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# An Analysis and Measurement of the Productivity of Indian Banking Sector

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**Abstract**
This paper attempts to provide empirical evidence regarding the growth in productivity of the Indian banking industry. The basic aim of the paper is to find out whether there has been any increase in the productivity of the Indian banking industry as a whole, over the period 2002 to 2010. Furthermore, a sample comprises of twenty banks has been compared with entire Indian banking industry for productivity results and analysis. Our findings revealed that the performance of the Indian banking industry remained moderate for the period 2002 till 2010 despite of the financial crisis 2008. Indian financial system remained sheltered from external shocks during the period merely because of having flexible exchange rate regime, the foreign reserves were high, the capital account is not yet fully convertible, and banks and their customers have limited foreign exchange exposure. Therefore, in present scenario, we recommend that the policy makers should carry on with their current economic policy as it has been successful in sheltering them from external shocks. Furthermore the policy makers have to emphasize on increasing the deposit base of the banks by increasing the interest rates on deposits. This paper proceeds as follows. The first section is about Introduction, next section reviews the empirical literature, section 3 is about data and methodology. In section 4 we present our analysis and findings and finally section 4 concludes.
**Keywords:** Indian banking industry, Growth, Productivity, Financial turmoil, Economic policy

## 1. Introduction

This Study explores the productivity growth of Indian banking industry for the period 2002 to 2010. The investigation of the productivity growth is achieved by computing Total Factor Productivity (TFP) growth using Cobb-Douglas production function, for determining the productivity growth. The basic aim of the study is to answer weather there has been any increase in the productivity of the sample Indian commercial banks and the Indian banking industry as a whole, over the period of nine years, from 2002 to 2010. It also compares the productivity results of the sample twenty banks selected for our study with that of the productivity of the Indian banking industry.

The study attempts to provide empirical evidence regarding the growth in productivity of the Indian banking industry. First, the study will present a detailed review of the productivity literature focusing on the developments relating to the parametric and non-parametric approaches as well as development in the literature on measurement of TFP with the non-parametric Malmquist index. Second, the study discusses about the data required to carry out the productivity exercise. This includes the sources of data, the sample set of banks used in the study, the processing of the data from its raw form and the descriptive statistics.

Third, the study discusses about the model used for determining the productivity of the commercial banks in India, the input/output variables, along with a brief overview of the model used for this purpose.

In the end, the results of the model and approaches used for determining the productivity are being discussed in detail along with a comparison for the productivity of the sample set of banks with that of the Indian banking industry.

Productivity, in simple terms, is just the ratio of the output to the input. Suppose, if we have only one output variable and one input variable, then we can define productivity as (Productivity = output / input).

In reality, firms depend on more than one input in the production process. Like in case of banking industry, banks got a combination of inputs which include “labor, deposits, fixed assets” and others. Again, it’s highly likely that more than one output is produced. For instance, loans are provided by banks as their main source of income whereas it also receives incomes from other earning assets, like loans to interbank, deposits with central bank, treasury activities and so on. Therefore, productivity that we are discussing here usually refers to “multiple factor productivity” or “total factor productivity (TFP)” referring to change in outputs as compared to inputs. For banking literature, “non-parametric methods” like “data envelopment analysis (DEA)”, as well as parametric techniques like stochastic frontier approach (SFA) are normally used for the estimation of the TFP change.

Dramatic Changes along with some rapid developments, for the past two decades, had been witnessed by the banking and financial systems over the world. On the one hand, banking deregulation, financial integration and merger and acquisition remark the extensive transformation of banking operational environment.

 

On the other hand, driven by the technological innovation, banks are able to save costs in providing financial services and create a range of new products. (Shen, 2009) . Being inspired by such developments, various studies on banking productivity & efficiency had been carried out so as to let know about this sector's performance and fast changing environment to the regulators, policy makers and practitioners.

## 2. Literature Review

When we talk about measuring productivity in the banking industry, there exist a broad literature investigating the productivity changes and issues. Banking Industries of the developed countries are mostly focused in these empirical studies, for example a survey by (Berger and Humphrey, 1997) and a short review by (Casu et al., 2004).

Mostly the impact of regulatory and other environmental factors on bank productivity are being studies and investigated in these analyses , like in a study conducted by (Sturm and Williams, 2004) , he assessed post-deregulation productivity performance of the banks for Australian banking industry ; Similar study on post-deregulation productivity was undertaken by (Tsionas et al., 2003) and (Rezitis, 2006) to investigate Greek banking industry ; and (Lozano-Vivas et al., 2002) and (Grifell-Tatjé and Lovell, 1996, Grifell-Tatjé and Lovell, 1997) analyzed the deregulation impact on bank productivity for the Spanish banking system .

Over the past twenty years or so, banking system has been deregulated by a large number of economies, including the developed countries, in order to bring about changes and improvement in the profitability, efficiency and also productivity, as well as to increase international competitiveness. India, after facing the economic crisis of 1991, began with their financial deregulation in 1992, thereby marking an important step towards economic and structural reform.

According to the studies on the productivity of Spanish Banks in the post-deregulation period by (Grifell-Tatjé and Lovell, 1996), for the period 1986 to 1993 using DEA approach and Malmquist productivity index, the author claimed that Spanish banks faced a decline in productivity, mainly due to the deterioration in production possibilities. To prove this, the authors examined the effect of branching and consolidation on the banks performance and concluded that the expansion & the mergers and acquisitions are not the causes of this decline in productivity. They further suggested that the new environment of open competition was brought by deregulation and liberalization in the country and that was the main cause of decline as the Spanish banks faced difficulties in adapting this new environment. Similarly , (Lozano-Vivas et al., 2002) using Parametric (Stochastic cost frontier) and nonparametric (Malmquist index) techniques analyzed the Spanish banking system and determined the decline in the productivity during the period 1986 – 1991.

(Gilbert and Wilson, 1998) asserted in their study which was conducted on the Korean banking industry that privatization and deregulation enhance potential output and productivity. Similarly researches on productivity development on the Turkish banking industry were concluded by (Isik and Kabir Hassan, 2003) & (Isik and Hassan, 2003) were conducted. Isik & Hassan made a research on banks performance in post deregulation period for turkey. They examined the productivity growth in Turkish commercial banks by utilizing an index i.e. DEA-type Malmquist productivity. They find that the banks have recorded significant productivity gains driven mostly by efficiency increases rather than technical progress.

(Guarda and Rouabah, 2009) carried out a study on Bank productivity and efficiency in Luxembourg and concluded that Productivity increase among Luxembourg banks was decomposed into technical change and efficiency gains. The study was conducted using quarterly data (1994 to 2007). He found that productivity increased on average about 1% per quarter in Luxembourg banks. Big banks showed the productivity growth above than the average. In most cases, productivity growth results from efficiency gains in spite of technical progress. Sometimes few individual banks shift the efficient frontier outwards, while most of the merely follow, improving their productivity by reducing inefficiency as compared to the top performers.

Another study carried out by (Karligash and Thomas, 2009) to measure efficiency and productivity of Russian banks, where a panel of over 900 commercial banks was used. They have concluded the research and found that the productivity of Russian banks was slightly declined during the period 1997 to 2005. This decline was in banking service production & financial intermediation. However, the profit generating procedures of the commercial banks were dynamic throughout the time span included in their analysis. Returns to scale profile is the main driver of banking productivity. The banks with more retail banking business are more profitable than the banks which involves only in services of business banking. Larger banks have weaker effect on banking system performance, while deposit insurance seems to have a positive effect on banking system performance.

## 3. Methodology And Data

### *3.1. Methodology*

In our analysis of productivity for Indian banking industry, we will be using Cobb Douglas production function in order to determine the TFP change for the Indian banking industry. TFP was first discussed by Robert Solow (Solow, 1956:58). Solow explained the issues by Cobb-Douglas production function as follows:

 

$$Y = F(A, K, L)$$

Where;

Y = aggregate production.

A = technology,

K = physical capital

L = labor force.

Technology is an independent variable .In Hicks-Natural form , modified production functions is

$$Y = A \cdot F(K, L) \quad (1)$$

As seen in in this equation, production function is influenced technological progress. Function, in terms of growth rate can be written by taking differences of eq (1) as follows :

$$\frac{Y^*}{Y} = \frac{A^*}{A}\left(\frac{F_A A}{Y}\right) + \frac{L^*}{L}\left(\frac{F_L L}{Y}\right) + \frac{K^*}{K}\left(\frac{F_K K}{Y}\right) \quad (2)$$

FK and FL represents marginal product of capital and labor. If;

$$\frac{F_L L}{Y} = \frac{WL}{Y} = S_L$$

$$\frac{F_K K}{Y} = \frac{RK}{Y} = S_K$$

$$\frac{A^*}{A} = \left(\frac{F_A A}{Y}\right) = g$$

Where “w’ and “R” are Labor force and physical capital income, SK and SL are the capital and labor share in the production (income). Now, we can write eq (2) as;

$$g = \frac{Y^*}{Y} - \frac{L^*}{L}(S_L) + \frac{K^*}{K}(S_K)$$

The total factor productivity (g) can be written as :

$$g = \frac{Y^*}{Y} - \frac{K^*}{K}(S_K)$$

In economics, Cobb-Douglas function form of production is widely used to represent the relationship of an output to inputs. It was proposed by Knut Wicksell and was tested against statistical evidence by Charles Cobb and Paul Douglas in 1928. They used the following function in order to model the production of American economy for the period 1899 to 1922.

$$P(L, K) = b\, L^{\alpha}\, K^{\beta}$$

Where, P = Total Production

L = Labor Input

K = Capital input

β = Total factor productivity (TFP)

α and β are output elasticity of labor & capital measuring the responsiveness of output for a given change in input , Labor and capital in this case. Also , if α + β = 1 , then we have constant return to scale for the production function i.e if input is increased by a certain amount , output also increases by the same amount. In our research , the function which we used for modeling productivity is as follows :

$$Q = \beta\, D^{\alpha 1}\, E^{\alpha 2}\, FA^{\alpha 3} \qquad Q = \beta\, f(D, E, FA)$$

 

Where

Q = Loans & Advances (Output)
D = Deposits
E = Staff / Employees (Inputs)
FA = Fixed Assets
β = Total Factor Productivity (TFP)
And **α1 + α2 + α3 = 1** (Constant Return to Scale)

After Log linearizing this function we get the following:

$$\mathbf{Ln\ Q = Ln\ \beta + \alpha 1\ Ln\ D + \alpha 2\ Ln\ E + \alpha 3\ Ln\ FA}$$

So, after taking the log of advances (credits), deposits, fixed assets and employees , we run the following regression for our data in panel format :

**Ln _Q c Ln_D Ln_ E Ln_ FA**

We estimate the above said equation , running several regression for different panel methods starting with "ordinary" and then using "White cross section" , White Diagonal" and "Cross Section Weights" methods for different combinations of cross sections and periods (Fixed , Random and None). In our case , the cross sections are the banks and period are the number of years.

Furthermore, we check each estimated equation for constant return to scale using Wald test. ( i.e to determine if the sum of the coefficients of the input variables is equal to 1 ) . From the estimated equations which passes the CRTS test, we use the values of the coefficients for the best equation (selected on the basis of AIC and $R^2$ value in case of multiple equations passing the CRTS test ) to run the following regression for finding the value of Ln β :

$$\mathbf{Ln\ \beta = Ln\ Q - \alpha 1\ Ln\ D - \alpha 2\ Ln\ E - \alpha 3\ Ln\ FA}$$

From here, we will get value of Ln β for our 180 observations (20 banks * 9 years = 180 Lnβ) for every years from 2002 to 2010 for 20 banks. After that we calculated the TFP (β) by taking the anti-log of the calculated values of Lnβ in order to determine whether the productivity of the banks have actually increased or decreased for the said period.

The above said procedure is carried out on the "Bank-Wise' panel data set for 20 commercial banks of India. The same procedure will be performed for the time series "aggregate data" collected from 2002 to 2010, for all the Indian Scheduled commercial banks and the performance of the 20 selected banks will be compared with the overall performance of the banking industry to determine which bank is performing well and which is not. On the basis of this , we can categorized our chosen 20 commercial banks into " Good " , " Bad " and " No Change " categories . Before that , we need to divide the values of each variable with the number of banks in India for which the aggregate data is collected to work on the average basis.

### *3.2. Data*

The Reserve bank of India's database has been used for extracting the data for the following twenty banks on India over the period of ten years, as well as for the aggregate of all schedule commercial banks in India. These banks have been selected randomly and includes banks belonging to old private sector , new private sector , public sector , State bank and its associates and foreign banks . Regional and rural banks are not considered for this analysis.

The data set includes bank-wise data on demand deposits, bank wise fixed assets, bank wise loans & advances, bank wise number of employees, bank wise nonperforming assets, aggregate of demand deposits for all schedule commercial banks, loans & advances, fixed assets and number of employees and non-performing assets for all schedule commercial banks of India.

Other data includes yearly weighted average interest rate on loans , interest rate on deposits , interest rate for 364 days treasury bills , Consumer Price Index(CPI), Wholesale Price Index(WPI), Gross Domestic Product(GDP), GDP deflator and personal disposable income and total labor force. These data have been collected for past ten year's period.

 

Table 1 – The sample of twenty Banks

| State bank of India & its Associates | Public Sector Banks (Nationalized) |
|---|---|
| 1. State Bank of India | 5.Allahabad Bank |
| 2. State Bank of Hyderabad | 6. Bank of Baroda |
| 3. State Bank of Mysore | 7. Bank of India |
| 4. State Bank of Patiala | 8. Union Bank of India |
| | 9. United Bank of India |
| **Private Sector Banks ( Old & New )** | **Foreign Banks** |
| 10. Axis Bank ( Former UTI Bank) | 16. Abu Dhabi Commercial Bank |
| 11. ICICI Bank | 17. Bank of America |
| 12. Karnataka Bank | 18. BNP Paribas |
| 13. Federal Bank | 19. Citi Bank |
| 14. Jammu & Kashmir Bank | 20.Deutsche Bank |
| 15. South Indian Bank | |

All the values in the data sets have been converted into one common measuring unit i.e. "Millions" from their respective units. Now, In order to perform regression on the collected data set, we first need to convert them in real terms. For that purpose, we need to divide them by Consumer Price index and Wholesale Price Index for the respective years.

Loan & Advances and Fixed Assets are divided by the WPI for that year to arrive at the real value terms for these two variables, whereas demand deposits and non-performing loans are divided by their respective CPI value for that year in order to arrive at their real values. Same exercise has been carried out on data for both individual banks and aggregate for all schedule commercial banks. Similarly Gross Domestic product has also been converted into its real value terms by dividing it by GDP deflator.

In order to arrive at the yearly average wage rate, we used the data for personal disposable income and divide it by the total labor force to arrive at this value.

### *3.3. Descriptive Statistics*

For the Bank-wise data, Table 2 provides some descriptive statistics of variables used for a common panel of 20 commercial banks in India as well as aggregate data for the years 2002 to 2010. Table 2 shows the descriptive stats of the selected variables over the period of nine years, from 2002 to 2010.The variations in the variables around their descriptive measures mean, standard deviation (S.D) is a little bit substantial, partly due to the difference in size of banks in the sample, for example, the one of the large bank in the sample has 209462 employees in 2002, whereas small bank has a total staff of only 82 during the same period.

 

Table 2- Summary Statistics Of Inputs And Outputs (Bank-Wise Data)

| Years | Descriptive Statistics Measures | Dependent Variables (OUTPUT) | INDEPENDENT VARIABLES (INPUT) | | |
|---|---|---|---|---|---|
| | | Credits | Demand Deposits | Fixed Assets | No. of Employees |
| 2002 | Mean | 2015.7 | 475.87 | 64.991 | 21171.35 |
| | S.D | 3260.606 | 1033.96 | 120.223 | 46048.28 |
| | Minimum | 35.192 | 4.07 | 1.026 | 82 |
| | Maximum | 14212.525 | 4748.91 | 498.746 | 209462 |
| 2003 | Mean | 2166.578 | 473.75 | 61.159 | 21399.45 |
| | S.D | 3510.968 | 1047.28 | 109.834 | 45903.87 |
| | Minimum | 30.547 | 7.65 | 0.906 | 78 |
| | Maximum | 15374.828 | 4845.5 | 453.206 | 208998 |
| 2004 | Mean | 2316.94 | 549.07 | 61.215 | 21415.5 |
| | S.D | 3753.475 | 1131.831 | 105.45 | 45403.42 |
| | Minimum | 17.547 | 5.92 | 0.824 | 76 |
| | Maximum | 16537.543 | 5244.09 | 424.755 | 207039 |
| 2005 | Mean | 2891.847 | 620.22 | 61.826 | 21640.75 |
| | S.D | 4654.58 | 1229.115 | 100.852 | 44989.57 |
| | Minimum | 8.985 | 6.19 | 0.759 | 37 |
| | Maximum | 20237.445 | 5661.23 | 403.804 | 205515 |
| 2006 | Mean | 3728.141 | 714.19 | 60.395 | 21739 |
| | S.D | 5950.953 | 1394.675 | 95.51 | 43497.04 |
| | Minimum | 11.324 | 5.16 | 0.675 | 38 |
| | Maximum | 24995.316 | 6408.64 | 380.056 | 198774 |
| 2007 | Mean | 4691.447 | 824.21 | 63.219 | 21833.9 |
| | S.D | 7366.052 | 1584.437 | 90.951 | 40556.09 |
| | Minimum | 18.521 | 5.24 | 0.611 | 36 |
| | Maximum | 30708.83 | 7262.88 | 357.162 | 185388 |
| 2008 | Mean | 5365.4 | 966.41 | 80.907 | 22090.4 |
| | S.D | 8258.006 | 1749.125 | 104.148 | 39217.33 |
| | Minimum | 13.576 | 5.48 | 0.554 | 39 |
| | Maximum | 34908.133 | 8024 | 344.158 | 179205 |
| 2009 | Mean | 6362.703 | 953.46 | 84.396 | 23382.35 |
| | S.D | 10111.133 | 1777.109 | 101.558 | 44766.46 |
| | Minimum | 11.327 | 7.89 | 0.533 | 40 |
| | Maximum | 44394.698 | 8167.67 | 314.063 | 205896 |
| 2010 | Mean | 6578.951 | 996.23 | 77.128 | 23476.5 |
| | S.D | 10532.487 | 1778.469 | 92.533 | 43551.27 |
| | Minimum | 11.39 | 5.48 | 0.466 | 41 |
| | Maximum | 47228.262 | 8069.75 | 329.814 | 200299 |
| Aggregate Data | Mean | 155943.1 | 31139.22 | 2847.28 | 1018209.11 |
| | S.D | 70937.91 | 10222.17 | 699.5696 | 36887.384 |
| | Minimum | 75969.76 | 17177.1 | 2241.152 | 962170 |
| | Maximum | 261364.3 | 42870.81 | 3957.529 | 1079411 |

## 4. Results & Discussion

After estimating our basic regression equation using different methods for panel data option and with different Cross section and period effects (None , Fixed and Random ) , we select only those results which satisfies the Wald test results for constant result to scale ( 10% significance level ) in order to calculate the value for Ln_B and thereon the value for TFP (β). In our case , as the table below shows , there were multiple estimation equations that satisfied the Wald test for CRTS .Table 3 summarizes the estimation outputs ($R^2$ and AIC) and Wald test results:

 

Table 3 – Estimation Output ($R^2$, AIC and Wald Test P-value)

| PANEL OPTION - ORDINARY | | | | | |
|---|---|---|---|---|---|
| ESTIMATION OUTPUT | | | | | WALD TEST RESULT |
| OBS # | EFFECT SPECIFICATIONS | | $R^2$ | AIC | ( P- VALUE ) |
| | CROSS SECTION | PERIOD | | | |
| **1** | None | Fixed | 0.9647 | 0.607 | -0.693 |
| **2** | None | None | 0.9492 | 0.8813 | -0.3483 |
| **3** | None | Random | 0.94928 | - | -0.2721 |
| **4** | Random | Fixed | 0.9007 | - | -0.3091 |
| **5** | **Fixed** | **Fixed** | **0.9889** | **-0.3453** | **-0.1098** |
| PANEL OPTION – WHITE CROSS SECTION | | | | | |
| **6** | **Fixed** | **Fixed** | **0.9889** | **-0.3453** | **-0.1729** |
| **7** | None | Fixed | 0.9647 | 0.607 | -0.6662 |
| **8** | None | None | 0.9492 | 0.8813 | -0.2281 |
| **9** | None | Random | 0.9492 | - | -0.2281 |
| **10** | Random | Fixed | 0.9007 | - | -0.5414 |
| **11** | Random | Random | 0.7984 | - | -0.1194 |
| PANEL OPTION – WHITE (DIAGONAL) | | | | | |
| ESTIMATION OUTPUT | | | | | WALD TEST RESULT |
| OBS # | EFFECT SPECIFICATIONS | | $R^2$ | AIC | |
| | CROSS SECTION | PERIOD | | | |
| **12** | **Fixed** | **Fixed** | **0.9889** | **-0.3453** | **-0.2405** |
| **13** | None | Fixed | 0.9647 | 0.607 | -0.7566 |
| **14** | None | None | 0.9492 | 0.8813 | -0.3536 |
| **15** | None | Random | 0.9492 | - | -0.3536 |
| **16** | Random | Fixed | 0.9007 | - | -0.4676 |
| PANEL OPTION – CROSS SECTION WEIGHTS | | | | | |
| **17** | **Fixed** | **Fixed** | **0.9889** | **-0.3453** | **-0.1845** |
| **18** | None | Fixed | 0.9647 | 0.607 | -0.7511 |
| **19** | None | None | 0.9492 | 0.8813 | -0.3692 |
| **20** | None | Random | 0.9492 | - | -0.3692 |
| **21** | Random | Fixed | 0.9007 | - | -0.4777 |

At 10% significance, for Wald test, if the P-Value is less than 10% then we reject the null in favor of alternative. The null in our case, for Wald test is that the sum of the coefficients of the input variables shows constant return to scale ( H0 : $\boldsymbol{\alpha 1 + \alpha 2 + \alpha 3 = 1}$ ).

From the table given above, we need to select only one observation for calculating the value of LN_B using the value of the coefficients of input variables from that one selected observation in the following equation :

$$\mathbf{Ln\ \beta = Ln\ Q - \alpha 1\ Ln\ D - \alpha 2\ Ln\ E - \alpha 3\ Ln\ FA}$$

Selecting on the basis of $R^2$ and AIC (Higher the value $R^2$ , the better and lower the value of AIC, the better), we are left with observation number 5 , 6 , 12 and 17 . Since all four observations have got the same values for $R^2$ and AIC , we will look into how significance the input variables are for these observations and

 

select the one which shows the high level of significance (from the estimation results) . The most reliable criteria was to select on the basis of P-value obtain from "Redundant fixed Effect" Test .Since the p-value obtained from there are all significant for the 4 methods used (0.0000) for fixed/fixed criteria, so we use the p-values of the variables obtained from the estimation results. Table 4 summarizes the p-values obtained for "Redundant fixed Effect" Test.

Table 4- Redundant Fixed Effect Tests

| Test Cross-Section and period fixed effects | | |
|---|---|---|
| Effects Test | Standard Error | Probability |
| Cross-section F | 17.26081 | 0.000 |
| Cross Section Chi | 209.4258 | 0.000 |
| Period F | 15.4296 | 0.000 |
| Period Chi | 108.482 | 0.000 |
| Cross-section/Period F | 19.8831 | 0.000 |
| Cross-section/Period Chi | 274.8069 | 0.000 |

The table 5 summarizes that p-values obtained from the initial estimations. The lower the P-value, the more significant the variable is.

Table 5 – P-Values of the variables from estimation results

| **OBS #** | **Effect Specifications** | | **Panel Method** | **Input Variables** | **( P- Value )** |
|---|---|---|---|---|---|
| | **Cross Section** | **Period** | | | |
| **5** | **Fixed** | **Fixed** | **Ordinary** | **Deposits**<br>**Fixed Assets**<br>**Employees** | **0.8523**<br>**0**<br>**0** |
| 6 | Fixed | Fixed | White Cross-Section | Deposits<br>Fixed Assets<br>Employees | 0.9006<br>0<br>0.0001 |
| 12 | Fixed | Fixed | White (Diagonal) | Deposits<br>Fixed Assets<br>Employees | 0.8952<br>0<br>0.0001 |
| 17 | Fixed | Fixed | Cross – Section Weight | Deposits<br>Fixed Assets<br>Employees | 0.8695<br>0<br>0 |

Looking at the table 5, we see that observation 5 best mach our purpose with p-value of 0.0000 for both fixed assets and employees and 0.8523 (the lowest in all four observations) for deposits . So from the table above, we find that observation 5 has got the lowest set of P-values for the three variables (obtained from the estimation output) making it more significant as compared to the rest of the three observation.

On the basis of this , we select observation 5 , having Fixed cross section and fixed period effect in order to calculate the value for Ln β and after that the Total Factor Productivity (β) by taking antilog of Ln_β . The estimates of the slope coefficients as well as their signs from the "Fixed-Fixed" estimation using ordinary panel method are presented in table 6.

Table 6 - Panel Regression

| **Dependent Variable: Credits** | | | | |
|---|---|---|---|---|
| **Variables** | **Coefficient** | **Standard Error** | **t-Statistic** | **Probability** |
| C | 1.862131 | 0.431189 | 4.318595 | 0 |
| LN_DP | -0.017437 | 0.09351 | -0.18647 | 0.8523 |
| LN_EMP | 0.471841 | 0.074132 | 6.364914 | 0 |
| LN_FA | 0.426095 | 0.045805 | 9.302429 | 0 |
| R-squared | 0.988982 | | | |
| Akaike Info Crit. | -0.345336 | | | |
| F-Statistic | 445.8184 | | | |
| Durbin-Watson | 0.81966 | | | |

More Specifically , the results of the probabilities in Table 6 indicates that only one of the coefficient is statistically insignificant i.e of deposits (LN_DP) at 5% or 10% significance level whereas the coefficients of Employees (LN_EMP) and Fixed assets (LN_FA) are highly significant with a probability of 0.0000. As a result, it says that the deposits affect negatively the credits and employees & fixed assets affects positively the credits.
By observing the signs of the coefficients of the explanatory factors, it is worth to mention that overall they present the expected signs with the exception of 1 factor; The Deposits (LN_DP). Despite the fact that an increase in deposits was assumed to lead to an increase of credits that banks can lend, the above factors present a

 

negative sign. Table 7 shows the results of the productivity of selected 20 banks.

Table 7 - Productivity of Selected 20 Commercial Banks of India

| **ABU DHABI COMMERCIAL BANK LTD** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.4599 | 4.2254 | 2.5465 | 1.8980 | 2.4754 | 4.3344 | 3.1920 | 2.6725 | 2.8170 |
| **ALLAHABAD BANK** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 2.6722 | 3.0282 | 3.6224 | 3.5693 | 4.7936 | 5.5425 | 6.3654 | 7.2579 | 8.2840 |
| **AXIS BANK LIMITED** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.7407 | 5.0528 | 4.6080 | 5.9851 | 6.9025 | 8.5063 | 9.6246 | 10.4105 | 11.7213 |
| **BANK OF AMERICA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 14.1599 | 17.3058 | 14.7805 | 17.3050 | 20.1735 | 15.9749 | 16.1223 | 15.2582 | 15.7150 |
| **BANK OF BARODA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.6505 | 4.6368 | 4.2441 | 4.9778 | 6.5241 | 8.2813 | 7.2913 | 9.9880 | 11.3082 |
| **BANK OF INDIA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.9986 | 5.2864 | 5.3288 | 6.2579 | 7.1860 | 9.3335 | 7.4597 | 9.1306 | 10.6880 |
| **BNP PARIBAS** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 3.4663 | 3.8593 | 3.6739 | 5.9985 | 6.5620 | 7.7717 | 11.5244 | 7.6536 | 7.6281 |
| **CITIBANK N.A** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 8.3529 | 8.4566 | 9.0251 | 8.7688 | 10.6834 | 9.5890 | 11.6873 | 11.8333 | 10.6726 |
| **DEUTSCHE BANK(ASIA)** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.4547 | 4.2304 | 5.2650 | 6.5782 | 4.5921 | 4.5693 | 6.4754 | 9.0030 | 12.3339 |
| **FEDERAL BANK LTD** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 3.3033 | 3.5228 | 4.0305 | 4.3722 | 6.0296 | 7.2523 | 7.4727 | 7.7269 | 8.5575 |
| **ICICI BANK LIMITED** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 6.3434 | 5.9019 | 6.2074 | 7.8534 | 10.5414 | 12.2049 | 11.9731 | 12.7040 | 10.7047 |
| **JAMMU & KASHMIR BANK LTD** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 3.7110 | 4.2431 | 4.4967 | 5.4546 | 6.8133 | 8.0232 | 7.9337 | 8.4976 | 8.7895 |
| **KARNATAKA BANK LTD** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 3.3496 | 3.5479 | 3.8379 | 4.9273 | 5.7965 | 6.7799 | 6.8236 | 6.7060 | 7.3925 |
| **SOUTH INDIAN BANK** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.1391 | 4.2035 | 4.3618 | 5.0396 | 5.3998 | 6.4135 | 7.0384 | 7.0268 | 8.2237 |
| **STATE BANK OF HYDERABAD** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.2671 | 4.5366 | 4.6149 | 5.8742 | 6.8625 | 8.7631 | 10.4923 | 12.4417 | 13.0555 |
| **STATE BANK OF INDIA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.5774 | 5.0954 | 5.4236 | 6.7444 | 8.5751 | 11.0233 | 12.2420 | 13.9438 | 14.7148 |
| **STATE BANK OF MYSORE** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.4171 | 4.5013 | 3.9155 | 4.9134 | 4.9840 | 7.4462 | 9.3971 | 5.2786 | 5.6653 |
| **STATE BANK OF PATIALA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 4.8480 | 5.2885 | 6.0977 | 6.8975 | 8.6370 | 11.1527 | 12.1877 | 13.8076 | 12.9700 |
| **UNION BANK OF INDIA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 3.4578 | 4.0389 | 4.4087 | 5.5200 | 7.2400 | 8.1363 | 6.1431 | 7.4478 | 8.7437 |
| **UNITED BANK OF INDIA** | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| **β** | 2.2745 | 2.4390 | 2.5264 | 3.4783 | 4.6088 | 4.1076 | 4.9897 | 6.4171 | 7.1295 |

 

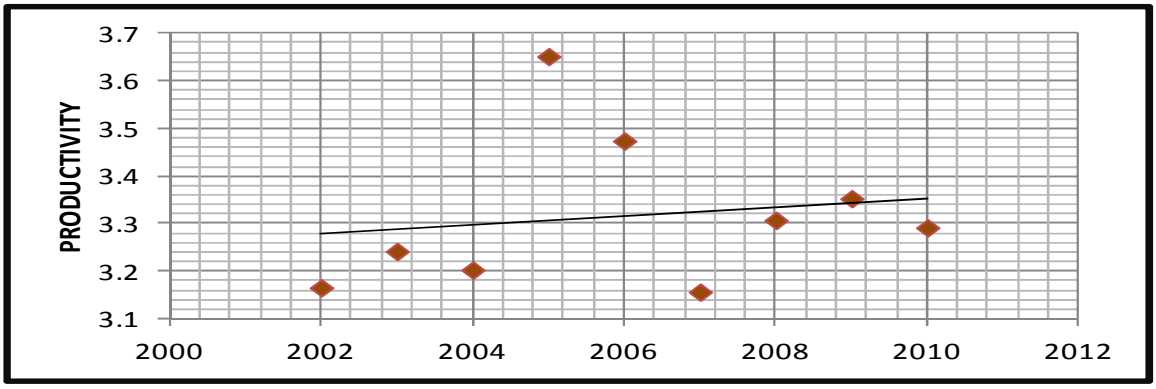


Fig 1 - Total Factor Productivity – Indian Banking Industry

| Year | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|
| β | 3.1656 | 3.2422 | 3.2031 | 3.6516 | 3.4739 | 3.1564 | 3.3074 | 3.3533 | 3.2919 |

As can be seen from the results above, the banks have performed well during the observed period resulting in an overall increase in the productivity of the banking industry. Productivity was highest in the year 2005 and after that it started to decline from 2005 till 2007. The reason behind the decline may possibly be due the in-coming global financial crises which resulted in the threat of total collapse from large financial institutions, the bailout of banks by national governments and downturns in stock markets around the world when it occurred. The crisis played a significant role in the failure of key businesses, declines in consumer wealth estimated in trillions of US dollars, and a downturn in economic activity.

In the period of financial crisis, from 2007 onwards, expectations were that the productivity would record a decline for the banking industry as it had for the rest of the world. Instead, great resilience was showed by the Indian financial system, showing an increasing trend for the productivity of the banking industry during that period. As we saw how other East Asian Countries suffered from the crisis which were triggered by some external macro-economic factors or shocks, however, Indian financial system remained sheltered from such external shocks as a result of having "flexible exchange rate regime, the foreign reserves are high, the capital account is not yet fully convertible, and banks and their customers have limited foreign exchange exposure."

Table 08 - Comparison of Productivity of Sample Banks with the Overall Banking Industry
(Industry Comparison with Sample Banks)

| Year | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|
| **Industry β** | 3.166 | 3.242 | 3.203 | 3.652 | 3.474 | 3.156 | 3.307 | 3.353 | 3.292 |
| **Abu Dhabi** | 4.460 | 4.225 | 2.547 | 1.898 | 2.475 | 4.334 | 3.192 | 2.673 | 2.817 |
| **Allahabad** | 2.672 | 3.028 | 3.622 | 3.569 | 4.794 | 5.543 | 6.365 | 7.258 | 8.284 |
| **AXIS** | 4.741 | 5.053 | 4.608 | 5.985 | 6.903 | 8.506 | 9.625 | 10.411 | 11.721 |
| **BOA** | 14.160 | 17.306 | 14.781 | 17.305 | 20.174 | 15.975 | 16.122 | 15.258 | 15.715 |
| **Baroda** | 4.651 | 4.637 | 4.244 | 4.978 | 6.524 | 8.281 | 7.291 | 9.988 | 11.308 |
| **BOI** | 4.999 | 5.286 | 5.329 | 6.258 | 7.186 | 9.334 | 7.460 | 9.131 | 10.688 |
| **BNP Paribas** | 3.466 | 3.859 | 3.674 | 5.999 | 6.562 | 7.772 | 11.524 | 7.654 | 7.628 |
| **CITI** | 8.353 | 8.457 | 9.025 | 8.769 | 10.683 | 9.589 | 11.687 | 11.833 | 10.673 |
| **Deutsche** | 4.455 | 4.230 | 5.265 | 6.578 | 4.592 | 4.569 | 6.475 | 9.003 | 12.334 |
| **Federal** | 3.303 | 3.523 | 4.031 | 4.372 | 6.030 | 7.252 | 7.473 | 7.727 | 8.558 |
| **ICICI** | 6.343 | 5.902 | 6.207 | 7.853 | 10.541 | 12.205 | 11.973 | 12.704 | 10.705 |
| **J & K Bank** | 3.711 | 4.243 | 4.497 | 5.455 | 6.813 | 8.023 | 7.934 | 8.498 | 8.790 |
| **Karnataka** | 3.350 | 3.548 | 3.838 | 4.927 | 5.797 | 6.780 | 6.824 | 6.706 | 7.393 |
| **South Indian** | 4.139 | 4.204 | 4.362 | 5.040 | 5.400 | 6.414 | 7.038 | 7.027 | 8.224 |
| **BOH** | 4.267 | 4.537 | 4.615 | 5.874 | 6.863 | 8.763 | 10.492 | 12.442 | 13.056 |
| **SBI** | 4.577 | 5.095 | 5.424 | 6.744 | 8.575 | 11.023 | 12.242 | 13.944 | 14.715 |
| **SBM** | 4.417 | 4.501 | 3.916 | 4.913 | 4.984 | 7.446 | 9.397 | 5.279 | 5.665 |
| **SBP** | 4.848 | 5.289 | 6.098 | 6.898 | 8.637 | 11.153 | 12.188 | 13.808 | 12.970 |
| **Union** | 3.458 | 4.039 | 4.409 | 5.520 | 7.240 | 8.136 | 6.143 | 7.448 | 8.744 |
| **United** | 2.275 | 2.439 | 2.526 | 3.478 | 4.609 | 4.108 | 4.990 | 6.417 | 7.130 |

 

As can be seen from the table presented above, the overall productivity of the Indian banking industries shows an increasing trend from 2002 to 2010. Comparing the productivity of our sample 20 banks with that of the industry, we see that majority of the commercial banks also showed an increasing trend in productivity, with productivity of the individual banks being more than that of the industry average productivity. There were three banks , Allahabad bank (till 2003) and United Bank of India ( till 2004) and Abu Dhabi Commercial bank (2004 to 2006 and from 2008 to 2010) , showed productivity lower than that of the industry average , but gained momentum (Allahabad Bank and United Bank of India) afterwards. Abu Dhabi commercial bank was not able to cope up with the industry average.

Great resilience was showed by the Indian financial system. As we saw how other East Asian Countries suffered from the crisis which were triggered by some external macro-economic factors or shocks, however, Indian financial system remained sheltered from such external shocks as a result of having "flexible exchange rate regime, the foreign reserves are high, the capital account is not yet fully convertible, and banks and their customers have limited foreign exchange exposure."

Eighteen out of sample twenty banks showed an increase in the productivity, so we classify them in the "Good" category. Similarly, only one bank showed a decrease in the productivity over the sample period and one bank showed no change in the productivity , so can be classified in "Bad" and "No Change" Category, though these banks have productivity greater than that of the industry average. Table 09 presents this categorization.

Table 09 - Classification of Banks on the Basis of Change in Productivity

| **GOOD Performers** | | |
|---|---|---|
| ALLAHABAD BANK | AXIS BANK LIMITED | BANK OF BARODA |
| BANK OF INDIA | BNP PARIBAS | CITIBANK N.A |
| DEUTSCHE BANK(ASIA) | FEDERAL BANK LTD | ICICI BANK LIMITED |
| JAMMU & KASHMIR BANK LTD. | KARNATAKA BANK LTD | SOUTH INDIAN BANK |
| STATE BANK OF HYDERABAD | STATE BANK OF INDIA | STATE BANK OF MYSORE |
| STATE BANK OF PATIALA | UNION BANK OF INDIA | UNITED BANK OF INDIA |
| **BAD Performers** | **No Change** | |
| ABU DHABI COMMERCIAL BANK | BANK OF AMERICA | |

## 5. Conclusion

Our study attempted to measure the productivity levels of few of the Indian commercial banks and the banking industry as a whole, for the period 2002 to 2010 using Cobb-Douglas productivity function to determine whether the productivity has improved or not due to the mentioned reforms.

Based on the methodology, our results showed that the Indian banking industry has gone through an inclining period in terms of productivity from 2002 to 2012 due to the reforms that took place. Using Cobb-Douglas approach, the latter period shows a much higher productivity gap between the sample set of twenty commercial banks and the Indian banking industry. For the banking industry , starting with a productivity level of 3.1656 in the year 2002 , the productivity level increased to as high as 3.6516 in the year 2005 after which it showed a declining trend till 2007. From 2007, it showed a moderate recovery and started to improve afterwards.

Overall, we can say that the performance of the Indian banking industry remained satisfactory for the period 2002 till 2012 despite of the financial turmoil that literally hampered the financial institutions all over the world. This was because Indian financial system remained sheltered from such external shocks as a result of having "flexible exchange rate regime, the foreign reserves were high, the capital account is not yet fully convertible, and banks and their customers have limited foreign exchange exposure. So in present scenario, we recommend that the policy makers should carry on with their current economic policy as it has been successful in sheltering them from external shocks. Furthermore we found that the deposits and credits are negatively related, which is surprising. As increase in deposits results in increase in credits. So we would recommend the policy makers to emphasize on increasing the deposit base of the banks by increasing the interest rates on deposits.

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