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Diversification Impact on Bank Efficiency: A Panel Data Analysis

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Indian banking sector has undergone major transformation especially in post 1990s following the series of reforms initiated for the entire financial sector in general and for the banking sector in particular. Consequently, research studies have also been directed to evaluate the impact of reforms on performance of the banks. The present paper contributes to the existing literature on banking efficiency. The paper evaluates the level of efficiency of Indian banks at a deregulated era for the period 2000 to 2014 using Data Envelopment Analysis (DEA) and also estimates the determinants of efficiency with the help of Tobit Model. It considers the special case of diversification (income and geographical) and its impact on bank efficiency. Results of analysis reveal no significant impact of Income Diversification on efficiency whereas geographical diversification was found to be having a significant negative impact on Technical Efficiency.

Keywords: Technical Efficiency, DEA, Tobit Regression, Diversification, HHI

JEL Classification: G10, G21, G28

Section I
Introduction

Indian banking sector has undergone major transformation especially in post 1990s following the series of reforms initiated for the entire financial sector in general and for the banking sector in particular. Such measures are directed to make the sector functionally autonomous and operationally efficient. With the waves of liberalization, globalization and privatization coupled with increased competition, technological innovations and major mergers and consolidation, the overall orientations of the banks have changed enormously leaving a greater space for scale and scope gains. However, the primary motive behind such innovations and reforms is to contribute towards an efficient banking system. A major development witnessed in the post reform era is a gradual move of banks towards non-traditional sources of revenue. At the same

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time there have been a gradual expansion of bank branches in the length and breadth of the country. This phenomenon, commonly termed as Income and Geographical Diversification, is expected to yield the potential diversification benefits in the sense that it can stabilize the earnings of a bank by reducing the cyclical variations of bank's earnings and create resilience to counter adverse shocks affecting revenue and profits adversely. Consequently, research studies have also been directed to evaluate the impact of reforms and changing orientation of banking operation on performance of the banks. One of the important aspects of banking efficiency studies is that efficiency measures are indicators of success, by which the performance of individual banks and the industry as a whole can be gauged. Also, this is the peculiar nature of the sector which tempts the stakeholders and all others to keep themselves abreast of the performance of the sector.

The present study contributes to the existing literature on banking efficiency. At the first place the paper evaluates the level of efficiency of Indian banks at a deregulated era and tries to compare the efficiency scores between public and private sector banks. Secondly the paper contributes to the literature on the determinants of efficiency. It considers the special case of diversification both in terms of income and geographical and its impact on bank efficiency. Apart from this, the study also analyzes the impact of size and capitalization on efficiency. The prime motive of capturing the impact of diversification on the efficiency is in view of the fact that like many countries of world, Indian banking sector has also increased its reliance on non-interest sources of income as well as owing to deregulation, there have been increasing network of branch expansion in the country.

Section II
Review of Literature

The matter of efficiency of banks has been widely and extensively studied in the last few decades. However, it gained special attention in Indian context only in the late 1990s. The empirical literature on banking efficiency can be classified into those concerning developing countries which essentially examines the impact of reforms, privatization, etc. on banking efficiency whereas those pertaining to developed nations mainly focus on analyzing the market structure, concentration and deregulation and the resultant impact on efficiency. There also exist methodological deviations in measuring efficiency. A large number of studies adopt the parametric approach involving stochastic frontier analysis, free hull disposal, texnomic regression techniques, etc. Whereas the non-parametric Data Envelopment Analysis (DEA) is popularly used in studies concerning bank efficiency, a relatively smaller number of literature adopt accounting ratios to evaluate efficiency. Since the present paper addresses the issue of bank efficiency with a special reference to diversification, therefore, review is made for both efficiency related studies as well as studies on diversification.

Repkova (2014), examined the efficiency determinants in the Czech banking sector. With panel data analysis over 15 Czech commercial banks for period from 2001-2012 the study employed DEA for evaluating efficiency. The bank specific and market specific factors that can potentially influence efficiency were considered for analysis. Results revealed that level of capitalization, liquidity risk and riskiness of portfolio have a positive impact on efficiency under CCR model whereas ROA, interest rate and GDP had a negative impact on efficiency. Other variables were found to statistically insignificant. Under BCC model liquidity risk and riskiness of overall portfolio was found to be having positive significant impact on efficiency whereas GDP had a negative impact on efficiency.

Jyoti (2015), attempted to evaluate efficiency of Indian public sector banks for the period 2013-2014 using CCR DEA model. The study included 26 banks. Further, the paper also attempted to rank the banks based on Andersen and Petersen's Super Efficiency model. Lastly the paper identified the determinants of the efficiency with the help of Tobit regression model. The results revealed potentials for cost savings to the extent of 13.4 per cent on an average. The SBI group outperformed the nationalized banks in terms of Technical efficiency. IDBI bank was identified as the super efficient bank. Rate of return, quality of staff and off balance sheet exposures were found to be having positive impact on efficiency.

Andries (2011) adopted DEA and SFA techniques to examine the technical efficiencies of Central and Eastern European counties. Apart from analyzing the TE and its decompositions, the study also measured productivity growth with the help of Malmquist TFP index identified the efficiency determinants. Empirical results revealed that highest level of efficiency is reported by Czech Republic and Romanian banking system whereas lowest efficiency is identified for Slovenia. Besides, productivity growth of 24.27 per cent was identified in 2008 in relation to 2004. Bank capital structure, size of the bank, total assets of banking institution, annual inflation rate, assets share of state and foreign owned banks, ownership form of the bank, the level of concentration in the banking system, banking reforms, interest rate liberalization level deposit rate and lending rate is found to be influencing the efficiencies of the banking system.

Ncube (2009) evaluated the cost efficiency and profit efficiency of four large and four small South African based banks with the help of Stochastic Frontier Analysis (SFA). The results revealed a significant improvement in cost efficiency. Besides, a week positive correlation between cost and profit efficiency is also identified in context of the sample banks. Size was found to negatively related to cost efficiency.

Alkhathlan (2010), adopted the CCR and BCC models to evaluate the relative efficiency of the Saudi banks from 2003-2008. Average Technical Efficiency score under CCR model was found to be ranging from 0.81 to 0.86. Only two

banks out of the sample of ten banks reported technical efficiency score of 1 throughout the study period. Under BCC model, the average technical efficiency score was found to be ranging between 0.87 to 0.95 and only three banks were benchmarked through out the study period.

Wang, *et al*. (2010), endeavored to study the technical efficiency and its decomposition in context of Pakistani commercial banks with panel data from 2001-2008 using DEA. Technical Efficiency (TE) both under CCR and BCC model was analyzed. Under CCR model cost savings potentiality to the extent of 18 per cent was identified. Foreign banks were the most efficient bank type followed by public banks and further followed by domestic private banks. The decomposition of efficiency into pure and scale components reveal that pure technical efficiency contribute more towards technical efficiency where the banks were found to be seriously scale inefficient.

Alumamani (2013), in his study intended to examine the relative efficiency of Saudi banks using CCR and BCC model of DEA for the period 2007-2011. The results revealed improvement in efficiency which was found to be stable over years. Further an attempt was also made to identify the determinants of efficiency in terms of bank size and capitalization. The results of analysis revealed that small Saudi banks outperformed the medium and large sized banks and banks with higher capital adequacy ratio was found to negatively associated with efficiency.

D'Souza, C and Lai, A (2003) investigated whether diversification of banking activities improves efficiency of Canadian banks. Their study explored the impact of diversification on banks' returns proxied by ROE, risk, proxied by NPAs, and efficiency, proxied by DEA scores. Diversification/Focus is measured through HHI. Their main objective was to assess whether banks should focus or diversify their loans portfolio with respect to industries and regions across Canada, and with respect to their business lines and financing sources. Their results identified that regional focus reduces inefficiency, and business-line focus increases inefficiency.

Ramasastri, Samuel & Gangadaran, (2004) made an attempt in India to examine whether non-interest income of the bank has helped in stabilizing the total income i.e. operating revenue of the schedule commercial banks during the period of 1997-2003. At the aggregate level they found that interest income of the banks is more stable than non-interest income. Further it was identified that in case of State Bank of India, foreign banks and old private sector banks non-interest income helped stabilize operating income. However in case of nationalized banks and new private sector banks the results were opposite. Sinha & Chatterjee (2008a) undertake a study on off Balance Sheet Exposures of Indian Commercial Banks. They compare the TE of banks using DEA. The results indicate that the mean TE scores of the observed public sector banks are considerably lower than the private banks. With regards to TFP, the observed

commercial banks exhibit negative growth. Only 13 out of 38 commercial banks exhibit TFP score greater than 1. In another study, Sinha & Chatterjee (2008b) rank the Indian commercial banks on the basis of their Assets Quality. They use the Super-efficiency Approach (Non-Parametric) to rank order the super-efficient firms out of a sample of 20 public sector banks and 8 private sector banks over the period from 2001-02 to 2004-05. Their results indicate that only SBI and ICICI bank exhibit super efficiency for all the years under observation. The number of super-efficient firms range from 5 to 8. Mittal & Dhade (2007) assess the achievement and performance of PSBs *vis-à-vis* private sector banks and foreign banks using ratio analysis. Performance is evaluated on the basis of profitability and productivity from 1999 to 2004 for 27 PSBs, 30 private sector banks and 33 foreign banks. The study reveals that PSBs are less profitable than private sector banks and foreign banks in terms of overall profitability (Spread-Burden ratio). The author conclude that Indian PSBs and old private banks are less efficient both in terms of productivity and profitability with the exception of SBI and its associates.

Against the backdrop of the existing literature on the subject, it can be stated that there have been growing volume of literature on banking efficiency and diversification both globally as well as nationally. The banks around the globe function in a highly dynamic environment with ever-changing regulations, technological innovation and strategic differentiation which necessitates such studies to be carried out at different points of time in order to realize the validity or otherwise of the previous studies on the subject.

Reforms and Reorganization in Indian Banking Sector in Post Reform Era

The post reform era has given birth to a liberalized banking sector allowing private participation and increased competition. Due to greater autonomy granted to banks, there has been a gradual move towards non-traditional revenue making activities of the banks. Banks in the pre-reform era catered to the planned development needs of the economy ultimately resulting into increased fiscal deficits of the government and inefficient performance of banks. Reforms in the sector proceeded with the objective of granting autonomy to the banks and bringing about a competitive and efficient banking sector. This led to the entry of many foreign banks and new private sector banks. In order to stay competitive, the situation warranted the banks to diversify into new areas of business and bring about product innovation. The State Bank of India took the lead in the process by introducing merchant banking to its line of business. Other commercial banks also emulated a similar strategy and consequently the banks transformed themselves into virtual banks with the objective to provide various corporate and retail financial services, personal finance, private equity, international banking, mortgages, consumer credit etc in addition to typical non-traditional services like mutual fund, leasing and factoring etc. As a result the components of income of banks *viz*; Net Interest Income (NET) and Non Interest Income (NON) also reflected change as exhibited in Table 1.

Table:1
Components of Total Income of Public and Private Sector Banks (1995-2014)

	Public				
	NON (In Crore Rs.)	*NET (In Crore Rs.)*	*NOR (In Crore Rs.)*	*COM (In Crore Rs.)*	*OPFIN (In Crore Rs.)*
PERIOD (1995-2014)	24117	57190	81223	11431	12686
P1 (1995-99)	6910	17000	24377	4553	2824
P2 (2000-04)	13852	32558	50048	6787	10703
P3 (2005-09)	24950	61978	89507	12383	15152
P4 (2010-14)	47315	132235	180897	24641	24412
	Private				
	NON (In Crore Rs.)	*NET (In Crore Rs.)*	*NOR (In Crore Rs.)*	*COM (In Crore Rs.)*	*OPFIN (In Crore Rs.)*
PERIOD (1995-2014)	5125	9993	15129	3134	1991
P1(1995-99)	548	1028	1610	258	324
P2(2000-04)	1667	2967	5151	701	1442
P3(2005-09)	3844	10300	15370	3168	1902
P4(2010-14)	13527	29600	44201	9728	4873

Source: Annual Report of Banks (1995-2014), (www.rbi.org.in)

Objectives of the Study

The objective of the study is to identify the level of efficiency of the commercial banks in India and to investigate the impact of diversification (Revenue and Geographical) on the level of bank efficiency.

Section III
Data, Variable and Methodology

Establishing an effective technique for measuring bank's performance has always been stressed upon by researchers and practitioners. It is found that estimates of efficiency are sensitive to the choice of the technique. Over the past two decades DEA has become a popular methodology for evaluating relative efficiency of Decision Making Units (DMUs) which uses homogeneous inputs to produce homogeneous outputs. It is used in diverse research areas e.g., in evaluating efficiencies in universities, schools, bank branches, hospital, power plants, police station, tax offices, etc where these entities are considered as

DMUs. DMUs are directly compared against a peer or a group of peer. The operating units of banks have multiple inputs such as staff size, salaries and hours of operation, advertising budget as well as multiple outputs such as profit, market share and growth rate. In this situation it is often difficult for a manager to determine which operating units are inefficient in converting their multiple inputs into multiple outputs. This problem is addressed by DEA. At the same time DEA also assigns a unique set of weights to each DMU. The weights for a DMU are determined using mathematical programming, as that weight which maximizes its efficiency subject to the condition that the efficiencies of other DMUs is restricted to values between 0 and 1.

Two essential DEA models are CCR model of Charnes *et al.* (1978) and BCC model of Banker *et al.* (1984). CCR demonstrate technical efficiency under Constant Return to Scale (CRS) condition and states that multiple inputs and outputs for a given DMU are linearly aggregated into single 'virtual' input and output (Widiarto & Emrouznejad, 2015). On the other hand, BCC model in Banker *et al.* (1984) modifies CCR model by applying a more realistic assumption of Variable Returns to Scale (VRS) wherein each DMU is allowed to exhibit different returns to scale due to different environment, hence named VRS model (Widiarto & Emrouznejad, 2015).

CCR Model is explained as:

$$\text{Max} \sum_{r=1}^{s} u_r\, y_{r0}$$

$$\text{Subject to:} \sum_{r=1}^{s} u_r\, y_{rj} - \sum_{i=1}^{m} v_i\, x_{ij} \leq 0$$

$$\sum_{i=1}^{m} v_i\, x_{i10} = 1,\ -ur \leq -\varepsilon$$

$$-v_i \leq -\varepsilon$$

BCC Model is explained as:

$$\text{Max} \sum_{r=1}^{s} u_r\, y_{r0} - u_0$$

$$\text{Subject to:} \sum_{r=1}^{s} u_r\, y_{r\bar{j}} - \sum_{i=1}^{m} v_i\, x_{ij} - u_0 \leq 0$$

$$\sum_{i=1}^{m} v_i\, x_{i10} = 1,\ -ur \leq -\varepsilon$$

$$-v_i \leq -\varepsilon$$

Two approaches in basic DEA models are input-oriented and output-oriented. In input oriented model, the input reduction is proportionally maximized, keeping output constant while in output-oriented model, the output is proportionally maximized holding inputs constant, the following equation 1 and equation 2 explains input-oriented and output-oriented models respectively.

θ = Min θ

Subject to

$$\sum_{j=1}^{n} \lambda_j \; y_{rj} \geq y_{r0}, \qquad r=1,2,\ldots,s;$$

$$\sum_{j=1}^{n} \lambda_j \; X_{ij} \leq \emptyset X_{i0}, \qquad i=1,2,\ldots,m;$$

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad \text{(eq)}$$

$\lambda_j \geq 0, \qquad j=1,2,\ldots,n.$

$\emptyset$= Max $\emptyset$

Subject to

$$\sum_{j=1}^{n} \lambda_j \; y_{rj} \geq \emptyset \; y_{r0}, \qquad r=1,2,\ldots,s;$$

$$\sum_{j=1}^{n} \lambda_j \; y_{rj} \leq \emptyset \; y_{r0}, \qquad r=1,2,\ldots,m;$$

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad \text{(eq2)}$$

$\lambda_j \geq 0, \qquad j=1,2,\ldots,n.$

The present study examines the level of efficiency of the banks with the help of DEA technique under both constant return to scale (CCR model) and variable returns to scale (BCC) assumption.

Selection of Input and Output:

There is lack of consensus amongst researchers as to what constitutes input and output for a bank. Two main approaches are found in literature in this regard.

(i) Production Approach; and

(ii) Intermediation Approach.

Production approach defines the bank activity as production of services and views the banks to be using physical inputs e.g., Labour and Capital to provide deposit and loan account. Berger & Humphery (1992) refer this as the value added approach. Under this approach it is the number of accounts of various types that are taken as measures of output produced by the use of capital and labour. Under the intermediation approach, a bank is treated as a producer of intermediation services as it receives funds from depositors and invests at different risk and maturity profile, by using labour and capital. But banks also produce services for which specific charges are levied. Thus money value of loans and non-interest income are taken as outputs while inputs are taken as labour and capital.

The present study adopts the intermediation approach to selection of inputs and outputs. Accordingly it is assumed that the banks use the deposit fund and with the use of labour (Employees Cost) produces Earning Assets

(Advances) and Non-Interest Income. Table 2 presents the key statistics relating to the input-output variables selected for the study.

Table 2
Summary Statistics of Inputs and Outputs

Year	*Inputs (Rs. In Crores)*		*Outputs Inputs (Rs. In Crores)*	
	Deposits	*Employee Cost*	*Advances*	*Net-Interest Income*
SBI & Group				
Mean	674109.416	10047.929	526288.65	449119.848
SD	1122345.59	16470.513	902741.9	695795.713
Max	2632832	38518.21	2140378	1650722
Min	33997.11	395.744	91415.35	20381.56
Nationalized Banks				
Mean	95679.78	1144.455	262860.9	68016.34
SD	51165.78	656.344	158512.53	37616.61
Max	194993.8	2903.64	692350.2	137249.4
Min	33273.59	493.23	82204.82	20345.86
Private Banks				
Mean	60115.933	760.571	102835.86	40729.403
SD	128653.005	1778.70	157378.76	83431.087
Max	508276	7038.643	601057.5	327634.9
Min	931.2847	18.589	5773.307	551.198
All Commercial Banks				
Mean	154647.1	2113.42	235780	105421.7
SD	419795.1	6198.831	350299.5	265168.7
Max	2632832	38518.21	2140378	1650722
Min	931.28	18.589	5773.307	551.198

Private sector banks have paved the way for competition. The idea of deregulation was to promote competition so that the banks at the public sector become efficient in their operation. However, private sector banks and so as the foreign banks enjoy an edge over the public sector banks in terms of managerial and cost saving efficiency (Sarkar and Bhaumik, 1998; Shirai, 2001; De 2003; Shammugham and Das, 2004; Kumbhakar and Sarkar, 2004; Sanyal and Shankar, 2005; Ramasastri & Achamma (2006); Mittal & Dhade (2007)). Hence it is hypothesized that there exist differences in efficiency classified on the basis of ownership of the banks.

H_1: There exists significant difference in the mean TE scores of the SBI and group, nationalized banks and domestic private banks in India.

Diversification Measures

Revenue Diversification

There are a good number of ways in which a particular bank can diversify its operation. The most popular one is to diversify its streams of income mainly by increasing the proportion of Non-Interest Income to the Total Operating Income thereby increasing the contribution of non-interest earning sources of income. The present study considers diversification of Net Operating Revenue (NOR) into Net Interest Income (NET) and Non-Interest Income (NON) component. There are different measures of diversification. Commonly adopted measures include, Herfindahl Hirschmann Index (HHI), Entropy Index, Concentration Ratio, Lerner Index, Boone Indicators, etc. The degree of diversification between the Net Interest Income (NET) and Non-Interest Income (NON) is estimated through the Herfindahl Hirschmann Index (HHI).

HHI is computed as sum of squared income (interest income and non-interest income) share in the Total Income which is then subtracted from one to get the diversification result.

$$\text{DIV\_ICM} = 1 - \left\{ \sum_{i=1}^{n} \text{Pi}^2 + \sum_{i=1}^{n} \text{Qi}^2 \right\}$$

Where, DIV_ICM = Diversification Index, "i" stands for bank and "n" indicates number of banks.

$$\text{Pi} = \left(\frac{NET}{NOR}\right) \quad \& \quad \text{Qi} = \left(\frac{NON}{NOR}\right)$$

NET = Net Interest income,

NON = Non-Interest income and

NOR = Net Operating Revenue (NOR=NET+NON).

Table 3 represents the summary statistics of important variables relating to revenue diversification.

Table 3
Summary Statistics of Important Variables Relating to Income Diversification

(Rs in Lakhs)

	NOR	*NON*	*NET*	*DIV-INCM*
SBI & Group				
Mean	4055127	1233092	2896153	0.2504
SD	2331883	597937	1805982	0.0430
Max	8219793	2270751	6298763	0.3547
Min	1520708	457850	1062858	0.2029
Nationalized Banks				
Mean	7194374	1839202	5355172	0.2238
SD	4141992	896810	3272489	0.0434
Max	14800212	3396570	11403642	0.3174
Min	14800212	3396570	11403642	0.3174
Private Banks				
Mean	2318420	676216	1319540	0.3896
SD	2128525	575157	1215625	0.0384
Max	6835714	1880450	3920685	0.4432
Min	293619	1880450	3920685	0.3302
All Commercial Banks				
Mean	9190130	2515418	6674712	0.2296
SD	5913675	1459636	4476491	0.0430
Max	20601347	5277020	15324327	0.3159
Min	2771833	777319	1994514	0.1696

Note: NON: Non-interest income, NET: Net interest income, NOR: Net Operating Revenue, DI-ICM: Income Diversification Index,

Diversifying into different sources of income brings about stability in returns. It checks for the volatility of earnings of banks. But these gains are typically offset by increased exposure to more volatile activities as a result the risk-adjusted performance suffers. That is, the increased share of volatile activities outweighs the traditional diversification effect *via* the covariance (Stiroh,2005). Thus the study frames the following hypothesis:

H_2: Income Diversification does not have significant impact on the TE scores of Indian banks.

Geographical Diversification

To measure the degree of geographical diversification, the study adopted a revisited index based on similar Herfindahl-Hirschman Index proposed by

(Acharya *et al.*, 2006).The Central monitory authority in our country i.e. Reserve Bank of India, divides the whole country into six different regions in which all commercial banks including their branches are functioning. These are: Northern Region (Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab and Rajasthan), North Eastern Region (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura), Eastern Region(Andaman & Nicobar, Bihar, Jarkhand, Orissa, Sikkim and West Bengal), Central Region(Chhattisgarh, Madhya Pradesh, Uttarakhand and Uttar Pradesh), Western Region(Dadra & Nagar Haveli, Daman & Diu, Goa, Gujarat and Maharashtra) and Southern Region(Andra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry and Tamil Nadu). In order to identify whether or not a bank is geographically diversified, the study used Branch Diversification Index and is calculated in the following manner:

BRCH-DIV-INDEX=

$$1 - \left\{ \sum_{i=1}^{n} D_1^{\,2} + \sum_{i=1}^{n} D_2^{\,2} + \sum_{i=1}^{n} D_3^{\,2} + \sum_{i=1}^{n} D_4^{\,2} + \sum_{i=1}^{n} D_5^{\,2} + \sum_{i=1}^{n} D_6^{\,2} \right\}$$

Where, BRCH-DIV-INDEX= Branch diversification Index, "i" stands for bank and "n" indicates number of banks.

$D_1 = \left(\frac{BCR}{BAR}\right)$ $D_2 = \left(\frac{BER}{BAR}\right)$ $D_3 = \left(\frac{BNER}{BAR}\right)$ $D_4 = \left(\frac{BNR}{BAR}\right)$ $D_5 = \left(\frac{BSR}{BAR}\right)$ $D_6 = \left(\frac{BWR}{BAR}\right)$

BCR= Total Number of Branches of a bank in Central Region.

BER= Total Number of Branches of a bank in Eastern Region.

BNER= Total Number of Branches of a bank in Northeastern Region.

BNR= Total Number of Branches of a bank in Northern Region.

BSR= Total Number of Branches of a bank in Southern Region.

BWR= Total Number of Branches of a bank in Western Region.

BAR= Total Number of Branches of a bank in all the Regions.

Table 4 presents the summary statistics of some of the important variables relating to Geographical Diversification.

Table 4
Summary Statistics of Geographical Diversification Index

	Public Sector Banks	*Private Banks*	*All Commercial Banks*
	DIV-GEO	*DIV-GEO*	*DIV-GEO*
Mean	0.64	0.412	0.529
SD	0.02	0.102	0.057
Max	0.61	0.69	0.68
Min	0.69	0.28	0.45

Note: DIV_GEO: Geographical Diversification Index.

Geographical Diversification brings about spread in geographical reach of the bank. As a result it brings greater revenue earnings potentiality as well as risk diversification. But dispersing of banking services in length and breadth may result into inefficiencies in management and control of branches. Also superior performance in one location may be offset by unfavourable performance in other location. There may be inefficiencies arising out of labour use (over staffing or under staffing) also there may over branching (Das, A *et al* 2005). All these may result into inefficiencies. Thus the diversification gain through geographical dispersal may be offset my managerial inefficiencies. It is hypothesized that:

H_3: Geographical Diversification does not have any significant impact on the TE scores of Indian banks.

Efficiency Estimation Model

The study adopts the Tobit regression model to estimate the determinants of efficiency. Tobit Model is also known as limited dependent variable regression model because of the restriction put on the values taken by the regress and Statistically, tobit model can be expressed as

$y_i = \beta_1 + \beta_2 X_i + \mu_1$ if RHS>0

$= 0$ otherwise

For the purpose both bank specific and country specific factors are taken into consideration.

The present study covers a total of 40 commercial banks including five under the category of SBI & Group, twenty under the category of nationalized banks and fifteen under the category of domestic private banks. The data are collected from the official website of Reserve Bank of India (RBI) where the data pertaining to the banks are readily available in the form of different publications and reports. However, in some cases the Annual Reports of the banks were also referred to in cases where data were not available from RBI website. The study is carried for a period of fifteen year from 2000-2015.

Empirical Results

Efficiency and its Decomposition

Table 5 presents the results of average Overall Technical Efficiency (OTE) and Technical Efficiency (TE) have been used interchangeably in this study] scores with standard deviation and Maximum (Max) and Minimum (Min) of the different bank type during the period from 2000 to 2014. The results have been obtained through running CCR model separately for each year. The empirical findings reported that average TE under CCR for all commercial bank is 0.761 with Standard Deviation of 0.130 and the maximum and minimum efficiency score is computed at 0.886 and 0.415 respectively. Thus, the Overall Technical Inefficiency [OTIE (%) = (1- OTE) X 100] of banks came out to be almost 24 per cent. This indicates that the branches can curtail their input expenditures on deposits, fixed assets and labour by 38 per cent by adopting best practices. For most the years the TE scores are found to be increase with slight decline noticed in the year 2002,2009,2012 and 2014. But a remarkable fall in TE is observed in the year 2011 which reported the least value of TE score of 0.415.

If the mean TE of SBI and Group, nationalized banks and private banks are examined separately, it reflects OTIE of 24, 25 and 23 per cent respectively. The mean TE scores indicate that the private sector banks account for maximum OTE estimated at 0.773 followed by SBI Group and nationalized banks respectively. Analysis of Maximum reveal that, nationalized banks account for a maximum value of TE value of 0.912 followed by private banks of 0.909 and further followed by 0.842 of SBI and Group. At the same time minimum TE score of 0.406 is reported by nationalized banks.

Table 5
Year-Wise Mean Overall Technical Efficiency of Banks under Input Oriented CCR DEA Model

Mean Overall Technical Efficiency (OTE) under CCR model

Year	*SBI & Group*	*Nationalized Banks*	*Private Banks*	*All Commercial Banks*
2000	0.757	0.694	0.673	0.694
2001	0.805	0.759	0.721	0.75
2002	0.716	0.671	0.733	0.70
2003	0.763	0.733	0.735	0.74
2004	0.760	0.756	0.752	0.755
2005	0.781	0.768	0.771	0.771
2006	0.816	0.872	0.871	0.842
2007	0.833	0.861	0.900	0.872
2008	0.819	0.850	0.893	0.862
2009	0.821	0.822	0.885	0.846
2010	0.842	0.857	0.881	0.864
2011	0.474	0.406	0.409	0.415
2012	0.737	0.504	0.602	0.57
2013	0.717	0.912	0.909	0.886
2014	0.841	0.846	0.853	0.848
Mean	0.765	0.754	0.773	0.761
SD	0.091	0.141	0.138	0.130
Max	0.842	0.912	0.909	0.886
Min	0.474	0.406	0.409	0.415

Note: SD denotes standard deviation. Max-Maximum, Min- Minimum
Source: Estimated using DEAP 2.1

Decomposition of Efficiency

As already discussed, the TE scores under BCC model can further be decomposed into Pure Technical Efficiency (PTE), the efficiency arising out of a manager's ability to utilize resources most efficiently and get the maximum possible returns, and Scale Efficiency (SE), that is the ability to increase/ decrease the scale of operation to the optimum and operate at the Constant Returns to Scale. Thus, Pure Technical Inefficiency (PTIE) also represents wastages that are devoid of Scale Inefficiency (SIE).

It can be seen from Table 6; the mean PTE score of all commercial banks is estimated to be 83 per cent with standard deviation measure of 0.0761. This indicates that 24 per cent of TIE is explained by 17 per cent of PTIE that is due to the incapability of the management to utilize the resources. The rest part of the TIE may be attributed to the fact that the banks are operating at below the optimal level.

SE of banks can be measured as the ratio of OTE to PTE. The value of SE equal to 1 indicates that a DMU is operating at most productive scale size and

value of less than one indicates that a DMU is not operating at optimal scale. The mean SE score of all commercial banks is estimated at 0.910 per cent with standard deviation measure of .090 which implies that average scale inefficiency (SIE) as much as 9 per cent is due to the choice of sub-optimal level of operation.

On the basis the mean PTE scores, the SBI and Group is ranked first while the private banks account for the least PTE scores. On the other hand private banks outperformed all other type of banks based on the Scale Efficiency scores whereas nationalized banks account for the least value of mean SE score. Private sector banks outperformed all other banks in terms of mean SE which is estimated to be highest i.e. 0.942. Observation from Table 5 reveals that all the banks report a higher Scale Efficiency score and that PTIE is the major source of TIE. Thus it can be apprehended that much of the inefficiency arise due to managerial inefficiencies in making the best use of input to produce optimal output than operating at the right scale.

Table 6
Pure Technical Efficiency (PTE) and Scale Efficiency (SE) under VRS Assumption (Input Oriented) DEA Model

Year	*Pure Technical Efficiency (PTE)*				*Scale Efficiency (SE)*			
	SBI & Group	*Nationalized*	*Private*	*All Commercial*	*SBI & Group*	*Nationalized*	*Private*	*All Commercial*
2000	0.837	0.784	0.612	0.753	0.920	0.895	0.986	0.932
2001	0.864	0.830	0.745	0.803	0.933	0.919	0.974	0.942
2002	0.878	0.781	0.790	0.788	0.890	0.858	0.931	0.889
2003	0.835	0.818	0.780	0.806	0.919	0.897	0.945	0.918
2004	0.812	0.811	0.771	0.796	0.947	0.934	0.979	0.952
2005	0.839	0.821	0.806	0.817	0.937	0.939	0.958	0.946
2006	0.858	0.856	0.88	0.865	0.957	0.957	0.989	0.975
2007	0.888	0.909	0.916	0.909	0.943	0.949	0.982	0.961
2008	0.861	0.908	0.915	0.904	0.957	0.938	0.977	0.955
2009	0.865	0.865	0.912	0.882	0.949	0.951	0.970	0.958
2010	0.901	0.940	0.938	0.934	0.934	0.911	0.937	0.924
2011	0.867	0.744	0.585	0.677	0.69	0.543	0.753	0.64
2012	0.887	0.727	0.729	0.748	0.82	0.698	0.829	0.762
2013	0.763	0.947	0.934	0.919	0.954	0.964	0.973	0.966
2014	0.930	0.918	0.893	0.91	0.905	0.922	0.954	0.932
Mean	0.859	0.844	0.814	0.834	0.910	0.885	0.942	0.910
SD	0.0395	0.0697	0.1132	0.0761	0.0703	0.1147	0.0655	0.0906
Max	0.93	0.947	0.938	0.934	0.957	0.964	0.989	0.975
Min	0.763	0.727	0.585	0.677	0.69	0.543	0.753	0.64

Note: SD denotes standard deviation
Source: Estimated using DEAP 2.1 based on data pertaining to Branch Financial Statements (2009-2013)

Table 7 reveals that all the banks taken together, majority of the banks (60 per cent) fall in the efficiency range of 0.75 to 0.99. This indicates that on an average, the banks exhibit the potentiality of cost savings of 1 per cent to 25 percent. In case of SBI and Group highest concentration (80 per cent) is found in the efficiency range of 0.50-0.75. This indicates that on an average, majority of the banks under SBI and Group exhibit cost saving potentiality of 25 per cent to 50 per cent. Under nationalized banks group, majority of the banks (75 per cent) is concentrated at the efficiency range of 0.75-0.99 reflecting cost savings potentiality of 1 per cent to 25 per cent. Under the category of private banks the highest number of branches is found under the efficiency range of 0.75-0.99 again reflecting the potentiality of the banks to reduce cost to the extent of 1 per cent to 25 per cent.

Table 7
Distribution of Banks in the Efficiency Range based on TE Scores

Efficiency Range	*SBI & Group*		*Nationalized Banks*		*Public Sector Banks*		*Private Banks*		*All Commercial Banks*	
	N	%	N	%	N	%	N	%	N	%
Below 0.50	0	0	1	5	1	4	0	0	1	2.5
0.50-0.75	4	80	4	20	8	32	6	40	14	35
0.75-0.99	0	0	15	75	15	60	9	60	24	60
1	1	20	0	0	1	4	0	0	1	2.5
Total	5	100	20	100	25	100	15	100	40	100

N= Number of observations.

In order to investigate whether there exists any statistically significant differences in the Mean TE scores of the different bank type, one-way ANOVA was done and the result is reflected in Table 8.

Table 8
Results of One-Way ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.002707	3	0.000902	0.056309	0.982255	2.769431
Within Groups	0.897486	56	0.016027			
Total	0.900194	59				

Since the computed f-value (0.056309) is less than the critical f-value (2.769431), therefore, there is no significant difference between the sample means. Thus the hypothesis H_1 is accepted.

Efficiency Determinants

The explanatory and dependent variables selected for the tobit model is exhibited below. Both degree of income and geographical diversification is measured through HHI. As already hypothesized income and geographical diversification is not expected to have any significant impact on TE scores of banks. Size of the bank is proxied by log value of Total Assets. It is expected that large sized banks are able to reap the benefits of economies of scale and scope and, therefore, are more efficient than the smaller sized banks. Degree of financial leverage is measured through the ratio of equity to total assets and hence a higher ratio indicates more of owners' fund which is costlier than the borrowed capital. This is expected to impact efficiency negatively. Profitability is measured through ROA where a higher ratio is expected to impact efficiency positively. Lastly, ownership of the banks are taken as a vector of dummy variables representing 1 for public sector banks and 0 otherwise. Efficiency is expected to be impacted by the ownership status of the banks and it is expected that the private sector banks would outperform the public sector banks.

Explanatory Variables:	**Measures**	**Symbol**
Degree of Income Diversification	Herfindahl Hirschmann Index (HHI)	DI_INC
Degree of Geographical Diversification	Herfindahl Hirschmann Index (HHI)	DI_GEO
Size	Log of Total Assets	SZ
Leverage	Equity/Total Assets	LEV
Returns	Return on Assets	ROA
Ownership	Dummy	1=Public Sector Banks, 0=Private Sector Banks

Thus, the equation is specified as below:

$$y^* = \alpha + \beta_1 DIV\_INC + \beta_2 DIV\_GEO + \beta_3 SZ + \beta_4 LEV + \beta_5 ROA + \beta_6 OWN + e$$

y* is the dependent variable which is Technical Efficiency (TE) estimated as per the first stage DEA. In the above model e is the error term assumed to be independently normally distributed with mean zero.

Table 9
Results of Tobit Regression

Dependent Variables

TE Scores

Explanatory Variables	*Coefficient*	*Std. Error*	*t*	*P>[t]*	*[95% conf. Interval*	
DI_INC	-0.6968059	.7577007	-0.92	0.368	-2.268181	.8745691
DI_GEO	-1.102365**	.2831535	-3.89	0.001	-1.68959	-.5151409
LNTA	0.259961	.031262	0.83	0.415	-.0388373	.0908295
LEV	0.9640061**	.3867979	2.49	0.021	.1618363	1.766176
ROA	0.0308924	.1117742	0.28	0.785	-.20099131	.2626979
OWN	-0.1730817**	.0746017	-2.32	0.030	-.3277962	-.0183672
Constant	1.222637	.6626922	1.84	0.079	-.1517029	2.596976
/sigma	.0914779	.0122242			.0661264	.1168295

Number of observation = 28

LR chi2(6) = 16.58

Prob > chi2 = 0.0110

Pseudo R2 = -0.4375

Note: ** Significant at 5 per cent level of significance

Section IV
Results and Discussion

Table 9 reveals that DI_INC, taken as an explanatory variable, representing degree of diversity between the different sources of revenues of a bank namely, Interest Income and Net-Interest income has a negative impact on efficiency. It is expected that income diversification would improve banking efficiency by enhancing revenue generating sources and thereby stabilizing returns and economizing operation. However, increasing the streams of income may at times increase the cost of operation and management. This may negatively impact efficiency. The result of tobit regression in Table 9 exhibit a negative coefficient of income diversification index which indicates negative impact on TE scores. However, the result is not statistically significant as hypothesised. Similarly geographical diversification index (DI_GEO) also report a negative coefficient indicating that increasing the customer reaching capacity by branch expansion may lead to increased managerial and operational costs making the bank cost inefficient. The result is found to be statistically significant. Size of the bank is found to be having a positive impact on efficiency. As hypothesized the large sized banks are found to be more efficient as compared to the smaller sized banks. This is found to be statistically significant. The proportion of equity to total assets (LEV) represents the leverage of a bank. Increasing proportion of

equity to total assets leads greater fragility in terms of its degree of leverage and capitalization (proxied by Equity to Total Assets Ratio). However, it is seen that the coefficient of LEV is positive and statistically significant which supports the fact that with greater infusion of fund as equity the scale of operation is enhanced and thereby bringing in cost savings. ROA is found to be positively affecting efficiency but statistically not significant. Bank ownership is found to be negatively and significantly affecting technical efficiency. Thus as compared to private sector banks public sector banks are found to be inefficient. Hence ownership of banks is found to be a significant determinant of efficiency.

Section V
Summary of Findings & Conclusion

The present study attempted to analyze the level of efficiency of commercial banks in India from 2000 to 2014. Results of analysis reveal that the OTE under CCR model for all commercial banks is 0.761. For most of the years the OTE scores were found to be increasing. 2011 is characterized by a remarkable fall in OTE to 0.415. Private banks outperformed all other categories of banks. The mean PTE score is found to be 83 per cent for all commercial banks representing inefficiency to the extent of 17 per cent. In other words, 24 per cent of TIE is explained by 17 per cent of PTE. SBI Group outperformed all other categories of bank under PTE. The mean SE score is found to be 0.10 implying that 9 per cent of SIE is due to the choice of sub-optimal level of operation. Private banks outperformed all other banks in terms of mean SE. Overall, the banks reported a higher level of scale efficiency and PTIE is found to be the major source of TIE. Distribution of banks in different efficiency range revealed that majority of the banks is concentrated in the TE range of 0.75 to 0.99. Only in case of SBI and Group the maximum concentration is found in the efficiency range of 0.50-0.75. One way Annova results reveal that there is no significant difference between the mean TE scores of different categories of bank. Thus the Hypothesis H1is accepted. The result of Tobit Model reveals that Income Diversification (DIV_INC) has no significant impact on TE whereas the Geographical Diversification (DIV_GEO) has a negative impact on TE. Thus, Hypothesis H2 is accepted and Hypothesis H3is rejected. The coefficient of control variables i.e. LEV, ROA and OWN reveals that excepting OWN no other variables have significant impact on TE.

Efficiency of banking sector is a crucial subject of discussion. With time the efficiency level and its determinants changes. It is more important to study the determinants of efficiency in light of changing environmental variables. Frontier inefficiency or X-inefficiency is a major challenge in global context. Studies of this nature are important for managerial consideration as well as policy formulation.

References

1. Abdelkarim, M (2013), "The Relative Efficiency of Saudi Banks: Data Envelopment Analysis Models", *International Journal of Academic Research in Accounting and Finance and Management.* 3(3), pp 152-161.
2. AlKhathlan, K and Malik, S A (2010), "Are Saudi Banks Efficient? Evidence Using Data Envelopment Analysis (DEA)", *International Journal of Economics and Finance,* 2(2), pp 53-58.
3. Andries, M. (2011), The Determinants of Bank Efficiency and Productivity Growth in The Central and Eastern European Banking Systems", *Eastern European Economics,* 49(6) 38-59 DOI: 10.2753/EEE0012-8775490603.
4. D'Souza, Chris. and La, Alexandra (2004), "Does Diversification Improve Bank's Efficiency?", *Journal of Financial Services Research,* 12, pp 88-96.
5. Das, A; Ray, S C and Nag, A (2005), "Labour Use Efficiency in Indian Banking: A Branch Level Analysis", University of Connecticut, Department of Economics, Working Paper Series, 2004-2005. Retrieved from <www.econ.uconn.edu.pdf>.
6. De, B. (2003). "Ownership Effects on Banks Performance: A study of Indian Banks", Retrieved from <www.igidr.ac.in.pdfii.pdf>.
7. Government of India. (1991). Report of the Committee on the Financial System (Narasimham Committee Report). New Delhi: Ministry of Finance.
8. Government of India. (1998). Report of the Committee on Banking Sector Reforms (Narasimham Committee 2nd Report). New Delhi: Ministry of Finance.
9. Jyoti (2015), "Measuring the Efficiency of PSBs in india: A Cross Sectional Analysis", *International Journal of Management and Social Sciences Research (IJMSSR)* 4(5) i-Explore International Research Journal Consortium.
10. Kumbhakar, S C and Sarkar, S (2004). "Deregulation, Ownership and Efficiency Change In Indian Banking: An Application of Stochastic Frontier Analysis", Retrieved from <www.igid.ac.in.pdf>.
11. Mittal, M and Dhade, A (2007), "Profitability and Productivity in Indian Banks: A Comparative Study", *AIMS International,* 1(2), pp 137-152.
12. Ncube, M (2010), "Efficiency of the Banking Sector in South Africa", A Paper presented at African Economic Conference on Fostering Development in an Era of Economic and Financial Crises, held at Addis Ababa on November 11-13, 2009.
13. Rakesh, M (2005), Address by Rakesh Mohan, Deputy Governor of the RBI at the 21st AGM and Conference of the Pakistan Society of Development Economists, Islamabad, 21 December. Retrieved from <http://www.rbi.org.in/Scripts/BS_SpeechesView.aspx?Id=269>
14. Ramasastri, A S; Samuel, A and Gangadaran, S (2004), "Income Stability of Scheduled Commercial Banks: Interest vis-à-vis Non-Interest Income", *Economic and Political Weekly,* 39(12) pp 1311-1319.
15. Repkova, I (2015), "Banking Efficiency Determinants in the Czech Banking Sector", *Procedia Economics and Finance,* 23, pp 191-196. Retrieved from www.sciencedirect.com

16. Reserve Bank of India (2000-14), "Basic Statistical Returns of Scheduled Commercial Banks in India", New Delhi, Ministry of Finance.

17. Reserve Bank of India (2000-14), "Report on Trend and Progress of Banking in India", New Delhi, Ministry of Finance.

18. Reserve Bank of India (2000-14), "Statistical Tables Relating to Banks in India", New Delhi, Ministry of Finance, Retrieved from http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/RTP0809PRD_Full.pdf

19. Sanyal, P and Shankar, R (2005), "Financial Sector Reforms and Bank Efficiency in India", Retrieved from <www.people.brandeis.edu>.

20. Sarkar, J and Bhaumik, S (1998), "Does Ownership Always Matter? Evidence from the Indian banking Industry", *Journal of Comparative Economics,* 26, pp 261-281.

21. Shammugham, K R and Das, A (2004), "Efficiency of Commercial Banks During the Reform Period", *Applied Financial Economics,* 14, pp 681-686.

22. Sinha, R P and Chatterjee, B (2008a), "Asset Quality Based Ranking of Indian Commercial Banks: A Super Efficiency Approach", *Artha Vijnana,* Vol. L, No. 1, March 2008, pp 79-92.

23. Sinha, R P and Chatterjee, B (2008b), "Off Balance Sheet Exposures of Indian Commercial Banks: A Total Factor Productivity Approach", *Indian Economic Journal,* March 2008.

24. Stiroh, Kevin J (2005), "Bank Risk and Revenue Diversification: An Assessment of Using Equity Returns", http://www.bis.org/bcbs/events/rtf05Stiroh.pdf

25. Usman, M; Wang , Z; Mahmood, F and Shahid, H (2013), "Scale Efficiency in Banking Sector of Pakistan", *International Journal of Business and Management,* 5(4), pp 104-116.

26. Yigit, Ihsan and Turkmen, Sibel Yilmaz (2012), "Diversification in Banking and its Effect on Banks' Performance: Evidence from Turkey", *American International Journal of Contemporary Research,* 12, pp 22-43.