

Performance of Regional Rural Banks in Paschim Medinipur District (2007-2012): A Comparative Exploration

Sibaram Chatterjee¹



Abstract

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 main motive of the reforms was to improve the operational efficiency of the banks to further enhance their productivity and profitability. The present study makes an attempt to find out the impact of ownership structure on the productivity growth (TFP) of these three banks, namely RRBs, VCCB and SBI using econometric techniques such as Data Envelopment Analysis (DEA) and Malmquist Productivity Index (MPI) taking 2007 to 2012 as the study period. Study results show that RRBs have serious scale inefficiency problem and they are persistently operating at an increasing return to scale whereas VCCB and SBI are operating at either decreasing return to scale or constant return to scale. It is also found that performance of RRBs is not significantly better than that of VCCB.

Key words - Banking, RRBs, Co-operative Banks, Data Envelopment Analysis, Malmquist Productivity Index.

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. 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

¹ Assistant Professor, Department of Commerce, Pingla Thana Mahavidyalaya, Maligram, Paschim Medinipur, West Bengal

Narasimham Committee (1997) recommended the merger of strong units of banks and adaptation of 'narrow banking' concept to rehabilitate weak banks.

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 institution³. 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 Regional Rural Banks (RRBs) are not beyond this track.

Almost since inception, RRBs 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, RRBs 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 RRBs have become the key issues which enable them to function as an effective and efficient institution of rural credit.

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 analyst. 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 Malmquist 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 performance of Indian banks at a macro level. Many of them have examined various issues relating to the performance of Indian banks, particularly that of the nationalized banks, but none of these studies have examined exclusively the performance of RRB 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 RRBs 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 RRBs at branch based micro-level in post-amalgamation period. The present study also makes an attempt to compare the efficiency and productivity change (Total Factor Productivity Growth) over the years of RRBs with those of State Bank of India and Co-Operative bank (Vidyasagar Central Co-Operative Bank Ltd VCCB, a leading co-operative bank in the sample district) 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 has 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 deals

with the analysis and interpretation of results relating to the efficiency and productivity change. Section V 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 *i*th DMU these are represented by the vectors x_i and y_i respectively. The K x N input matrix, X and the M x N output matrix, Y represent the data of all N DMUs.

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

$$\begin{aligned} & \min_{\theta, \lambda} \theta \\ & \text{Sub to -} \\ & - y_i + Y \lambda \geq 0, \\ & \theta x_i - X \lambda \geq 0, \lambda \geq 0, \end{aligned} \quad \text{Equation (1).}$$

Where, θ , the efficiency score for the *i*th DMU, is a scalar and λ is a N x 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 $\sum \lambda = 1$ 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:

$$\begin{aligned} & \min_{\theta, \lambda} \theta \\ & \text{Sub to -} \\ & - y_i + Y \lambda \geq 0, \\ & \theta x_i - X \lambda \geq 0, \end{aligned}$$

$$N1' \lambda = 1, \lambda \geq 0,$$

Equation (02)

Where, N1 is an N x 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:

$$m_0(Y_{t+1}, X_{t+1}, Y_t, X_t) = \sqrt{\frac{d_u^t(X_{t+1}, Y_{t+1})}{d_o^t(X_t, Y_t)}} \times \sqrt{\frac{d_j^{t+1}(X_{t+1}, Y_{t+1})}{d_o^{t+1}(X_t, Y_t)}} \dots\dots \text{Equation (03)}$$

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:

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

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

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

Sub to $-\theta y_{i,t+1} + Y_{t+1} \lambda \geq 0,$
 $x_{i,t+1} - X_{t+1} \lambda \geq 0,$
 $\lambda \geq 0, \dots\dots\dots \text{Equation (b)}$

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

$$\begin{aligned} \text{Sub to } & -\theta y_{i,t+1} + Y_t \lambda \geq 0, \\ & x_{i,t+1} - X_t \lambda \geq 0, \\ & \lambda \geq 0, \dots \dots \dots \text{Equation (c)} \end{aligned}$$

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

$$\begin{aligned} \text{Sub to } & -\theta y_{it} + Y_{t+1} \lambda \geq 0, \\ & x_{it} - X_{t+1} \lambda \geq 0, \\ & \lambda \geq 0, \dots \dots \dots \text{Equation (d)} \end{aligned}$$

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:

$$m_j(y_{t+1}, x_{t+1}, y_t, x_t) =$$

$$\frac{d_o^{t+1}(X_{t+1}, Y_{t+1})}{d_o^t(X_t, Y_t)} X \sqrt{\frac{d_o^t(X_{t+1}, Y_{t+1})}{d_o^{t+1}(X_{t+1}, Y_{t+1})} \frac{d_o^t(X_t, Y_t)}{d_o^{t+1}(X_t, Y_t)}}$$

Or

2.3. Malmquist Productivity Index (MPI) = Change in technical efficiency (EFFCH) x 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:

$$\text{Productivity Change} = \text{Pure Technical Efficiency Change} \times \text{Scale Efficiency Change} \times \text{Technological Change}$$

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 1976, Mallyabhum Gramin Bank was working as a leading Regional Rural Bank in Paschim Medinipur. On 21st February 2007, due to restructuring of the RRBs this bank became Bangiya Gramin Bikash bank. At present it has 37 branches working in this district. The present study deals with the branch wise performance evaluation of RRBs of post amalgamation period. So the study period has been restricted to 2007 to 2012. Relevant branch wise data have been collected from the regional office of RRBs of Paschim Medinipur district for the said period. Subsequently, in this study balanced panel data consists of yearly observations for 37 branches between 2007 and 2012, 37 for each year and 222 (37x6) in total. In order to make a district level overall performance comparison of RRBs with that of State Bank of India and Vidyasagar Central Co-Operative Bank Ltd, data (compiled by the District Regional Office) has been collected from the regional office of the respective banks of Paschim Medinipur. DEAP software (Version 2.1)⁵ has been used for analyzing the efficiency and productivity scores.

4. Analysis and Results

Inter-Branch 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 RRBs 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 RRBs and its' constituents, *viz.*, pure technical efficiency (PTE) and scale efficiency (SE) are presented by year in Table 1. Thereafter, the overall technical efficiency scores and its' constituents, *viz.*, pure technical efficiency and scale

efficiency of RRBs vis-à-vis State Bank of India and Vidyasagar Central Co-Operative Bank Ltd at district level have also been reported in the study.

The empirical finding reveals that the average overall technical efficiency scores of all the RRBs, working in this district is highest in the year 2010 (76.2%), indicating a 23.8% potential reduction in input utilization for the bank as a whole, followed by 2012 (74.3%). RRB occupies the lowest percentage of average over all technical efficiency score (31.5%) in the year 2009, followed by 2007 (66.2%). The reason for overall technical inefficiencies of the first three years (i.e. 2007-2009) can be attributed to scale inefficiencies and for the last three years (i.e. 2010-2011), pure technical inefficiencies i.e. management inefficiencies is responsible for this. The results also indicate that the RRBs have more serious scale inefficiency problem in the year 2009, i.e. average 54.6% (100-45.4), which results in lower overall technical efficiency. Scale efficiency scores provide the information about 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: 02 illustrate the return to scale characteristic of different branches of RRBs in the district under study. The analysis shows that out of 37 branches of RRB, average 28 branches (76%) are persistently operating at an increasing return to scale over the study period. This may be due to relatively stronger rural based business background and introduction of information technology, like core banking system which helps them to take advantages of technological innovations and productive opportunities rapidly.

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

Table 03 shows that SBI has the highest average overall technical efficiency (100%), followed by RRBs (94.4%) and VCC bank (89.6%) over the entire sample period. Fisher's t-test has been used to examine whether the efficiency of RRBs is significantly greater than that of VCC bank 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 be statistically significant. For 6 sample observations (years) (as exhibited in Table 04), the hypothesis is accepted resulting in a conclusion that the efficiency of RRBs is not significantly greater than that of VCC bank. The decomposition of overall technical efficiency scores for RRBs and VCC bank further suggests that the scale inefficiency is exclusively only reason for the overall inefficiency of these banks.

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 5 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 Change and its Components:

Table No 06, Table No 07 and Table No 08 show the Malmquist TFP index and its constituents for each category of bank by year.

The empirical results show that 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. 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 the first two years i.e. 2008 and 2009 there was a decline trend in TFP index but reached its peak point in 2010 (23.2%), followed by a regression in TFP growth occurred in 2011 (1.022) and 1.019 in 2012.

Looking at the components in TFP growth, it can be inferred that 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. In this study, it may also be observed that in case of RRBs, efficiency change and technology change are positively 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 statistically significant as evident from Table 10, resulting in a conclusion that so far as ownership structure is concerned, there is no significant difference in TFP growth

across three banks under study. This finding is in conformity with the earlier research findings made by Mohan and Ray, 2004; Ashis Kumar and Vikas Batra (2012). Table 10 represents t-statistic test for difference in annual growth of TFP across banks having different ownership structure.

5. Conclusions

The present study empirically explores the branch wise efficiency measurement of RRBs, working in the district of Paschim Medinipur, of post amalgamation period by applying DEA methodology. The study makes an attempt to quantify the productivity change (Total Factor Productivity Growth) of the three banks over the years and also ascertain its constituents by applying a non-parametric Malmquist Productivity Index (MPI) method. 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 RRBs with that of State Bank of India and Vidyasagar Central Co-Operative Bank Ltd. 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 empirical finding reveals that the average over all technical efficiency score of all the branches of RRBs, working in this district is highest in the year 2010 (76.2%), indicating a 23.8% potential reduction in input utilization for the bank as a whole, followed by 2012 (74.3%). The results also indicate that the RRBs have more serious scale inefficiency problem in the year 2009, which results in lower overall technical efficiency. The analysis also shows that out of 37 branches of RRB, average 28 branches (76%) are persistently operating at an increasing return to scale over the study period. 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 entire sample period. The study concludes that the efficiency of RRBs is not significantly greater than that of VCC bank. The decomposition of overall technical efficiency scores for RRBs and VCC bank further suggests that the scale inefficiency is exclusively only reason for the overall inefficiency of these banks. The empirical results also point out that only RRBs are operating persistently either at increasing or at constant return to scale and in contrast to this both SBI as well as VCC bank are persistently operating either at decreasing or at constant return to scale.

So far as productivity growth is concerned, the study finds out that 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. Looking at the components in TFP growth, it can be inferred that the majority of growth has come from technological progress. The study observes that in case of RRBs and VCC bank (except SBI), efficiency change and technology changes are positively related with each other. The Malmquist TFP index results also display that average annual TFP growth is almost similar (not

statistically significant) irrespective of ownership structure across three banks over the entire sample period.

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Table 01: Descriptive Statistics on Branch Wise Efficiency Scores (TE) and its' Components of RRBs by Year:

Years	Geo Mean			Max			Min			SD		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
2007	0.662	0.829	0.798	1	1	1	0.167	0.367	0.389	0.25	0.17	0.18
2008	0.668	0.852	0.784	1	1	1	0.171	0.412	0.224	0.19	0.12	0.16
2009	0.315	0.693	0.454	1	1	1	0.027	0.393	0.059	0.33	0.20	0.32
2010	0.762	0.835	0.913	1	1	1	0.461	0.554	0.474	0.17	0.15	0.11
2011	0.728	0.833	0.873	1	1	1	0.136	0.559	0.235	0.19	0.15	0.16

Table 02: Return to Scale of Different Branches of RRBs

Year	Branches of RRBs		
	IRS	CRS	DRS
2007	27	07	03
2008	32	03	02
2009	31	06	00
2010	26	09	02
2011	22	09	06
2012	30	04	03
Average	28 (76%)	6.33 (17%)	2.67 (7%)

Table 03: Descriptive statistics

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

Table 04: Testing of Hypotheses in relation to Efficiency Comparison

Alternative Hypothesis (H ₁)	Test Statistic	d.f	Calculated Value	Null Hypothesis H ₀ Accepted/Rejected
Efficiency of RRBs is significantly greater than that of VCC bank	t-test	10	0.746	Accepted

Table 05: Return to Scale of Three Banks

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

Table 06: TFP Growth and its' Components of RRBs, 2008-2012

Years	Effch	Techch	Pech	Sech	TFPch
2008	0.937	1.165	1	0.937	1.091
2009	0.787	1.022	1	0.787	0.805
2010	1.356	1.228	1	1.356	1.666
2011	0.99	0.870	1	0.990	0.861
2012	1.010	1.111	1	1.010	1.123
Geo Mean	1	1.072	1	1	1.072

Table No 07: TFP Growth and its' Components of VCC bank, 2008-2012

Years	Effch	Techch	Pech	Sech	TFPch
2008	1.192	1.302	1	1.192	1.552
2009	1	0.980	1	1	0.980
2010	0.740	0.725	1	0.740	0.536
2011	1.352	1.457	1	1.352	1.969
2012	0.797	0.881	1	0.797	0.702
Geo Mean	0.99	1.035	1	0.990	1.024

Table 08: TFP Growth and its Components of SBI, 2008-2012

Years	Effch	Techch	Pech	Sech	TFPch
2008	1	1.190	1	1	1.190
2009	1	1.018	1	1	1.018
2010	1	1.232	1	1	1.232
2011	1	1.022	1	1	1.022
2012	1	1.019	1	1	1.019
Geo Mean	1	1.092	1	1	1.092

Table 09: TFP Growth and its Components, Mean of All Farms Mean, 2008-12

	Effch	Techch	Pech	Sech	TFPch
Mean of All Farms Mean	0.997	1.066	1	0.997	1.062

Table 10: 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.		