Vidyasagar University Journal of Commerce
Vol. 23, 2018/ISSN 0973-5917

A COMPARATIVE STUDY ON THE PERFORMANCE OF VIDYASAGAR CENTRAL CO-OPERATIVE BANK LTD. IN PASCHIM MEDINIPUR DISTRICT: AN APPLICATION OF MALMQUIST PRODUCTIVITY INDEX

Sibaram Chatterjee*

Abstract

The present study is an attempt to analysis the efficiency and total factor productivity growth of a cooperative bank (VCC bank) at the branch level for the period 2007 to 2012. The study also makes a district level comparison of efficiency scores and productivity growth of VCC bank with that of SBI and RRB. Bank efficiency has been assessed by applying DEA methodology. Malmquest productivity index has been used to quantify the branch wise total factor productivity growth over the study period. The empirical results establish that there is a declining trend in overall technical efficiency scores of VCC bank. The empirical results also show that this bank registered a negative growth rate of productivity. District level inter-bank comparison shows that SBI has the highest average overall technical efficiency, followed by RRBs and VCC bank over the sample period. The study also examines that the total factor productivity growth of VCC bank is not significantly lower than that of RRB and also SBI. The study confirms that ownership structure has no impact on TFP growth of the banks.

Key Words: *Efficiency, Total Factor Productivity, Malmquest Productivity Index, DEA.*

1. Introduction

The Government of India introduced economic and financial sector reforms in general and banking sector reforms in particular to improve the performance of the Indian banks. The first phase of banking sector reform was introduced in 1991 after the recommendation of Narasimham Committee[1]. It focused on the reduction in Statutory Liquidity Ratio and Cash Reserve Ratio, deregulation of interest rates, transparent guidelines or norms for entry and exit of private sector banks, direct access of public sector banks into capital markets, liberalization of branch licensing policy, setting up of Debt Recovery Tribunals, asset classification and provisioning, income recognition, formation of Asset Reconstruction Fund. While the second Narasimham Committee[2] (1997) recommended the merger of strong units of banks and adaptation of 'narrow banking' concept to rehabilitate weak banks.

* Assistant Professor, Department of Commerce, Pingla Thana Mahavidyalaya, Paschim Medipur, West Benal, India;
E-mail: sibaramchatterjee@gmail.com

The main motive of the reforms was to improve the operational efficiency of the banks to further enhance their productivity and profitability. However, financial sector reforms in the early 1990s have brought about fierce competition in the banking sector. The financial crisis in emerging market economies in the mid-1990s has clearly exposed the dangers of a bank's excessive reliance on the traditional business activities. Stone *et al.* (2000) have particularly pointed out the lack of proper diversification of the loan portfolio as a key catalyst of bank distress after financial deregulation. Eventually, the structure of banking markets of emerging economies has been shaped by the policies that encourage the provision of financial services to specific sectors of economies on the fringe of economic development. As a consequence, the universal banking model, which allows banks to combine a wide range of financial activities, including commercial banking, investment banking and insurance, has emerged as a desirable structure of a financial institution[3]. Such diversifications of activities have been leading to a blurring of line across different financial institutions and have been facilitated by relatively liberal laws as regards banking and securities business. Thus, enhanced profitability, productivity and operational efficiency through proper product mix or diversification have become essential for growth and survival of any bank. Obviously cooperative Banks are not beyond this track.

Almost since inception, cooperative banks with a rural focus are suffering from serious problems, namely, high risk due to exposure to the rural poor people, escalating losses due to non-viable level of operations in branches located at resource-poor areas, switch over to narrow investment banking as a turn-over strategy. In the ensuing years, cooperative banks have to face tight competition with other commercial banks for their growth and survival irrespective of the fact that their very role in the society required a special status and a different set of policies. Thus, the productivity, profitability and operational efficiency of cooperative banks have become the key issues which enable them to function as an effective and efficient institution of rural credit.

Profitability, productivity and efficiency have become burning issues in the era of banking sector reforms and have enjoyed a great deal of interest among researchers studying performance analysis. The banking performance is commonly measured by using different financial ratios. Yeh (1996) has observed that the major drawback of this method is its dependence on benchmark ratios, which could be arbitrary and may mislead an analysist. Further, Sherman and Gold (1985) have noted that the financial ratios do not capture the long term performance and many aspects of performance such as, operations, marketing and financing. Amandeep (1991) considered eleven factors which reflect different dimensions of banking operations and hence affect the banking profitability. Kaushik (1995) has evaluated productivity and profitability of Indian banks during 1973 to 1997 by using nine indicators and concluded that the social obligation is not a major drag on profitability of the banks. Bhatia and Verma (1998) have made an attempt to determine empirically the factors influencing profitability of public sector banks in India by applying multiple regression technique. Their study reveals that priority sector advances, fixed / current deposit ratio and establishment expenses influence the profitability of public sector banks negatively. Das and Ghosh (2005) have argued that there is a strong effect of ownership on bank's performance.

In recent times, there is a trend towards measuring banks' performance using frontier analysis technique, which includes parametric and non-parametric approach. Sathye (2001) assessed the efficiency of banks in India, using Data Envelopment Analysis (DEA). He used two models to show how efficiency scores vary with change in inputs and outputs. Sayuri and Shrai (2002) assessed the impact of deregulation by examining the changes in performance of banking sector in post-reform era by applying DEA. The study has concluded that the performance of the public sector bank has improved in the second half of the 1990's. Jackson and Fethi (2000) have evaluated the technical efficiency of individual Turkish banks, using DEA methodology and investigated the determinants of efficiency by using Tobit model. Cingi and Tarin (2000) have examined the efficiency and productivity change in Turkish Commercial banks, using DEA and DEA-based Malmquest Total Factor Productivity Index. Ashish and Batra (2012) empirically explored the productivity changes of Indian banking industry during the post liberalization period (2006-2011) by applying a non-parametric Malmquist Productivity Index (MPI). Results showed that during the study period, Indian banking industry experienced stagnation in technological progress. The group-wise analysis showed no significant difference among the banks. Further, scale inefficiency seems to be the main reason for overall inefficiency in the banking industry.

Most of the earlier studies have measured the efficiency of the Indian banks at a macro level. Many of them have examined various issues relating to the performance of Indian banks, particularly the nationalized banks, but none of these studies have examined exclusively the performance of the cooperative banks so far at branch level. There is no prominent work which has been so far carried out on the performance evaluation and efficiency measurement of cooperative banks at the branch level, specifically in the backward districts in the state of West Bengal. The present study is an attempt to analysis the efficiency and total factor productivity growth of cooperative banks at branch based micro-level. The present study also makes an attempt to compare the efficiency and productivity change (Total Factor Productivity Growth) over the years of cooperative bank (Vidyasagar Central cooperative Bank Ltd, a leading cooperative bank in the sample district) with those of State Bank of India and Regional Rural Bank (RRB) at district level which has also not been touched in the earlier studies. The three banks, namely RRBs, VCC bank and SBI are completely different in respect of ownership structure. The present study makes an attempt to find out the impact of ownership structure on the productivity growth (TFP) of these three banks, which have been left out in the earlier studies.

The rest of the paper is divided into four sections. Section II is devoted to methodological treatment for assessment of efficiency and total factor productivity growth. Section III represents the sample frame and data sources. Section IV and V deal with the objectives of the study and hypothesis respectively. Section VI deals with the analysis and interpretation of results relating to the efficiency and productivity change. Section VII concludes.

2. Methodological Treatment

2. 1 DEA: A Technique of Efficiency Measurement

Efficiency relates to how well a bank employs its resources relative to the existing production possibilities frontier or relative to the current best practice of the bank and how a bank simultaneously minimizes cost and maximizes revenue, based on an existing level of production technology (Tandon, 2003). Thus, efficiency compares the observed ratio of inputs to outputs for a firm against an optimal one which constitutes the efficient frontier.[4] The overall efficiency of a firm consists of two components, namely, technical efficiency, which reflects the ability of a firm to obtain maximal output from a given set of inputs and allocative efficiency, which reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices. Technical efficiency can be decomposed into pure technical efficiency and scale efficiency. Pure technical efficiency measures the management performance in maximizing output. Scale efficiency reflects whether a decision making unit (DMU) is operating at the optimal scale size. There would be scale inefficiencies if the firm is operating at any other scale size (Avkiran, 1999).

The measurement of efficiency is a relative assessment of a firm against an efficient frontier. In frontier analysis, the DMUs, *i.e.*, the bank branches of the cooperative bank under study, having better performance relative to a particular standard are separated from those having relatively poor performance. Such line of separation is marked either by applying a non-parametric or parametric frontier analysis. Both approaches are useful in assessing efficiency of a DMU as well as productivity change over the period and identifying the factors responsible for the productivity change. Parametric techniques require an explicit specification of a production function but non- parametric techniques do not have such requirement. The main reason for the selection of DEA, a non-parametric approach, is that it permits for variations found in data to be assessed (Alam, 2001). It does not impose any form specification on the production function. It does not require prior knowledge of the functional form of the frontier, error and inefficiency structures (Isik and Hassan, 2003).

DEA, introduced by Charnes, Cooper and Rhodes (1978), is a mathematical technique used to form the efficient production frontier for estimating the efficiency of a DMU. The purpose of DEA is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier*, i.e.,* no observed point lies beyond the frontier. DMUs lying on the frontier are assigned an efficiency score of 1, considered as fully efficient, while those lying below the frontier are assigned scores of zero and below one and are said to be relatively inefficient as compared to the bench mark DMU.

Efficiency itself is capable of being defined by both output orientated and input orientated models. Output oriented model addresses the question how much output can be feasibly enhanced by keeping the given level of input as constant. On the other hand, the input orientation looks at how much input can be feasibly reduced to produce the same level of output. The output and input orientated measures will only provide equivalent results of technical efficiency when constant return to scale exists, but will be unequal when increasing or decreasing return to scale is present (Fare and Lovell, 1978). In many DEA studies, analysts have tended to select input orientated model because in most DMUs, input quantities seem to be the primary variables (Coelli, 1996).

The DEA-based efficiency measurement is based on two assumptions, namely, constant return to scale (CRS) and variable return to scale (VRS). The constant return to scale assumption represents the technology using a unit isoquant (Farrell, 1957). Assume, there are data on K inputs and M outputs of each of N bank branches of RRBs or DMUs. For the ith DMU these are represented by the vectors x_i and y_i respectively. The K × N input matrix, X and the M × N output matrix, Y represent the data of all N DMUs.

Using linear programming input orientated CRS model can be derived as:

$$\min_{\theta,\lambda} \theta$$

$$\text{Sub to} \quad -y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0, \quad \lambda \geq 0, \qquad \text{Equation (1).}$$

Where, θ, the efficiency score for the ith DMU, is a scalar and λ is a N × 1 vector of constant. The linear programming problem must be solved N times, once for each DMU in the sample. A value of θ is then obtained for each DMU.

The CRS assumption is only appropriate when all DMUs are operating at an optimal scale. But imperfect competition, constraints on finance etc. may cause a DMU to be not operating at optimal scale. The use of CRS specification, when all DMUs are not operating at the optimal scale, will result in measure of technical efficiency, which is confounded by scale efficiencies (SE). CRS model does not differentiate between pure technical inefficiencies and inefficiencies due to non constant (increasing or decreasing) return to scale effect. The use of VRS specification will permit the calculation of technical efficiency devoid of these SE effects (Coelli, 1996).

The assumption of CRS model can be relaxed by adding the convexity constraint $N^1\lambda = 1$ to equation (1), which defines a technical efficiency score for each DMU under VRS assumption

(Banker, Charnes and Cooper, 1984).

The model under VRS assumption is as follows:

$$\min_{\theta,\lambda} \theta$$

$$\text{Sub to } -y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0,$$

$$N^1\lambda = 1, \ \lambda \geq 0, \qquad \text{Equation (2)}$$

Where, N1 is an N × 1 vector of ones. This approach forms a convex hull of intersecting planes which envelope the data points more tightly than the CRS conical hull and thus provides technical efficiency scores which are greater than or equal to those obtained using CRS model.

This model decomposes the overall technical efficiency, *i.e.*, technical efficiency scores obtained from a CRS DEA, into pure technical efficiency and scale efficiency. This may be done by conducting both a CRS and a VRS DEA upon the same data. If there is a difference in the two scores for a particular DMU, then this indicates that the DMU has scale inefficiency and that scale inefficiency can be calculated from the difference between the VRS TE score and the CRS TE score. Scale efficiency is the ratio of CRS TE to VRS TE.

In equation form,

Overall technical efficiency = Pure technical efficiency x Scale efficiency

In this study, the input orientated variable return to scale DEA model has been used to measure technical efficiency, decomposed into pure technical efficiency and scale efficiency.

2. 2 Malmquist Productivity Index: A Technique of Assessing Productivity Change

The productivity is defined as the rate of transformation of inputs to outputs or simply the ratio of outputs over inputs (Coelli *et al.,* 1998). To increase productivity, a DMU has to either maximize outputs for a given level of inputs or minimize inputs for a given level of outputs. Sometimes, both productivity and efficiency terms are interchangeably used. But there is a sharp difference between the two. Productivity enhancement basically depends on two sources, namely technological progress and production efficiency. In terms of the production frontier that reflects the maximum output attainable from each input level or simply as the current production technology, technological progress is seen as shifts (not necessarily parallel shifts) in the production frontier over time due to technological innovation (Coelli *et al.,* 1998). This must be distinguished from technical efficiency gain that indicates the distance of an observed production away from the production frontier. Fully efficient DMUs are located on the production frontier. Hence, a movement closer to the production frontier indicates improving efficiency. But increased efficiency from one period to another does not necessarily indicate higher productivity since the production technology may have changed. Similarly, improved productivity does not indicate a corresponding improvement in efficiency if the production frontier has shifted but the relative distance from the new frontier remains same as the previous distance from the previous production frontier.

In this study, total factor productivity growth (TFP) has been calculated by using the Malmquist Productivity Index (MPI), as introduced by Caves *et al.* (1982) and developed by Fare *et al.* (1994). The MPI can be computed by using only quantitative data for both inputs and outputs alone and is expressed as the ratio of distance functions. Distance functions are function representations of multiple-output and multiple-input technology that require only data on quantities without the need to specify behavioural objectives such as cost minimization or profit maximization (Avkiran, 2000). Distance functions can either be input or output orientated. An input distance function defines the production technology by referring to the maximum contraction of the input vector given an output vector. By contrast, the output distance function seeks maximum expansion of the output vector given to the input vector.

When there is panel data, DEA-like linear programs and 'Malmquist Total Factor Productivity Index' may be used to assess productivity changes, and to decompose this productivity growth into two components *viz.,* technological change and technical efficiency change. Following Fare *et al.* (1994), the output oriented Malmquist Productivity Index has been used for the present study. They specified an output based Malmquist Productivity Change Index as:

$$m_0(Y_{t+1}, X_{t+1}, Y_t, X_t) = \sqrt{\frac{d_0(X_{t+1}, Y_{t+1})}{d_0^t(X_t, Y_t)}} \times \sqrt{\frac{d_0^{t-1}(X_{t-1}, Y_{t-1})}{d_0^{t-1}(X_t, Y_t)}} \qquad \text{Equation (3)}$$

Where, m_0 is the productivity of the production point (x_{t+1}, y_{t+1}) relative to the production point (x_t, y_t). A value greater than one indicates positive total factor productivity growth from period t to period t+1. Fare *et al.* (1992) specified that m_0>1 indicates productivity gain; m_0<1 indicates productivity loss; and m_0=1 means no change in productivity from time t to t+1. To solve equation (3) four component distance functions, which involve four linear programming problems (similar to those conducted in calculating technical efficiency measures) be formulated. The VRS or CRS option has no influence on the Malmquist DEA because both are used to calculate the various distance functions used to construct the Malmquist indices (Coelli, 1996). The output orientated four LP models for formulating four distance functions (assuming CRS technology) are:

$$[d_0^t(x_t, y_t)]^{-1} = \max_{\theta,\lambda} \theta$$

$$\text{Sub to} \quad -\theta y_{it} + Y_t\lambda \geq 0, \quad x_{it} - X_t\lambda \geq 0, \quad \lambda \geq 0, \qquad \text{Equation (a)}$$

$$[d_0^{t+1}(x_{t+1}, y_{t+1})]^{-1} = \max_{\theta,\lambda} \theta,$$

Sub to $-\theta y_{i,t+1} + Y_{t+1}\lambda \geq 0$,

$x_{i,t+1} - X_{t+1}\lambda \geq 0,$

$\lambda \geq 0$ Equation (b)

$$[d_0^{t}(x_{t+1}, y_{t+1})]^{-1} = \max_{\theta,\lambda} \theta,$$

Sub to $-\theta y_{i,t+1} + Y_{t}\lambda \geq 0$,

$x_{i,t+1} - X_{t}\lambda \geq 0,$

$\lambda \geq 0$ Equation (c)

$$[d_0^{t+1}(x_{t}, y_{t})]^{-1} = \max_{\theta,\lambda} \theta,$$

Sub to $-\theta y_{it} + Y_{t+1}\lambda \geq 0$,

$x_{it} - X_{t+1}\lambda \geq 0,$

$\lambda \geq 0$ Equation (d)

The above four LP equations must be calculated for each firm in the sample.

A same way of presenting this index as cited in Equation (03) is as follow:

$$m_j(y_{t+1}, x_{t+1}, y_t, x_t) = \frac{d_0^{t+1}(X_{t+1}, Y_{t+1})}{d_0^{t}(X_t, Y_t)} \times \sqrt{\frac{d_0^{t}(X_{t+1}, Y_{t+1})}{d_0^{t+1}(X_{t+1}, Y_{t+1})} \times \frac{d_0^{t}(X_t, Y_t)}{d_0^{t+1}(X_t, Y_t)}}$$

Or

Malmquist Productivity Index (MPI) = Change in technical efficiency (EFFCH) × Technological change (TECH)

The first component (EFFCH) on the right hand side represents change in technical efficiency. This factor shows the change of the relative position of the observed unit and the frontier between time t and t+1. The second factor (TECH) that is the square root term represents technological change. The value of TECH greater than unity means technological progress that is the expansion of the frontier; the value of TECH less than one symbolizes technological regress, i.e. the contraction of the frontier.

EFFCH can be further decomposed into two parts: one is pure technical efficiency change and other is scale efficiency change. Therefore, total productivity change and its components can be determined in a successive period of time with the help of the following equation:

Productivity Change = Pure Technical Efficiency Change x *Scale Efficiency Change × Technological Change*

2.3 Specification of Input and Output Variables

There is no unanimity among the previous studies over the choice of input and output variables for the purpose of DEA based efficiency and productivity analysis of the banks. DEA is a flexible technique and produces efficiency scores that are different when alternative sets of input and output are considered. Banks are typically multi-input and multi-output firms. Since many of the financial services are jointly produced and prices are typically assigned to a bundle of financial services, specification of 'input' and 'output' is a difficult task. Additionally, banks may not be homogeneous with respect to the types of outputs actually produced. In view of these complexities, four approaches have come to dominate the studies on banking input-output specification, namely, production approach, intermediation approach, operating (income-based) approach and more recently modern approach (Berger and Humphrey, 1992). Since introduction of financial sector reforms, banking industries have been forced to shift their focus from social banking to a more efficient and profit oriented banking through more and more concentration on maximization of income and minimization of cost. In view of these changing circumstances in banking sector, the present study considers the operating approach (or income-based approach), taking interest expenses and non-interest expenses as input variables and interest income and non-interest income as output variables, which could be justified in post reforms era.

3. Sample and Data Source

On the basis of a number of socio economic indicators, districts of West Bengal are segregated into two groups: relatively developed districts and relatively backward districts (Das, 2011). In the present study, Paschim Medinipur has been purposively selected from the group of backward districts. Since inception, Vidyasagar Central Co-Operative Bank Ltd. (VCC) was working as a leading cooperative bank in Paschim Medinipur. At present, it has 36 branches working in Paschim Medinipore. The present study deals with the branch-wise performance evaluation of VCC bank. The study period has been restricted from 2007 to 2012. Subsequently, in this study balanced panel data consists of yearly observations for 36 branches between 2007 and 2012, 36 for each year and 216 (36 × 6) in total. Relevant branch-wise data have been collected from the head office of VCC bank. In order to make a district level overall performance comparison of VCC bank with that of State Bank of India and Bangiya Gramin Bikash Bank (BGBB), the only leading RRB in this district, relevant district level data (compiled by the District Regional Office) have been collected from the regional office of SBI and RRB of Paschim Medinipur. DEAP software (Version 2.1)[5] has been used for analyzing the efficiency and productivity scores.

4. Objectives of the Study

The study sets the following objectives:

1. To explore the branch wise efficiency measurement of VCC bank, working in the district of Paschim Medinipur.
2. To quantify the productivity change (Total Factor Productivity Growth) of VCC bank over the years and also ascertains its constituents.
3. To make a district level overall comparison of efficiency scores and productivity growth, obtained by VCC bank with that of SBI and RRB.
4. To find out the impact of ownership structure on the productivity growth (TFP) of these three banks.

5. Hypotheses

The above-mentioned issues may be addressed by testing the following three research hypotheses.

i. Efficiency of VCC bank is significantly greater than that of others in the study.

ii. Ownership structure of the bank has a significant impact on the productivity growth (TFP).

6. Analysis and Results

6.1 Inter-Branch Comparison

Efficiency Analysis

The study first reports the year wise inter-branch overall efficiency variation (TE) and its' constituents namely, Pure technical efficiency (PTE) and scale efficiency (SE) of VCC bank under the DEA methodology for the study period 2007 to 2012.

Descriptive statistics on the status of branch wise overall technical efficiency scores (TE) of VCC bank and its' constituents, *viz.*, pure technical efficiency (PTE) and scale efficiency (SE) are presented by year in Table 1.

The empirical finding reveals that the average over all technical efficiency scores of all the branches of VCC bank, working in this district is highest in the year 2007 (92.8%), indicating a 7.2% potential reduction in input utilization for the bank as a whole, followed by 2010 (85.5%). The study also reveals that there is a declining trend in overall technical efficiency scores over the study period. The reason for overall technical inefficiencies during the study period (i.e. 2007-20012) can be attributed to pure technical inefficiencies *i.e.* management inefficiencies is responsible for this. Scale efficiency scores provide the information about

Table 1 Descriptive Statistics on Branch Wise Efficiency Scores (TE) and its Components of VCC Bank, 2007-12

	Mean(Geometric)			**Max**			**Min**			**SD**		
Years	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
2007	0.928	0.954	0.973	1	1	1	0.768	0.785	0.856	0.065	0.058	0.035
2008	0.854	0.886	0.964	1	1	1	0.680	0.692	0.765	0.102	0.094	0.056
2009	0.833	0.893	0.935	1	1	1	0.688	0.701	0.755	0.1	0.093	0.073
2010	0.855	0.914	0.938	1	1	1	0.656	0.724	0.776	0.096	0.097	0.071
2011	0.816	0.879	0.933	1	1	1	0.691	0.694	0.734	0.087	0.1	0.076
2012	0.805	0.857	0.942	1	1	1	0.665	0.669	0.729	0.103	0.111	0.073

Source: Authors' calculation

whether a particular branch is operating at the optimal scale or not, but it does not indicate the specific area where it is scale inefficient.

Table 2 illustrates the return to scale characteristic of all the branches of VCC bank in this district. The analysis shows that out of 36 branches of VCC bank, average 19 branches (52.77%) are persistently operating at a decreasing return to scale over the study period. This may be due to fierce competition with other commercial banks, greater reliance on rural based business, limited scope of diversifying their business etc. The empirical result indicates that pure technical inefficiencies *i.e.* management inefficiencies is greater responsible for declining overall technical efficiencies during the study period. This may be due to desire of necessary expertise or human resources in the line of management which leads the bank to take the advantages of technological innovations and productive opportunities rapidly.

Table 2 Distribution of Bank Branches of VCC Bank by Return to Scale, 2007-12

Year	**Branches of VCC Bank**		
	IRS	**CRS**	**DRS**
2007	07	09	20
2008	10	06	20
2009	17	05	14
2010	14	07	15
2011	14	05	17
2012	04	03	29
Average	11 (30.56%)	06 (16.67%)	19 (52.77%)

Source: Authors' calculation

The distribution of bank branches of VCC bank by level of efficiency in Paschim Medinipore districts during 2007-2012 is shown in Table 3. The efficiency of VCC bank has been notably declined over the study period. The number of bank branches with high efficiency scores (0.80 and above) decreased from 34 in 2007 to 17 branches in 2012.

Table 3 Distribution of Bank Branches of VCC Bank by Level of Efficiency, 2007-2012

Level of **Efficiency** (E_{it})	2007	2008	2009	2010	2011	2012
$0.60 < E_{it} \leq 0.70$	00	02	03	02	01	07
$0.70 < E_{it} \leq 0.80$	02	12	13	09	15	12
$0.80 < E_{it} \leq 0.90$	09	12	11	12	14	11
$0.90 < E_{it} \leq 1$	25	10	09	13	06	06
Total number of Bank Branches (N)	36	36	36	36	36	36

Source: Authors' calculation

Productivity Analysis

The branch level total factor productivity growth ($TFPC_{it}$) of VCC bank that has been measured by 'Malmquest Productivity Index' methodology is shown in Table 4. The number of bank branches with positive total factor productivity growth (*i.e.* $TFPC_{it}>1$) increased from 4 in 2008 to 31 branches in 2010. Thereafter, it got regression momentum. In 2011 it became 27. In 2012, the number of bank branches having positive productivity growth reached at dip point.

Table 4 Distribution of Bank Branches of VCC Bank by Total Factor Productivity Growth, 2007-2012

Total Factor Productivity Growth ($TFPC_{it}$)	2008	2009	2010	2011	2012
$TFPC_{it} \leq 0.60$	00	02	00	00	00
$0.60 < TFPC_{it} \leq 0.70$	03	04	00	00	00
$0.70 < TFPC_{it} \leq 0.80$	08	02	00	00	02
$0.80 < TFPC_{it} \leq 0.90$	15	08	00	03	14
$0.90 < TFPC_{it} \leq 1$	06	13	05	06	15
$1 < TFPC_{it} \leq 1.10$	01	06	15	18	04
$1.10 < TFPC_{it} \leq 1.20$	02	01	07	07	01
$1.20 < TFPC_{it} \leq 1.30$	00	00	05	02	00
$TFPC_{it} > 1.30$	01	00	04	00	00
Total number of Bank Branches (N)	36	36	36	36	36

Source: Authors' calculation

Descriptive statistics on the status of total factor productivity growth (TFPG) of VCC bank and its' constituents, *viz.*, technical efficiency change (EFFCH) and technological change (TECH) are presented by year in Table 5.

The empirical results show that VCC bank registered an average annual negative growth rate of productivity of 4.3% over the sample period. The time pattern of TFPG reveals that for the first two years *i.e.* between 2008 and 2009 there was a regression in TFP index but in 2010, the TFP index reached at a peak point (12.3%), followed by a regression in the year 2011(5.4%). In 2012, it again got regression momentum. The bank registered a negative growth rate of 8.30% in 2012. The decomposition of total factor productivity growth shows that though both the factors, namely, efficiency change (EFFCH) and technological change (TECH) are jointly responsible for such negative growth rate of productivity during the study period, but efficiency change is relatively more responsible than technological change. The decomposition of change in efficiency (EFFCH) into its two components (PECH and SECH) indicates that pure technical efficiency (PECH) that measures performance only due to managerial activity is relative more responsible for negative change in efficiency.

Table 5 Descriptive Statistics on Productivity Growth and its' Components of VCC Bank

		2008	2009	2010	2011	2012	Mean
Geometric Mean	**TFPG**	0.862	0.857	1.123	1.054	0.917	**0.957**
	EFFCH	0.916	0.976	1.027	0.955	0.984	**0.971**
	TECH	0.941	0.878	1.093	1.103	0.932	**0.985**
	PECH	0.925	0.991	1.026	0.995	0.977	**0.982**
	SECH	0.99	0.985	1.001	0.961	1.007	**0.989**
Maximum	**TFPG**	1.685	1.101	1.638	1.287	1.125	-
	EFFCH	1.12	1.088	1.225	1.114	1.264	-
	TECH	1.629	1.073	1.388	1.287	0.992	-
	PECH	1.022	1.175	1.142	1.216	1.212	-
	SECH	1.108	1.039	1.131	1.017	1.355	-
Minimum	**TFPG**	0.656	0.409	0.91	0.86	0.729	-
	EFFCH	0.76	0.837	0.79	0.809	0.814	-
	TECH	0.789	0.431	0.941	1.019	0.827	-
	PECH	0.779	0.845	0.88	0.805	0.702	-
	SECH	0.863	0.888	0.79	0.847	0.905	-
Standard Deviation	**TFPG**	0.180	0.153	0.161	0.094	0.08	-
	EFFCH	0.086	0.061	0.087	0.072	0.091	-
	TECH	0.138	0.131	0.12	0.049	0.043	-
	PECH	0.067	0.067	0.058	0.068	0.088	-
	SECH	0.048	0.036	0.06	0.039	0.079	-

Note: TFPG=total factor productivity growth, EFFCH = change in technical efficiency, TECH= technological change, PECH = pure technical efficiency change and SECH = scale efficiency change.
Source: Authors' calculation

6.2 District Level Comparison

Efficiency of VCC bank vis-à-vis RRB and SBI

In order to make a district level comparison between the efficiency of VCC bank, RRB and SBI, operating in the study area, year wise overall technical efficiency scores of different banks (CRSTE*) under the DEA methodology have been calculated for the study period 2007 to 2012. Descriptive statistics overall efficiency scores of different banks are presented by year in Table 03:

Table 6 Descriptive statistics: District Level Overall Efficiency Scores

Bank / Year	Overall Technical Efficiency (CRSTE)								
	RRB			**VCC**			**SBI**		
	TE	**PTE**	**SE**	**TE**	**PTE**	**SE**	**TE**	**PTE**	**SE**
2007	1	1	1	0.839	1	.839	1	1	1
2008	0.937	1	0.937	1	1	1	1	1	1
2009	0.737	1	0.737	1	1	1	1	1	1
2010	1	1	1	0.740	1	0.740	1	1	1
2011	0.99	1	0.99	1	1	1	1	1	1
2012	1	1	1	0.797	1	0.797	1	1	1
Mean	0.944	1	0.944	0.896	1	0.896	1	1	1

Source: Authors' calculation

Table 03 shows that at district level, SBI[1] has the highest average overall technical efficiency (100%), followed by RRBs (94.4%) and VCC bank (89.6%) over the sample period. t-test has been used to examine whether the efficiency of VCC bank is significantly lower than that of RRB in Paschim Medinipur district or not. Although there appears to be a difference in the absolute value of efficiency but these differences are not found to statistically significant. For 6 sample observations (years) (as exhibited in Table 03), the null hypothesis is accepted resulting in a conclusion that the efficiency of VCC bank is not significantly lower than that of RRB. The decomposition of overall technical efficiency scores for VCC bank and RRBs further suggests that the scale inefficiency is exclusively only reason for the overall inefficiency of these banks as exhibited in Table 03.

Testing of Hypotheses in relation to Efficiency Comparison between VCC bank and RRB

Alternative Hypothesis (H_1)	Test Statistic	d.f	Calculated Value	Null Hypothesis H_0 Accepted/Rejected
Efficiency of VCC bank is significantly lower than that of RRB	t-test	10	-0.746	H_0 is Accepted, H_1 is rejected. Since, the observed value of t is -0.746. The table value is 1.81. The result is not significant at 5% level.

1. Since the Efficiency Scores (TE) of SBI become 1(one) over the study period, hence t test should not be done.

DEA is a flexible technique and produces efficiency scores that are different when alternative sets of inputs and outputs are used. In the present study, prices of inputs (interest and non-interest expenses) as the input variables have been used. In this model, State Bank of India appears to be more efficient in generating return and reducing cost (interest expenses and non-interest expenses) as compared to RRBs and VCC bank. This means that there are inefficiencies in accelerating income and reducing costs among RRBs and VCC banks, which need to remedy to achieve increased efficiency. The relatively lower scores for RRBs and VCC banks, as compared to SBI in this study could be because these banks are in the expansion phase and could have higher amount of fixed assets employed which have yet to start generating return.

Table 7 Return to Scale

Year	RRB	VCC	SBI
2007	CRS	DRS	CRS
2008	IRS	DRS	DRS
2009	IRS	DRS	DRS
2010	CRS	DRS	CRS
2011	IRS	CRS	CRS
2012	CRS	DRS	CRS

Source: Authors' calculation

Table 4 illustrates the returns to scale characteristic of the three banks under study. The empirical results show that only RRBs are operating persistently either at increasing or at constant return to scale and in contrast to this both SBI and VCC bank are operating either at decreasing or at constant return to scale.

Total Factor Productivity Growth and its Components of VCC bank vis-à-vis RRB and SBI:

Table No: 05 show the Malmquist TFP index and its constituents for each category of bank by year.

Table 8 Total Factor Productivity Growth and its Constituents across Banks

Year	RRBs					VCC Bank					SBI				
	Effc	Techc	Pec	Sech	TFP	Effc	Techch	Pec	Sech	TFP	Eff	Tech	Pech	Sech	TFP
2008	0.937	1.165	1	0.937	***1.091***	1.192	1.302	1	1.192	***1.552***	1	1.190	1	1	***1.190***
2009	0.787	1.022	1	0.787	***0.805***	1	0.980	1	1	***0.980***	1	1.018	1	1	***1.018***
2010	1.356	1.228	1	1.356	***1.666***	0.740	0.725	1	0.740	***0.536***	1	1.232	1	1	***1.232***
2011	0.99	0.870	1	0.990	***0.861***	1.352	1.457	1	1.352	***1.969***	1	1.022	1	1	***1.022***
2012	1.010	1.111	1	1.010	***1.123***	0.797	0.881	1	0.797	***0.702***	1	1.019	1	1	***1.019***
Geo Mean	1	1.072	1	1	***1.072***	0.99	1.035	1	0.990	***1.024***	1	1.092	1	1	***1.092***

Source: Authors' calculation

The empirical results show that at the district level, SBI registered an average annual growth rate of 9.2% over the sample period, followed by 7.2%% by RRBs and 2.4% by VCC bank. The time pattern of TFP growth of RRBs reveals that for the first two years i.e. between 2008 and 2009 there was a regression in TFP index but high rising trend in TFP growth occurred in 2010, followed by a regression in the year 2011. In 2012, it again began to improve. TFP growth of RRBs reached its peak point in the year 2010, scoring a TFP growth index 1.666. The time pattern of TFP growth of VCC bank reveals that this bank reached its peak growth point in the year 2011, scoring a TFP growth index 1.969, followed by 2008 (1.552). There was a regression in TFP growth of VCC bank, occurred in 2009 and 2010, followed by a high rise in 2011. In 2012, it again got regression momentum. For SBI, for the first two years i.e. 2008 and 2009 there was a decline trend in TFP index but reached its peak point in 2010 (1.232), followed by a regression in TFP growth, 1.022, occurred in 2011 and 1.019 in 2012.

Table 05 shows that at district level, SBI registered an average annual growth rate of 9.2% over the sample period, followed by 7.2%% by RRBs and 2.4% by VCC bank. t-test has been used to examine whether the total factor productivity growth as indicated by TFP growth index of VCC bank is significantly lower than that of RRB and SBI in Paschim Medinipur district or not. Although there appears to be a difference in the absolute value of TFP growth index but these differences are not found to statistically significant. For 6 sample observations (years) (as exhibited in Table 05), the null hypothesis is accepted in both the cases resulting in a conclusion that the total factor productivity growth of VCC bank is not significantly lower than that of RRB and also SBI.

Testing of Hypotheses in relation to TFP Growth: Comparison between VCC bank, RRB and SBI

Alternative Hypothesis (H_1)	Test Statistic	d.f	Calculated Value	Null Hypothesis H_0 Accepted/Rejected
1. TFP Growth of VCC bank is significantly lower than that of RRB.	t-test	08	-0.125	Accepted, Since, the observed value of t is -0.125. The table value is 1.86 at d.f 8. The result is not significant at 5% level.
2. TFP Growth of VCC bank is significantly lower than that of SBI.	t-test	08	-0.189	Accepted, Since, the observed value of t is -0.189. The table value is 1.86 at d.f 8. The result is not significant at 5% level.

Source: Authors' calculation

Looking at the components in TFP growth, it can be inferred that for all the banks, the majority of growth has come from technological progress. The average growth due to technological progress of SBI is 9.2%, followed by RRBs (7.2%) and VCC bank (3.5%). TFP growth is very much dependent upon the technology growth throughout the entire study period, which signifies the importance of technology change in overall productivity growth. From the Table No: 05, it may also be observed that in case of RRBs, efficiency change and technology change are positively co-related with each other. The calculated Pearson correlation coefficient (r) is 0.534. For VCC bank, the calculated Pearson correlation coefficient (r) between efficiency change and technology change is 0.985, i.e. positively highly correlated and significant at 1% level. But, for SBI, irrespective of technological progress, efficiency change is constant.

Ownership wise analysis shows that the average annual growth rate registered by RRBs, VCC banks and SBI is 7.2%, 2.4% and 9.2% respectively. Although there is a difference in the absolute growth values but these differences are not found to be statistically significant, which implies that ownership structure has no impact on TFP growth of the banks. This finding is in conformity with the earlier research findings made by Mohan and Ray, 2004; Ashis Kumar and Vikas Batra (2012). Table 6 presents T statistic Test for difference in annual growth of TFP across banks having different ownership structure.

Table 9 t- Statistic Test for Difference in Annual Growth of TFP across Banks

	Mean	**t-Statistics (RRBs vs. VCC)**	**t-Statistics (RRBs Vs. SBI)**	**t- Statistics (VCC vs. SBI)**
RRBs	1.072	0.1523	0.12445	0.2434
VCC	1.024	No significant difference in TFP growth across three banks under study.		
SBI	1.092			

7. Summary and Conclusion

Financial sector reforms in the early 1990s have brought about fierce competition in Indian banking sector due to subsequent entry of domestic and foreign private banks. Enhanced profitability, productivity and efficiency have become essential for growth and survival of any bank. Obviously cooperative banks are not beyond this track. In this perspective, the present study is an attempt to analysis the efficiency and total factor productivity growth of cooperative banks at branch level.

The study has been conducted in Paschim Medinipore district, a less developed district of West Bengal. Bank efficiency has been assessed by applying DEA methodology. Malmquest productivity index has been used to quantify the branch wise total factor productivity growth over the study period. This methodology helps in exploring the different performance measures viz., productivity growth, technological change, technical efficiency change, management efficiency change and scale efficiency change for the study period. The study also makes a district level overall comparison of efficiency scores and productivity growth, obtained by VCC bank with that of SBI and RRB. The present study also concentrates on finding out the impact of ownership structure on the productivity growth (TFP) of these three banks under study. In specifying the variables input-output, the operating approach (or income-based approach) is chosen, which could be justified in post reforms era.

The study first reports the year wise inter-branch overall efficiency variation (TE) and its' constituents namely, Pure technical efficiency (PTE) and scale efficiency (SE) of VCC bank under the DEA methodology for the study period 2007 to 2012. The study reveals that there is a declining trend in overall technical efficiency scores of VCC bank over the study period. The empirical result indicates that pure technical inefficiencies *i.e.* management inefficiencies is greater responsible for declining overall technical efficiencies during the study period. The analysis shows that around 53 per cent branches are persistently operating at a decreasing return to scale over the study period. This may be due to fierce competition with other commercial banks, greater reliance on rural based business, limited scope of diversifying their business etc. The empirical results show that VCC bank registered an average annual negative growth rate of productivity of 4.3 per cent over the sample period. The decomposition of total factor productivity growth shows that though both the factors, namely, efficiency change (EFFCH) and technological change (TECH) are jointly responsible for such negative growth rate of productivity, but efficiency change is relatively more responsible than technological change.

So far as district level inter-bank comparison in regard to overall efficiency is concerned, the study observes that SBI has the highest average overall technical efficiency (100%), followed by RRBs (94.4%) and VCC bank (89.6%) over the sample period. The study finds out that SBI to be more efficient in generating return and reducing cost (interest expenses and non-interest expenses) as compared to RRBs and VCC bank. This means that there are inefficiencies in accelerating income and reducing costs among RRBs and VCC banks, which need to remedy to achieve increased efficiency. The empirical result also shows that the efficiency of VCC bank is not significantly lower than that of RRB. The empirical results also show that only RRBs are operating persistently either at increasing or at constant return to scale and in contrast to this both SBI and VCC bank are operating either at decreasing or at constant return to scale. So far as district level inter-bank comparison regarding productivity growth is concerned, the empirical results show that at district level, SBI registered an average annual growth rate of 9.2 per cent over the sample period, followed by 7.2 per cent by RRBs and 2.4 per cent by VCC bank. The study also observes that the total factor productivity growth of VCC bank is not significantly lower than that of RRB and also SBI.

Looking at the components in TFP growth, the study concludes that for all the banks, the majority of growth has come from technological progress. TFP growth is very much dependent upon the technology growth throughout the entire study period, which signifies the importance of technology change in overall productivity growth. Ownership wise analysis shows that although there is a difference in the absolute growth values of all the three banks but these differences are not found to be statistically significant, which implies that ownership structure has no impact on TFP growth of the banks

Notes

1. A Committee chaired by Sri M. Narasimham was appointed by the Govt. of India with an objective to develop a diversified, efficient and competitive financial system with the ultimate goal of improving the allocative efficiency of resources through operational flexibility, improved financial viability and institutional strengthening.
2. Govt. of India appointed second Narasimham Committee in the year 1997 to review the first phase of banking sector reforms and the Committee submitted its report with some new recommendations.
3. Laeven (2007) pointed out that while most banking systems not surprisingly still rely mainly on income from traditional banking, the post-1997 financial crisis years have seen an increasing number of banks specially in East-Asia and Latin-America moving into investment banking-type activities, fee-based business and related activities.
4. The efficient frontier is critical for efficiency measurement because efficiency involves a comparison of the actual output from a given input with the maximum possible output.
5. A Guide to DEAP Version 2.1: A DATA Envelopment Analysis (Computer) Programme by Tim Coelli, Centre for Efficiency and Productivity Analysis, Dept. of Econometrics, University of New England, Armidale, NSW, 2351, Australia, *http://www.une.edu.au/econometrics/cepa.htm*.

References

1. Acharya, V.V., Hasan, I. and Saunders, A. 2006. "Should Banks be Diversified? Evidence from Individual Bank Loan Portfolios." *Journal of Business*, 79(3), pp. 1355-1412.
2. Alam, lla M.S. 2001. "A Non-parametric Approach for Assessing Productivity Dynamics of Large US Banks." *Journal of Money, Credit and Banking*, 33. pp. 121.
3. Ali-Yrkko, J. 2002. "Mergers and Acquisitions – Reasons and Results." Discussion Paper Nr.792, *The Research Institute of the Finish Economy*, Helsinki.
4. Amandeep. 1991. "Profits and Profitability of Indian Nationalized banks." *Thesis submitted to UBS, Punjab University*, Chandigarh, pp. 43-53.
5. Avkiran, N. K. 2000, "Rising Productivity of Australian Trading Banks under Deregulation 1986-1995." *Journal of Economics and Finance*, 24, pp. 122-140.

6. Banker, R.D., Charnes, A. and Cooper, W. W. 1984. "Some models for estimating technical and scale inefficiencies in data envelopment analysis." *Management Science*, 30, pp. 1078-1092.
7. Berg, S.A., Forsund, F.R. and Jansen, E.S. 1992. "Malmquest Indices of Productivity Growth During the Deregulation of Norwegian Banking, 1980-1989." *Scandinavian Journal of Economics*, 94, pp. 211-228.
8. Berger, A.N. and Humphrey, D.B. 1992. "Measurement and Efficiency Issues in Commercial Banking." In Z. Griliches (ed.) *Measurement Issues in the Service Sectors, Chicago: National Bureau of Economic Research*, University of Chicago Press.
9. Berger, A.N. and Humphrey, D.B. 1997. "Efficiency of Financial Institutions: International Survey and Directions for Future Research." *European Journal of Operation Research*, 98, pp. 332-345.
10. Boyd, J., G. Hanweck, and P. Pithyachariyakul. 1980. "Bank holding company diversification." In proceedings from a Conference on Bank Structure and Competition, May. Federal Reserve Bank of Chicago. pp.105-120.
11. Breusch, T., and Pagan, A. 1980. "The Lagrange Multiplier test and its Applications to Model Specification in Econometrics." *Review of Economic Studies*, 47(1), pp. 239-253.
12. Caves, D.W., Christensen, L.R. and Diewert, W.E. 1982. "The economic theory of index numbers and the measurement of input, output and productivity." *Econometrica*, 50(6), 1393-1414.
13. Charnes, A., Cooper W.W. and Rhodes E. 1978. "Measuring the Efficiency of Decision Making Units." *European Journal of Operation Research*, 2, pp. 429-444.
14. Coelli, T. 1996. "A Guide to DEAP Version 2.1: A Data Envelopment (Computer) Programme." *CEPA Working Paper 96/08*, University of New England, Australia.
15. Coelli, T., P. D. S Rao and G. E Battese (2002), "An Introduction to Efficiency and Productivity Analysis." *Kluwer Academic Publishers*, Boston.
16. Das, Abhiman & Ghosh, Saibal. 2006. "Financial Deregulation and Efficiency: An empirical analysis of Indian Banking during the Post-Reform Period." *Review of Financial Economics*, 15, pp. 193-221.
17. De Young, R. and Rice, T. 2004. "Non-interest Income and Financial Performance at U.S. Commercial Banks." *The Financial Review*, 39(1), pp. 456-478.
18. Farrell, M.J. 1957. "The Measurement of Productive Efficiency." *Journal of the Royal Statistical Society*, 120, pp. 253-290.
19. Fare, R. and C.A.K. Lovell. 1978. "Measuring the Technical Efficiency of Production." *Journal of Economic Theory*, 19, 150-162.

20. Fare, R., Grosskopf, S., Norris, M. and Zhang, Z. 1994. "Productivity Growth, Technical Progress and Efficiency Change in Industrialized Countries.' *The American Economic Review*. 84, pp. 66-83.
21. Gallo, J., V. Apildado. And J. Kolari. 1996. "Commercial bank mutual fund activities." *Journal of Banking and Finance*, 20, pp. 1775-1791.
22. Gujarathi, D. N. and Sangeetha. 2009. Basic Econometrics. *Tata McGraw Hill.*, New Delhi.
23. Hausman, J. 1978. "Specification Tests in Econometrics." *Econometrica*, 46(6), pp. 1251-72.
24. Ibrahim, M. Syed. 2010. "Performance Evaluation of Regional Rural banks in India." *International Business Research*, 3(4), pp. 203-211, retrieved from *www.ccsenet.org/ibr.*
25. Jackson, P.M. and Fethi, M.D. 2000. "Evaluating the Efficiency of Turkish commercial banks: An application of DEA and Tobit Analysis." *Presented at the International DEA Symposium*, University of Queensland, Brisbane, Australia, 2-4 July, 2000.
26. Koushik, Sanjoy. 1995. "Social Objectives and Profitability of Indian Banks." *Thesis submitted to UBS, Punjab University*, Chandigarh, pp. 190-242.
27. Kumar, Ashish. 2011. "Analysis of Efficiency of Banks in a developing Economy: A Case Study of India." *International Journal of Computer Science and Management Studies*, 11 (3), pp. 17-27.
28. Kumar, Ashish and Batra, Vikas. 2012. "Efficiency Analysis of Indian Banks (2006-2011): An Application of Malmquest Productivity Index." *National Conference on Emerging Challenges for Sustainable Business,* 2012, pp. 57-80.
29. Kumar, Sharad and Sreeramula, M. 2007. "Employees' Productivity and Cost – A Comparative Study of Banks in India During 1997 to 2008." *Reserve Bank of India, Occasional Papers (winter)*, 28(3), pp. 35-50.
30. Kwast, M. L. 1989. "The impact of Underwriting and Dealing on Bank Return and Risks." *Journal of Banking and Finance*, 13, pp. 101-125.
31. Landi A. and Venturelli V. 2000. "The Diversification Strategy of European Banks: Determinants and Effects on Efficiency and Profitability." Retrieved from www.papers.ssrn.com.
32. Laeven, L., 2007. "Banking sector performance in East Asian countries: The effect of competition, diversification and ownership." Paper prepared as a background paper for *"East Asian Finance: the road to robust markets,"* World Bank.

33. Lepetit, L., E. Nys., P. Rous and A. Tarazi. 2007. "Bank income structure and risk: An empirical analysis of European banks." *Journal of Banking and Finance*, 32, pp. 1452-1467.

34. Mishra, P. and Sahoo, D. 2012. "Operational Diversification and Stability of Financial Performance in Indian Banking Sector: A Panel Data Investigation." *Research Journal of Finance and Accounting*, 3(3), pp.70-87. *www.iiste.org.*

35. Mittal, Manish and Dhade, Aruna. 2007. "Profitability and Productivity in Indian Banks: A Comparative Study." *AIMS International*, 1(2), pp. 137-152.

36. Narasimham Committee Report (1991), Report of the Committee on the financial Sector Reforms, Government of India.

37. Sathye, M. 2001. "X-efficiency in Australian banking: an empirical investigation." *Journal of Banking and Finance*, 25, pp. 613-630.

38. Sathye, M. 2002. "Measuring Productivity Changes in Australian Banking: An Application of Malmquest Indices, *Managerial Finance*." Managerial Finance, 28, pp.48-59.

39. Second Narasimham Committee.1997. Committee on Banking Sector Reform, *Gazette of India Extraordinary Notification*, Part-II, Sec 3(ii), Ministry of Finance, Govt. of India.

40. Sherman, H.D. and F. Gold. 1985. "Bank Branch Operating Efficiency: Evaluation with DEA." *Journal of Banking and Finance*, 9(2), pp. 297-315.

41. Stiroh, k.J., 2006. "A portfolio view of banking with interest and non-interest activities." *Journal of Money, Credit and Banking*, 38(5), pp. 1351-1361.

42. Stiroh, K.J. and Rumble, A. 2003. "The Dark side of Diversification: The case of U.S. Financial Holding Companies." Working Paper.

43. Stone, M.R. 2000. "The corporate sector dynamics of systemic financial crises." *IMF working paper-114*.

44. Sturm, J.E. and Williams, B. 2004. "Foreign bank entry, deregulation and bank efficiency: Lessons from the Australian experience, *Journal of Banking and Finance*, 28, pp. 1775-1799.

45. Templeton, W. K. and Severiens, J. T. 1992. "The Effects of Non-Bank Diversification on Bank Holding Company Risk." *Quarterly Journal of Business and Economics*, 31(1), pp. 3-17.

46. Yeh, Q.1996. "The Application of Data Envelopment Analysis in Conjunction with Financial Ratios for Bank Performance Evaluation."*Journal of Operation Research Society*, 47, pp. 980-988.