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# Cost Efficiency Of Indian Public Sector Banks With Information Technology (It) Investments- A Stochastic Frontier Approach (SFA)

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**Abstract:** This research study explores the Cost efficiency of Indian Public Sector banks by employing Stochastic Frontier Approach (SFA). This paper empirically evaluated the impact of Information Technology (IT) on the Cost efficiency of the Indian public sector banks .The present study is based on panel data over the period of 2008-2012. For this paper, all the 19 Nationalised banks and 6 SBI& its associate banks are being considered. This paper identifies the average cost efficiency of Nationalised banks found to be 92.5 percent and for SBI& its associate banks 85.5 percent over the entire period of study. The findings of this paper suggest that to some extent IT impact the cost efficiency of Indian public sector banks. Some of nationalised bank cost inefficiency increased by 3 % for the study period by Information Technology (IT) and for SBI & it's associate banks cost inefficiency increased by 17.4 % by Information Technology (IT). This is due to the higher cost for IT expenditure and realized benefit is comparatively smaller. The Information Technology increased cost inefficiency to both Nationalised banks and SBI & its associate banks old and new public sector banks.

**Key words:** Information Technology (IT), Indian public sector Banks, Nationalized banks, SBI& its associate banks, Cost efficiency, Stochastic Frontier Approach (SFA), cost efficiency.

## INTRODUCTION

Banking system is the backbone of any economy. The growth of various banking technologies changed the nature and functioning of commercial banks all over the world.

Banking technology is defined as the information and communication technologies used by banks to provide various services to its customers in a secure and reliable way in an electronic platform. In India, the IT has brought uprising in the functioning of the banks. The level and utilization of IT depends upon the investment in technology.

Banks in India have been investing and continued to invest enormous amount of funds on computer and related technologies expecting substantial payoff. In the present day rigorous banking environment, a cost benefit analysis of the investments in IT is bound to be a difficult exercise.

It has been a question whether investments in IT provides efficiency in banking performance. Many scholars failed to identify the relationship between higher IT Investment by banks and their efficiency. So they coined the term "IT Productivity Paradox".

Frontier efficiency is tool to measure the performance of the banks. If a bank capable of producing a same level output with minimizing the inputs, achieve the cost advantage. It is known as cost efficiency. **Cost efficiency** is a measurement indicates how efficiently a bank can reduce its cost. Sometimes, IT provides cost efficiency to the banks because it reduces the operating expenses in the long run.

The efficiency Studies of banks divided in to parametric and non-parametric methods. In the parametric methods, the Stochastic Frontier Approach (SFA) was often used. Berger (2003) identified 24 studies used SFA out of the 60 studies in parametric. The translog cost function was the most widely used in the SFA method.

This research paper explores the cost efficiency of Indian Public Sector banks using a Stochastic Frontier Approach (SFA). This paper empirically evaluated the impact of Information Technology (IT) on the cost efficiency of the Indian public sector banks .The present study is based on panel data over the period of 2008-2012.

### *Objectives Of The Study:*

This paper consists of the following objectives:

1. To identify the variables influencing cost efficiency of Indian public sector banks.
2. To measure the cost efficiency of various public sector banks in India.
3. To compare the cost efficiency of banks in bank-wise and year-wise.

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***Hypothesis:***

**$H_{01}$:** Among the bank groups operating in India, there is no significant difference in the
**$H_{01a}$:** bank-wise cost efficiency
**$H_{01b}$:** year-wise cost efficiency

***Literature Review:***

Rai *et al*. (1997) identified that IT investments influence the business performance positively.

Lee and Menon (2000) found that higher investment in IT contribute higher efficiency. They employed non parametric approach to analyze the performance of hospitals.

Shao and Lin (2001) identified IT had impact on efficiency. The authors investigated the impact of IT investments to the performance of 370 firms and concluded that there is a impact of IT towards the performance of the firms.

Simon H. Kwan (2001) identified cost efficiency of banks in Hong Kong. He used the SFA and found that the efficiency of banks was in between 16 percent to 30 percent.

Namchul Shin (2006) identified the importance of business value of IT in relation to strategic firm performance to reduce the cost of coordinating business resources across multiple markets.

William *et al*. (1991) examined technological changes and its impact on output for U.S. commercia1 banks. They suggested that technological change can lower the real costs by 1% per year.

Costas Lapavitsas and Paulo L. Dos Santos (2008) identified the money transaction cost reduced due to investment in IT.

Shirley J. Ho and Sushanta K. Mallick (2008) examined that IT can improve efficiency of banks in two ways. The two ways are known as cost effect and network effect.

Baker and Berenblum (1996), identified IT is one of the important factor decides the success or failure of organizations.

Morrison and Berndt (1990) identified marginal IT investments provided negative impact to efficiency. They also found that compared to cost, the benefit is lesser and thus provided negative contribution to efficiency.

Kaparakis et.al (1994) found the significant negative correlation between cost efficiency and size of the bank and significant positive correlation between efficiency and the ratio of capital to total assets.

Meeusen and vanden Broeck (1977) and Aigner, Lovell and Schmidt (1977) provided the fundamental model of stochastic frontier approach. They applied SFA in many studies related to cost efficiency in the banks

Jeffrey et. al. (2002) recommended to include off-balance-sheet (OBS) activities in the cost efficiency measurement.

Altinkemer, Kemal, Ozdemir, Zafer (2006) investigate the reengineering of companies by Information Technology (IT) in their business processes improved their productivity .

Claudia Girardone *et al*(2004) analyzed the cost efficiency of banks in Italy. They used a Fourier-flexible(FF)model of stochastic cost function to estimate the cost efficiency. They found cost inefficiency decreased over the study period.

Laurent Weill (2009) employed three efficiency approaches SFA, DFA and DEA. The authors measured the cost efficiency of banks and found some similarities exist between the approaches.

Sealey and Lindley (1977) introduced variables (Input and Output) for intermediation approach. The output variables are Y1 = loans, Y2 = investment. The inputs are prices of labor, physical capital and borrowed funds.

Lapavitsas, Costas and Dos Santos, Paulo L(2008) argued technological innovation has contributed to recent changes in the conduct and character of banking, but its impact has been contradictory. First, money-dealing transactions have become cheaper, but investment costs have increased and a broader range of services had to be provided. The cost efficiency of banks has not improved.

Yao Chen and Joe Zhu (2004) recognized that the link between information technology (IT) investment and firm performance is indirect due to the effect of mediating and moderating variables. The IT generate funds from the customer in the forms of deposits. Profits then are generated by using deposits as a source of investment funds.

Barbara Casu & Claudia Girardone, (2005) identified the impact of the inclusion of these activities varies. Overall, the inclusion of OBS items results in an increase in estimated productivity levels for all countries under study. However, the impact seems to be the biggest on technological change rather than efficiency change.

Altunbas *et al*. (2000) identified proxy variables to measure the price of labor, price of physical capital and price of borrowed funds.

***Research Methodology:***

This study is an empirical study to identify the Information Technology(IT) impact to cost efficiency of Indian public sector banks. Cost efficiency is measured using the translog cost function and employed stochastic

cost frontier approach. A panel data were used and the sample includes 19 Nationalised banks and 6 SBI& its associate banks of India.

Cost inefficiency was estimated by using Frontier 4.1. To estimate the cost function the Maximum Likelihood (ML) estimator is used. The likelihood ratio test is used to identify the suitability of a cost function.

For the estimation of the cost function and thus measuring the cost efficiency of banks, the below relationship has to be assumed.

$$\ln C_{it} = f(y_{it,}, w_{it,}; \beta) + e_{it} \quad (1)$$

where,

$C_{it}$ = *T*otal cost of bank *i*,

$y_{it,}$ = Natural logarithm of the output,

$w_{it}$ = *N*atural logarithm of input prices,

$\beta$ =The unknown parameter to be estimated.

$e_{it}$ is a one-sided error term . The error term is used to measure effects of inefficiency. The general assumption is, $e_{it}$ is half normally distributed.

Translog cost function is used for efficiency estimation in many studies. The translog cost function was first introduced by Cristensen *et al*. (1971). Hence, this study used translog cost function in the place of standard production model.

For the definition of input and output variables ,this study use intermediation approach consider three inputs (labour, deposits and physical capital) and two outputs (loans and Investments).

This study used three basic inputs for the banking sector.

The input prices are defined as

$P_1$= Input Price of labour (Salaries and employee benefits/ the total number of the employees)

$P_2$ = Input Price of deposit (Total interest expenses of deposits/ saving deposits+ other deposits) and

$P_3$ = Input Price of Physical capital (Physical capital expenses/Physical capital)

The outputs used include loans & advances and investment. Where $Y_1$ = Loans and Advances; $Y_2$ = Investment.

The stochastic translog cost model is expressed as follows:

$$C = \beta_0 + \sum_{n=1}^{N} \beta_{yn} y_n + \sum_{m=1}^{M} \beta_{pm} p_m + \frac{1}{2}\left( \sum_{n=1}^{N}\sum_{l=1}^{N} \beta_{yn\ yl} y_n y_l + \sum_{m=1}^{M}\sum_{k=1}^{M} \beta_{pm\,pk} p_m p_k \right) + \sum_{n=1}^{N}\sum_{m=1}^{M} \beta_{yn\,pm} y_n p_m + V_{it} + U_{it} \quad (2)$$

Where

$y_n$ = N outputs in logs

$p_{m=}$ Prices of the M inputs in logs.

Standard symmetry and linear homogeneity conditions are imposed. For simplicity notations 'i'(for bank) and't' (for time) have been omitted in the model.

$U_{it}$ is the cost inefficiency measures indicates how the costs of a bank 'i' at time't' are to the banks on the cost efficient frontier, producing the same output.

$V_{it}$ stands for the usual error term.

The variables for analyzing the If

$U_{it}$ = zero,

Ci*(Frontier Cost Function) = f (yi, xi, β) and () of bank

CE (Cost efficiency)= $CE = C_i / C_i^* = f(y_i, x_i, \beta) \exp(U_{it}) / f(y_i, x_i, \beta)$

$$CE = \exp(U_{it}) \quad (3)$$

Cost inefficiency estimation from OLS, is then regressed with Information Technology (IT) investment by maximum likelihood model.(Technical efficiency) is as:

$$U_{it} = \Delta_0 + \Delta_1 Z_{it} + e_{it} \quad (4)$$

Here

$\Delta_0$ = Intercept;

$\Delta_1$ = maximum likelihood regression Coefficient;

$Z_{it}$ = IT investment by the bank i and the year t; and

$e_{it}$ is a error term.

**Table 1:** Input and Output Variables

| Variable | Variable name | Definition |
|---|---|---|
| C | Total costs | Interest expenses and operating expenses |
| Π | Pretax Profit | Income before taxation |
| OUTPUT VARIABLES | | |
| $Y_1$ | Loans and Advances | Loan |
| $Y_2$ | Investments | Investments |
| PRICES OF INPUT OF VARIABLES | | |
| $P_1$ | Input Price of labour | Salaries and employee benefits/ the total number of the employees |
| $P_2$ | Input Price of deposit | Total interest expenses of deposits/ saving deposits+ other deposits |
| $P_3$ | Input Price of Physical capital | Physical capital expenses/Physical capital |
| REGRESSION VARIABLE(ML estimation) | | |
| Z | Information Technology Investment | Various Expenses involved in IT |

*Note : Variables identified and grouped by the researchers.*

Frontier efficiency is tool to measure the performance of the banks. If a bank capable of producing a same level output with minimizing the inputs, achieve the cost advantage. It is known as cost efficiency. **Cost efficiency** is a measurement indicates how efficiently a bank can reduce its cost. Sometimes, IT provide cost efficiency to the banks because it reduce the operating expenses in the long run.

***Cost Efficiency Of Nationalised Bank:***

**Table 2,** Provides SFA -Cost Translog Estimates for Nationalised Bank. For Nationalised Bank, 19 banks are considered. The negative sign in the significant coefficients indicates that, the respective variables try to reduce the cost inefficiency. So the respective variables increase the cost efficiency of Indian Nationalised bank.

The Input and Output variables which increased the cost efficiency of Indian Nationalized banks are:

Joint significance of Loans and Advances and Investments [-1.61 (-1.896)*** significant at 10 %] indicate Indian banks are effectively handling their loan portfolio and Investments for the period 2008-2012.Thus, ***the allocation of funds between Loans and Advances and Investments is optimum to reduce the cost.***

Joint significance of Deposit and Physical capital [-3.691 (-4.026)* significant at 1 %] indicate Indian banks are increasing their deposit and reducing the rent expenses to attain the cost efficiency for the period 2008-2012.

Joint significance of Loans and Advances and labour [-5.322 (-6.31)* significant at 1 %] indicate employees of Indian nationalized banks effectively handle loan portfolio.

The Input and Out put variables which reduced the cost efficiency of Indian Nationalized banks are:

Labour [2.964 (4.496)* significant at 1 %] indicate the labour expenses are increased significantly which leads to cost inefficiency in Nationalized banks for the study period. This is not due to the Number of Employees.

The Number of Employees is reduced from 24567 to 23993 and reduced by 2.33 %.This may be due to increase in salary for the period.

Joint significance of investments and Deposit [4.061 (4.699)* significant at 1 %] indicate the mobilized deposits are not properly invested in different Investment of nationalized banks .

**Table 2:** Sfa -Cost Translog Estimates -Nationalised Bank

| | | OLS | | CORRECTED OLS | ML | |
|---|---|---|---|---|---|---|
| VARIABLES | VARIABLES | COEFFICIENT | t VALUE | COEFFICIENT | COEFFICIENT | t VALUE |
| beta0 | Intercept | 0.334 | 0.124 | 0.293 | 0.993 | 1.232 |
| beta1 | Y1 | -1.958 | -1.187*** | -1.958 | 0.16 | 0.168 |
| beta2 | Y2 | -0.55 | -0.315 | -0.55 | -1.567 | -1.715 |
| beta3 | P1 | 0.731 | 0.408 | 0.731 | 0.151 | 0.166 |
| beta4 | P2 | -3.02 | -1.529 | -3.02 | -1.58 | -1.651 |
| beta5 | P3 | -1.822 | -0.958 | -1.822 | -2.419 | -2.652 |
| beta6 | Y1*Y1 | 2.683 | 1.912*** | 2.683 | 2.964 | 4.496* |
| beta7 | Y1*Y2 | -0.643 | -0.341 | -0.643 | -1.61 | -1.896*** |
| beta8 | Y2*Y2 | -2.303 | -1.603 | -2.303 | -1.154 | -1.636 |

| | | | | | | |
|---|---|---|---|---|---|---|
| beta9 | P1*P1 | -0.419 | -0.259 | -0.419 | 0.004 | 0.006 |
| beta10 | P1*P2 | 1.182 | 0.681 | 1.182 | 0.959 | 1.105 |
| beta11 | P1*P3 | 2.315 | 1.35 | 2.315 | 2.46 | 2.978* |
| beta12 | P2*P2 | -1.321 | -0.885 | -1.321 | 0.051 | 0.071 |
| beta13 | P2*P3 | -2.045 | -1.192 | -2.045 | -3.691 | -4.026* |
| beta14 | P3*P3 | 0.615 | 0.471 | 0.615 | 1.406 | 1.936*** |
| beta15 | Y1*P1 | -4.056 | -2.223** | -4.056 | -5.322 | -6.31* |
| beta16 | Y1*P2 | 1.589 | 0.789 | 1.589 | 0.271 | 0.311 |
| beta17 | Y1*P3 | 0.107 | 0.058 | 0.107 | 0.977 | 1.15 |
| beta18 | Y2*P1 | 0.686 | 0.383 | 0.686 | 1.77 | 2.032*** |
| beta19 | Y2*P2 | 5.101 | 2.664** | 5.101 | 4.061 | 4.699* |
| beta20 | Y2*P3 | 0.584 | 0.351 | 0.584 | 0.232 | 0.273 |
| delta0 | | | | | -0.132 | -1.892*** |
| delta1 | | | | | 0.03 | 2.471** |
| sigma-squared | | 0.002 | | | 0.004 | 6.665 |
| gamma | | | | | 1 | 5938.808* |
| log likelihood function | | 162.05 | | | 168.818 | |
| LR test of the one-sided error | | | | | 13.541 | |

Note : result computed using FRONTIER 4.1

* 1% significance level, ** 5 % significance level, *** 10% significance level

The log –likelihood function for full stochastic model where inefficiency is assumed to be half-normal is calculated to be 168.818 and the value for OLS function is 162.05, which is less than the full frontier model. LR test statistics for testing the absence of the technical inefficiency effect from the frontier is calculated to be 13.54. This value is significantly higher than the critical value 2.706 at 5% level of significance, obtained from Kodde and Palm (1986) for df equal to 1. The *null hypothesis ($H_{07a}$) is rejected.* Thus, ***there is a significant difference among the Indian Nationalised bank in their cost inefficiency.***

The sigma-square is 0.03 and significant at 5% level, indicating the correctness of the specified assumptions of the distribution of the composite error term. The gamma value is 1.00 and significant at the 1% level. It is an indication that 100 % variation in output is attributed to bank specific technical inefficiency and there is no remaining variation in output is attributed to noise.

The variation in cost efficiency seems to have increased over time, as represented by the delta values. The difference in cost inefficiency between the best practice and worst practice banks is significantly increased by 3 % by Information technology. Thus, some of the Nationalised bank cost efficiency reduced by 3 % for the period 2008-2012.

**Table 3:** Cost Inefficiency Estimate Of Nationalised Bank

| SL.NO | NAME OF THE BANK | COST INEFFICIENCY ESTIMATE | | | | | AVERAGE (BANK WISE) |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2009 | 2010 | 2011 | 2012 | |
| 1 | Allahabad Bank | 1.056 | 1.014 | 1.028 | 1.016 | 1.117 | 1.046 |
| 2 | Andhra Bank | 1.099 | 1.026 | 1.011 | 1.085 | 1.105 | 1.065 |
| 3 | Bank of Baroda | 1.085 | 1.036 | 1.163 | 1.091 | 1.056 | 1.086 |
| 4 | Bank of India | 1.051 | 1.068 | 1.100 | 1.091 | 1.119 | 1.086 |
| 5 | Bank of Maharashtra | 1.057 | 1.115 | 1.063 | 1.101 | 1.041 | 1.075 |
| 6 | Canara Bank | 1.049 | 1.026 | 1.045 | 1.173 | 1.085 | 1.076 |
| 7 | Central Bank of India | 1.176 | 1.112 | 1.101 | 1.086 | 1.048 | 1.105 |
| 8 | Corporation Bank | 1.181 | 1.107 | 1.045 | 1.034 | 1.019 | 1.077 |
| 9 | Dena Bank | 1.134 | 1.248 | 1.155 | 1.072 | 1.049 | 1.132 |
| 10 | Indian Bank | 1.000 | 1.048 | 1.059 | 1.080 | 1.122 | 1.062 |
| 11 | Indian Overseas Bank | 1.083 | 1.044 | 1.039 | 1.026 | 1.126 | 1.063 |
| 12 | Oriental Bank of Commerce | 1.002 | 1.062 | 1.069 | 1.096 | 1.113 | 1.068 |
| 13 | Punjab and Sind Bank | 1.247 | 1.050 | 1.178 | 1.015 | 1.002 | 1.099 |
| 14 | Punjab National Bank | 1.061 | 1.136 | 1.091 | 1.033 | 1.132 | 1.090 |
| 15 | Syndicate Bank | 1.026 | 1.038 | 1.048 | 1.054 | 1.096 | 1.052 |
| 16 | UCO Bank | 1.014 | 1.055 | 1.154 | 1.092 | 1.071 | 1.077 |
| 17 | Union Bank of India | 1.067 | 1.015 | 1.123 | 1.044 | 1.119 | 1.074 |
| 18 | United Bank of India | 1.059 | 1.074 | 1.026 | 1.013 | 1.052 | 1.045 |
| 19 | Vijaya Bank | 1.028 | 1.094 | 1.057 | 1.010 | 1.135 | 1.065 |
| | AVERAGE (YEAR WISE) | 1.078 | 1.072 | 1.082 | 1.064 | 1.084 | 1.075 |

Note : Computed using FRONTIER 4.1

**Table 3,** Provides cost inefficiency estimate of total banking industry. For nationalized banks , 19 banks are considered. The results show that overall the banks are over 7.5 % Cost inefficient i.e. 92.5 % Cost efficient,

with United Bank of India being the most Cost efficient and Dena Bank the least. The average inefficiency score for Dena Bank is 1.132, implying that its inefficiency is 13.2 % higher than it should be.

**Table 4:** Analysis of Variance (Bank-wise)

| Source of Variation | SS | Df | MS | F | F crit |
|---|---|---|---|---|---|
| Between banks | 0.03976 | 18 | 0.002209 | 0.808912 | 1.741189 |
| Within banks | 0.207533 | 76 | 0.002731 | | |
| Total | 0.247293 | 94 | | | |

Note : Computed using SPSS 16.0

**Table 4** gives the results based on ANOVA test. As the calculated value is (0.808912) lesser than the table value (1.741189), the null hypothesis ($H_{07a}$) is accepted. Thus, ***there is no significant difference among the nationalised bank in their cost efficiency.***

**Table 5:** Analysis of Variance (Year -wise)

| Source of Variation | SS | Df | MS | F | F crit |
|---|---|---|---|---|---|
| Between the Year | 0.005164 | 4 | 0.001291 | 0.479836 | 2.472927 |
| Within the Year | 0.24213 | 90 | 0.00269 | | |
| Total | 0.247293 | 94 | | | |

Note : Computed using SPSS 16.0

**Table 5** gives the results based on ANOVA test. As the calculated value is (0.479836) lesser than the table value (2.472927), the null hypothesis ($H_{07b}$) is accepted. Thus, ***there is no significant difference in cost inefficiency among the Indian nationalised bank in year-wise.***

***Cost Efficiency Of Sbi& Associate Bank:***

**Table 6,** Provides SFA -Cost Translog Estimates for SBI& Associate Banks. For SBI& Associate Banks, 6 banks are considered. The negative sign in the significant coefficients indicates that, the respective variables try to reduce the cost inefficiency. So the respective variables increase the cost efficiency of Indian SBI& Associate Banks. The positive sign in the significant coefficients indicates that, the respective variables try to increase the cost inefficiency. So the respective variables decrease the cost efficiency of Indian SBI& Associate Banks.

The Input and Output variables which increased the cost efficiency of SBI& Associate banks are:

Loans and Advances [-7.448 (-8.008)* significant at 1 %] indicate Indian banks are effectively handling their loan portfolio for the period 2008-2012.

Joint significance of Deposit and Physical capital [-0.362 (-2.192)*** significant at 10 %] indicate SBI& Associate Bank are increasing their deposit and reducing the rent expenses to attain the cost efficiency for the study period.

The Input and Output variables which reduced the cost efficiency of SBI& Associate Bank are:

Labour [4.22(4.401)*significant at 1 %] indicate the labour expenses are increased significantly which leads to cost inefficiency. This is not due to the Number of Employee. The Number of Employee is reduced from 38597 to 38371 in SBI& Associate Bank for the period 2008-2012 and reduced by 0.58 % for the period . This may be due to increase in salary for the study period.

Physical capital [2.341(1.957)*** significant at 10 %] indicate the rent ,insurance and maintenance expenses are increased significantly which leads to cost inefficiency in in SBI& Associate Banks for the period 2008-2012.

The log –likelihood function for full stochastic model where inefficiency is assumed to be half-normal is calculated to be 73.424 and the value for OLS function is 57.611, which is less than the full frontier model. LR test statistics for testing the absence of the technical inefficiency effect from the frontier is calculated to be 31.628. This value is significantly higher than the critical value 2.706 at 5% level of significance, obtained from Kodde and Palm (1986) for df equal to 1. The *null hypothesis ($H_{07a}$) is rejected.* Thus, ***there is a significant difference among SBI& Associate Banks in their cost inefficiency.***

The sigma-square is 0.02 and significant at 1% level, indicating the correctness of the specified assumptions of the distribution of the composite error term. The gamma value is 0.12 and significant at the 1% level. It is an indication that 12 % variation in output is attributed to bank specific technical inefficiency and remaining variation 88% in out put is attributed to noise.

The variation in cost efficiency seems to have decreased over time, as represented by the delta values. The difference in cost inefficiency between the best practice and worst practice banks is significantly increased by 17.4 % for the period 2008-2012 by Information technology. Thus, some of SBI& Associate Bank cost efficiency reduced by 17.4 % for the period 2008-2012.

**Table 7,** Provides cost inefficiency estimate of SBI& Associate Banks For SBI & Associate Banks, 6 banks are considered. The results show that overall the banks are over 14 % Cost inefficient i.e. 86 % Cost efficient, with State Bank Of mysore being the most Cost efficient and State Bank Of India the least. The average

inefficiency score for State Bank of mysore is 1.0124, implying that its inefficiency is 1.2 % higher than it should be. The average inefficiency score for State Bank of India is 1.6478, implying that its inefficiency is 64.78 % higher than it should be. For natural log, the most cost efficient firm will have a value of 1, the farther the value from 1, the most cost inefficient the firm is.

**Table 6:** Sfa -Cost Translog Estimates -Sbi Group

| | | OLS | | CORRECTED OLS | ML | |
|---|---|---|---|---|---|---|
| VARIABLES | VARIABLES | COEFFICIENT | t VALUE | COEFFICIENT | COEFFICIENT | t VALUE |
| beta0 | Intercept | 0 | -0.003 | -0.011 | -0.027 | -0.469 |
| beta1 | Y1 | -7.926 | -1.173 | -7.926 | -7.448 | -8.006* |
| beta2 | Y2 | 0.408 | 0.05 | 0.408 | -0.665 | -0.589 |
| beta3 | P1 | 5.423 | 0.885 | 5.423 | 4.22 | 4.401* |
| beta4 | P2 | -3.401 | -0.762 | -3.401 | -2.015 | -1.478 |
| beta5 | P3 | 0.074 | 0.011 | 0.074 | 2.341 | 1.957*** |
| beta6 | Y1*Y1 | 2.17 | 0.461 | 2.17 | 1.968 | 2.967** |
| beta7 | Y1*Y2 | 2.387 | 0.525 | 2.387 | 1.598 | 1.628 |
| beta8 | Y2*Y2 | -1.669 | -0.396 | -1.669 | -1.621 | -1.519 |
| beta9 | P1*P1 | -2.584 | -0.468 | -2.584 | -3.238 | -4.992* |
| beta10 | P1*P2 | 0.104 | 0.318 | 0.104 | -0.092 | -0.625 |
| beta11 | P1*P3 | 0.944 | 0.17 | 0.944 | 0.56 | 0.64 |
| beta12 | P2*P2 | 1.895 | 0.827 | 1.895 | 1.33 | 1.935*** |
| beta13 | P2*P3 | -0.444 | -1.401 | -0.444 | -0.362 | -2.192*** |
| beta14 | P3*P3 | -2.163 | -0.514 | -2.163 | -2.716 | -4.148* |
| beta15 | Y1*P1 | -0.368 | -0.089 | -0.368 | 0.242 | 0.29 |
| beta16 | Y1*P2 | 0.155 | 0.538 | 0.155 | 0.045 | 0.338 |
| beta17 | Y1*P3 | 1.817 | 0.299 | 1.817 | 1.901 | 2.268*** |
| beta18 | Y2*P1 | -0.923 | -0.182 | -0.923 | 1.643 | 1.708 |
| beta19 | Y2*P2 | -0.137 | -0.411 | -0.137 | -0.047 | -0.303 |
| beta20 | Y2*P3 | 2.175 | 0.461 | 2.175 | 1.254 | 1.225 |
| delta0 | | | | 0 | -0.904 | -5.742* |
| delta1 | | | | 0 | 0.174 | 5.607* |
| sigma-squared | | 0.007 | | 0.003 | 0.002 | 3.78* |
| gamma | | | | 0.05 | 0.12 | 4.745* |
| log likelihood function | | 57.611 | | | 73.424 | |
| LR test of the one-sided error | | | | | 31.628 | |

*Note : Computed using FRONTIER 4.1*

** 1% significance level, ** 5 % significance level, *** 10% significance level*

**Table 7:** Cost Inefficiency Estimate Of Sbi Associate Bank

| SL. | NAME OF THE BANK | COST INEFFICIENCY ESTIMATE | | | | | AVERAGE |
|---|---|---|---|---|---|---|---|
| NO | | 2005 | 2006 | 2007 | 2008 | 2009 | (BANK WISE) |
| 1 | State Bank Of Bikaner & Jaipur | 1.007 | 1.056 | 1.086 | 1.119 | 1.158 | 1.0852 |
| 2 | State Bank Of Hyderabad | 1.007 | 1.044 | 1.069 | 1.086 | 1.098 | 1.0608 |
| 3 | State Bank Of India | 1.547 | 1.619 | 1.66 | 1.69 | 1.723 | 1.6478 |
| 4 | State Bank Of Mysore | 1 | 1.003 | 1.004 | 1.018 | 1.037 | 1.0124 |
| 5 | State Bank Of Patiala | 1.006 | 1.014 | 1.026 | 1.048 | 1.068 | 1.0324 |
| 6 | State Bank Of Travancore | 1.004 | 1.018 | 1.026 | 1.039 | 1.055 | 1.0284 |
| | AVERAGE (YEAR WISE) | 1.09517 | 1.12567 | 1.14517 | 1.16667 | 1.18983 | 1.1445 |

Note : Computed using FRONTIER 4.1

Table 8: Analysis of Variance (Bank-wise)

| Source of Variation | SS | Df | MS | F | F crit |
|---|---|---|---|---|---|
| Between banks | 1.676928 | 7 | 0.239561 | 179.477318 | 2.312741 |
| Within banks | 0.042713 | 32 | 0.001335 | | |
| Total | 1.719641 | 39 | | | |

Note : Computed using FRONTIER 4.1

**Table 8** gives the results based on ANOVA test. As the calculated value is (179.477318) higher than the table value (2.312741), the null hypothesis ($H_{07a}$) is rejected. Thus, ***there is significant difference among the Indian SBI bank group in their cost efficiency.***

**Table 9:** Analysis of Variance (Year -wise)

| Source of Variation | SS | Df | MS | F | F crit |
|---|---|---|---|---|---|
| Between the Year | 0.026848 | 4 | 0.006712 | 0.138779 | 2.641465 |
| Within the Year | 1.692792 | 35 | 0.048365 | | |
| Total | 1.719641 | 39 | | | |

Note : Computed using FRONTIER 4.1

**Table 9** gives the results based on ANOVA test. As the calculated value is (0.138779) lesser than the table value (2.641465), the null hypothesis ($H_{07b}$) is accepted. Thus, ***there is no significant difference in cost inefficiency among the Indian SBI bank group in year-wise.***

## RESULT AND DISCUSSION

The allocation of funds between Loans and Advances and Investments is optimum to reduce the cost.The variation in cost efficiency seems to have increased over time, as represented by the delta values. The difference in cost inefficiency between the best practice and worst practice banks is significantly increased by 3 % by Information technology. Thus, some of the Nationalised bank cost efficiency reduced by 3 % for the period 2008-2012.

For nationalized banks, 19 banks are considered. The results show that overall the banks are over 7.5 % Cost inefficient i.e. 92.5 % Cost efficient, with United Bank of India being the most Cost efficient and Dena Bank the least. The average inefficiency score for Dena Bank is 1.132, implying that its inefficiency is 13.2 % higher than it should be.

There is no significant difference among the nationalised bank in their cost efficiency bank- wise and year-wise.There is a significant difference among SBI& Associate Banks in their cost inefficiency.The difference in cost inefficiency between the best practice and worst practice banks is significantly increased by 17.4 % for the period 2008-2012 by Information technology. Thus, some of SBI& Associate Bank cost efficiency reduced by 17.4 % for the period 2008-2012.

There is significant difference among the Indian SBI bank group in their cost efficiency.There is no significant difference in cost inefficiency among the Indian SBI bank group in year-wise.

The findings of this paper suggest that to some extent IT impact the cost efficiency of Indian public sector banks. Some of nationalised bank cost inefficiency increased by 3 % for the study period by Information Technology (IT) and for SBI & it's associate banks cost inefficiency increased by 17.4 % by Information Technology (IT).

This is due to the higher cost for IT expenditure and realized benefit is comparatively smaller. The Information Technology increased cost inefficiency to both Nationalised banks and SBI& its associate banks old and new public sector banks.

## REFERENCES

Aigner, D.J., C.A.K. Lovell and P. Schmidt, 1977. "*Formulation and Estimation of Stochastic Frontier Production Function Models*," Journal of Econometrics, 6(1): 21-37.

Allen N. Berger, 2003. "*The Economic Effects of Technological Progress: Evidence from the Banking Industry* " Journal of Money, Credit and Banking, 35(2): 141-176.

Altinkemer, Kemal; De, Prabuddha; and Ozdemir, Zafer, 2006 *"Information Systems and Health Care XII: Toward a Consumer-to-Healthcare Provider (C2H) Electronic Marketplace*," Communications of the Association for Information Systems, Vol. 18, Article 19. http://aisel.aisnet.org/cais/vol18/iss1/19.

Altunbas, Y., M.H. Liu, P. Molyneux and R. Seth, 2000. "*Efficiency and Risk in Japanese Banking*", Journal of Banking and Finance, 24: 1605-1628.

Baker, R. And E. Berenblum, 1996. *Aligning the IT audit strategy with the business strategy – strategies for survival in uncharted waters*, Australasian Regional Conference "State of Play" EDPAC, Perth, 163-176.

Barbara Casu & Claudia Girardone, 2005. "*An analysis of the relevance of off-balance sheet items in explaining productivity change in European banking*," Applied Financial Economics, Taylor and Francis Journals, 15(15): 1053-1061.

Claudia Girardone, Philip Molyneux And Edward P.M. Gardenerx, 2004. "*Analysing the determinants of bank efficiency: the case of Italian banks*",Applied Economics, 36: 215-227.

Costas Lapavitsas And Paulo L. Dos Santos, 2008." *Globalization And Contemporary Banking: On The Impact Of New Technology* "Contributions to Political Economy, 27: 31-56.

Jeffrey, A. Clark; Thomas F. Siems, 2002. "*X-Efficiency in Banking: Looking beyond the Balance Sheet*",Journal of Money, Credit and Banking, 34(4): 987-1013.

Kaparakis, E., S. Miller and A. Noulas, 1994. "*Short-Run cost Inefficiency of Commercial Banks: A Flexible Stochastic Frontier Approach*", Journal of Money, Credit and Banking, 26: 875-893.

Kodde and Palm, 1986. Wald Criteria for Jointly Testing Equality and Inequality Restrictions,' *Econometrica* , 54(5): 1243-1248.

Lapavitsas, Costas and Dos Santos, L. Paulo, 2008. *Globalization and Contemporary Banking: On the Impact of New Technology* (2008). Contributions to Political Economy, 27(1): 31-56.

Laurent Weill, 2009. *"Convergence in banking efficiency across European countries*," Journal of International Financial Markets, Institutions and Money, Elsevier, 19(5): 818-833.

Lee, B., and N.M. Menon, 2000. "Information Technology Value through Different Normative Lenses," Journal of Management Information Systems (16:4): 99-119.

Meeusen, W. and J. van den Broeck, 1977. "*Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error*," International Economics Review, 18(2): 435-444.

Morrison, C., and E. Berndt, 1990. "Assessing the Productivity of Information Technology Equipment in the US Manufacturing Industries." Working Paper No. 3582 (January). Cambridge, MA: National Bureau of Economic Research.

Namchul Shin, 2006. "The impact of information technology on the financial performance of diversified firms", Decision Support Systems, 41: 698-70.

Rai, A., R. Patnayakuni, and N. Patnayakuni, 1997. "Technology Investment and Business Performance," Communications of the ACM, 40(7): 89-97.

Sealey C. and J. Lindley, 1977. "*Inputs, Outputs, and a Theory of Production and Cost at Depository Financial Institutions*", Journal of Finance, 32: 1251-1266.

Shao, B.B.M. and W.T. Lin, 2001. "Measuring the Value of Information Technology in Technical Efficiency with Stochastic Production Frontiers," Information and Software Technology, 43: 447-456.

Shirley J. Ho and Sushanta K. Mallick, 2008."The Impact of Information Technology on the Banking Industry: Theory and Empirics" Queen Mary, University of London, UK.

Simon H. Kwan, 2001. "The X-efficiency of commercial banks in Hong Kong," Working Papers in Applied Economic Theory , Federal Reserve Bank of San Francisco.

Sushanta, K. Mallick & Shirley J. Ho, 2008. "On Network Competition And The Solow Paradox: Evidence From Us Banks," Manchester School, University of Manchester, 76(s1): 37-57, 09.

William, C. Hunter; Stephen G. Timme, 1991. "Technological Change in Large U.S.Commercial Banks",The Journal of Business, 64(3): 339-362.

Yao Chen and Joe Zhu, 2004.,"Measuring Information Technology's Indirect Impact on Firm Performance" Information Technology and Management, 5: 9-22.