014-15 to FY 2018-19.

Table 1: Average efficiency of banks

| Efficiency | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|
| $\theta^{CCR}$ | 0.69 | 0.67 | 0.72 | 0.73 | 0.50 |
| $\theta^{CCR,NPA}$ | 0.71 | 0.70 | 0.75 | 0.76 | 0.72 |
| $\theta^{BCC,NPA}$ | 0.78 | 0.81 | 0.86 | 0.88 | 0.87 |
| Risk Efficiency | 0.97 | 0.97 | 0.96 | 0.96 | 0.72 |

From above table 1, it is observed that due to the inclusion of NPAs, the average performance of banks increased from 66% to 73%. It reveals that due to NPAs, the banks experienced around 7% of the input losses during the five financial years. When it comes to scaling efficiency banks experience 11% input losses due to scale differences.

The impact of the nonperforming assets is evaluated using the 'Risk efficiency'. From the above table, it is observed that due to the risk inefficiency on average, there is an 8% efficiency deterioration in the overall efficiency. It reveals that the banks experienced 8% input losses due to risk inefficiency.

*Statistical Significance of the impact of NPAs:* To test the statistical significance of the impact of NPAs on the efficiencies of the Indian commercial banks, we set up the null hypothesis as:

$H_0$: The NPAs don't have any impact on the efficiency of Indian Commercial banks.

To test the efficiency change due to the inclusion of the NPAs as undesirable output is statistically significant, the "Wilcoxon Signed Rank test" is an appropriate test and the results are represented as below:

Table 2: Wilcoxon Signed Rank Test

| Year | Average mean Difference | p-value |
|---|---|---|
| 2014-15 | 0.0189* | 0.001 |
| 2015-16 | 0.0287* | 0.000 |
| 2016-17 | 0.0317* | 0.000 |
| 2017-18 | 0.0307* | 0.000 |
| 2018-19 | 0.2108* | 0.000 |

*indicates significant at 5% level of significance.

Since, the p-values for all the five financial years are less than 0.05, the hypothesis is rejected at 5% level of significance and we can say that the NPAs have significant impact on the efficiency of Indian commercial banks.

## VI. CONCLUSIONS

The efficiency of Indian banks were evaluated for the five financial years from 2014-15 to 2018-19 using the data envelopment analysis. The overall efficiency was multiplicatively decomposed into risk and scale efficiencies to identify and assess the risk efficiency of NPAs. To measure the efficiency of banks, we have identified two input variables: fixed assets and operating expenses and three output variables: deposits, investments, and advances. The NPA variables are considered undesirable input variables. The overall efficiency of banks under a risk-free environment without NPAs, reveals that on average the Indian banks are 66% efficient and 34% of the inputs are freely disposed of. When it is considered under the risk environment with NPAs as undesirables output, the average efficiency score increased to 73% with 27% input losses. After removing the scale differences, the banks achieved 84% efficiency. The 'Risk efficiency' is measured and it reveals that due to NPAs the banks experienced 8% input losses and on an average 7% of the efficiency deteriorated due to risk inefficiency. Due to scale inefficiency, the banks experienced 13% input losses. The 'Wilcoxon Signed Rank' test reveals that the NPAs have a significant impact ($p<0.05$), on the efficiency of banks on all financial years.

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