

# THE ANATOMY OF PROFITABILITY, EFFICIENCY AND PRODUCTIVITY OF REGIONAL RURAL BANKS IN SELECTED BACKWARD DISTRICTS OF WEST BENGAL: A PANEL DATA INVESTIGATION

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## Abstract

*The paper attempts to examine the impact of branch level efficiency, total factor productivity, growth and priority sector lending of RRBs on their profitability and determine the factors that significantly influence the efficiency of these banks in three selected backward districts of West Bengal by applying Malmquist productivity index and Data Envelopment Analysis.*

**Keywords :** RRB, Profitability, Efficiency, Total Factor Productivity, Revenue Diversification, Malmquist Productivity Index, DEA.

## 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<sup>1</sup>. It focused on the reduction in Statutory Liquidity Ratio and Cash Reserve Ratio, deregulation of interest rates, transparent guidelines, 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<sup>2</sup> (1997) recommended the merger of strong units of banks and adaptation of 'narrow banking' concept to rehabilitate weak banks.

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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<sup>3</sup>. 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 are suffering from serious problems like high risk due to exposure only to the target group, 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. Misra (2006) pointed out that the mandate of promoting banking with a rural focus, however, would be an enduring phenomenon only when the financial health of the RRBs is sound. With built-in restrictions on their operations, it is common to expect that the financial health of the RRBs itself would be a matter of concern. With the onset of the neo-liberal economic reforms, the RRBs came under the scanner once again. The Narasimham Committee (1997) recommended that to impart viability to the operations of RRBs, they should be permitted to engage in all types of banking business and should not be forced to restrict their operations to the target groups. However, over a period of time, RRBs were allowed to finance the non-target group, non-farm sector and non-priority sector clients in a defined proportion. In the ensuing years, RRBs have to face tight competition with the 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.

Profitability, productivity, efficiency and importance of functional diversification 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.

Conventional theory regarding diversification of banking activities predicts that combining different types of activities, namely, non-interest earning activities and interest earning activities, and rebalancing bank income away from interest income activities and towards non-interest activities may increase return and diversify risks, therefore boosting performance. Stiroh (2002, 2006) has observed that greater reliance on non-interest income is associated with higher volatility of bank income and higher risk, but not higher returns. Gamra and Plihon (2002) have found that gains generating from revenue diversification are more than offset by the cost of increased exposure to the non-interest income, specifically by the trading income volatility.

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 the RRBs 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 examine the impact of efficiency, total factor productivity growth and priority sector lending of RRBs on their profitability at branch-based micro-level. The study makes an attempt to determine the factors that significantly influence the branch efficiency in either direction. The study further attempts to investigate the relationship between bank efficiency and revenue diversification in the changing structure of emerging economies.

The rest of the paper is divided into five sections. Section II is devoted to methodological treatment for assessment of profitability, efficiency, total factor productivity growth and revenue diversification. Section III represents the sample frame and data sources. Section IV represents the regression model for estimation of profitability and efficiency. Section V deals with the analysis of empirical results relating to the estimation of profitability and efficiency. Section VI concludes.

## **II. Methodological Treatment**

### ***(a) Profitability Measurement***

The term 'profitability' is a relative measure which depicts the relationship of the absolute amount of profit with various other factors. It indicates the ability of a bank to raise its income level. The most widely used ratio of bank profitability is net profit as a percentage of working fund. Working fund refers to total assets or liabilities, which is taken as the base for measuring this ratio. However, banks do not get return on all assets rather on total business, i.e., sum of all deposits and advances. Thus, in this study, total business has been considered<sup>4</sup> as the base

for calculating the profitability ratio instead of working fund, i.e., net profit ratio as percentage of total business (Y). Profitability of bank is highly affected by a number of endogenous and exogenous factors. Changes in policies made by RBI are exogenous factors, whereas the factors like careful control of expenditure, timely recovery of loans and volume of business are endogenous.

***(b) 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. 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 RRBs, 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 formal 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 returns to scale (CRS) and variable returns 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  $K \times N$  input matrix, X and the  $M \times N$  output matrix, Y represent the data of all N DMUs.

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

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

Subject to—

$$-y_i + Y\lambda \geq 0,$$

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

Equation (01)

Where,  $\theta$ , the efficiency score for the  $i$ th DMU, is a scalar and  $\lambda$  is a  $N \times 1$  vector of constant. The linear programming problem must be solved N times, once for each DMU in the sample. A value of  $\theta$  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  $N1'\lambda = 1$  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:

$$\begin{aligned} & \min_{\theta, \lambda} \theta \\ & \text{Sub to -} \\ & -y_i + Y\lambda \geq 0, \\ & \theta x_1 - X\lambda \geq 0, \\ & N1'\lambda = 1, \lambda \geq 0, \end{aligned} \quad \text{Equation (02)}$$

Where, N1 is an  $N \times 1$  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.

**(c) 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:

$$m_0(Y_{t+1}, X_{t+1}, Y_t, X_t) = \sqrt{\frac{d_0^t(X_{t+1}, Y_{t+1})}{d_0^t(X_t, Y_t)}} \times \sqrt{\frac{d_0^{t+1}(X_{t+1}, Y_{t+1})}{d_0^{t+1}(X_t, Y_t)}} \quad \text{Equation (03)}$$

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:

$$\begin{aligned}
 [d_0^1(x_t, y_t)]^{-1} &= \max_{\theta, \lambda} \theta \\
 \text{Sub to } &-\theta y_{it} + Y_t \lambda \geq 0, \\
 &x_{it} - X_t \lambda \geq 0, \\
 &\lambda \geq 0
 \end{aligned}
 \tag{Equation (a)}$$

$$\begin{aligned}
 [d_0^{t+1}(x_{t+1}, y_{t+1})]^{-1} &= \max_{\theta, \lambda} \theta \\
 \text{Sub to } &-\theta y_{i,t+1} + Y_{t+1} \lambda \geq 0, \\
 &x_{i,t+1} - X_{t+1} \lambda \geq 0 \\
 &\lambda \geq 0
 \end{aligned}
 \tag{Equation (b)}$$

$$\begin{aligned}
 [d_0^t(x_{t+1}, y_{t+1})]^{-1} &= \max_{\theta, \lambda} \theta \\
 \text{Sub to } &-\theta y_{i,t+1} + Y_t \lambda \geq 0, \\
 &x_{i,t+1} - X_t \lambda \geq 0, \\
 &\lambda \geq 0
 \end{aligned}
 \tag{Equation (c)}$$

$$\begin{aligned}
 [d_0^{t+1}(x_t, y_t)]^{-1} &= \max_{\theta, \lambda} \theta \\
 \text{Sub to } &-\theta y_{it} + Y_{t+1} \lambda \geq 0 \\
 &x_{it} - X_{t+1} \lambda \geq 0 \\
 &\lambda \geq 0
 \end{aligned}
 \tag{Equation (d)}$$

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:

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

#### ***(d) 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.

#### ***(e) Herfindhal Approach: A Technique of Assessing Revenue Diversification***

In banking sector, the term 'diversification' is used to define multi-dimensionality in operations. The bank adopts the strategy of diversification primarily to reduce the risks and increase return. They also diversify their operations to grow their business, particularly when the prospect of growth in the present line of operation is limited. This growth may be realized by broadening the horizon of their services, i.e., by adding new services into their portfolio. The other motives

of diversification by the banks may include gaining market power, maximizing value, strengthening capital base, etc. (Ali-Yrkko, 2002).

To measure the income diversification, the study follows the basic Herfindhal-type approach. The measure of revenue diversification ( $RDIV_{it}$ ), accounts for variation in the breakdown of net operating income into two broad categories, viz., interest income and non-interest income. Using this breakdown, revenue diversification of the banks has been measured as follow:

$$RDIV_{it} = 1 - (SH_{INT}^2 - SH_{NONINT}^2)$$

Where,  $SH_{INT}$  is the share of interest income and  $SH_{NONINT}$  is the share of non-interest income, defined as:

$SH_{INT} = \text{Interest Income} / (\text{Interest Income} + \text{Non-interest Income})$ ,

$SH_{NONINT} = \text{Non-Interest Income} / (\text{Interest Income} + \text{Non-interest Income})$ ,

The non-interest income includes commissions and fees income, and trading and other income. Diversification variables measure the degree of bank diversification. A higher value indicates a more diversified mix. The value 0 means a complete concentration, while 0.5 means a complete diversification.

### III. 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, Bankura and Purulia districts of West Bengal have been purposively selected from the group of backward districts. Since inception, Mallabhum Gramin Bank was working as a leading Regional Rural Bank in Paschim Medinipur, Bankura and Purulia. On 21st February 2007, due to restructuring, this bank became Bangiya Gramin Bikash Bank. At present, it has 37 branches working in Paschim Medinipore, 70 branches in Bankura and 30 branches in Purulia district. The present study deals with the branch-wise performance evaluation of RRBs, working in these three backward districts during post-amalgamation period. So the study period has been restricted from 2007 to 2012. Relevant branch-wise data have been collected from the respective regional offices of the RRBs of the three districts for the concerned period. Subsequently, in this study, balanced panel data consist of yearly observations for 137 branches between 2007 and 2012, 137 for each year and 822 ( $137 \times 6$ ) in total. DEAP software (Version 2.1)<sup>6</sup> has been used for analyzing the efficiency and productivity scores. STATA 9.0 software has been used for panel data analysis.

### IV. Regression Model for Estimation of Profitability and Efficiency

#### (a) *Multivariate Profitability Analysis of RRBs*

In this section, an attempt has been made to measure the impact of selected variables or factors on RRB's profitability over the study period. The primary objective of this analysis is to determine the factors that significantly influence the bank's profitability in either direction.

**Specification of the Function**

The study assumes that the profitability ( $Y_{it}$ ) of RRBs depends on its efficiency ( $E_{it}$ ), total factor productivity change ( $TFPC_{it}$ ), lending to priority sector as a percentage to total advances ( $PSL_{it}$ ), subsidy as percentage of total business ( $S_{it}$ ), i.e.

$$Y_{it} = f(E_{it}, TFPC_{it}, PSL_{it}, S_{it})$$

The linear regression equation based on the above function can be written as:

$$Y_{it} = \alpha + \beta_1 E_{it} + \beta_2 TFPC_{it} + \beta_3 PSL_{it} + \beta_4 S_{it} + u_{it} \dots\dots\dots \text{Equation No (i)}$$

**Hypothetical Impact of Factors influencing profitability**

**Efficiency ( $E_{it}$ ):** Greater efficiency is expected to strengthen the profitability position of the bank. In other words, the banks with greater efficiency are likely to have higher profitability. The efficiency of ith branch at time t ( $E_{it}$ ) is measured by applying Data Envelopment Analysis, as stated earlier.

**Total Factor Productivity Growth ( $TFPC_{it}$ ):** The growth in productivity can be attributed to technological progress (Sturm and Williams, 2004) and also to efficiency improvement (Berg et al., 1992). Hence, the banks with greater productivity are likely to have higher profitability. The productivity growth of ith branch at time t ( $TFPC_{it}$ ) is measured by applying Malmquest Productivity Index, as stated earlier.

**Share of Priority Sector Lending ( $PSL_{it}$ ):** Increase in share of priority sector lending to total advances is expected to produce higher percentage of non-performing assets, which may adversely affect the bank's profitability. This perception is in conformity with the earlier research findings made by Bhatia and Verma (1998) who observed that priority sector advances affected the profitability of public sector bank negatively. The share of priority sector lending of ith branch at time t is measured as the ratio of its priority sector advances to its total advances at time t.

**Subsidy as percentage of Total Business ( $S_{it}$ ):** Each branch is entitled to get a subsidy from the head office on its excess of fund over loan portfolio. The banks with higher percentage of subsidy to total business are likely to have higher profitability.

**(b) Explaining Efficiency Variation: A Multivariate Analysis**

The primary objective of this analysis is to determine the factors that significantly influence the bank's efficiency in either direction.

**Specification of the Function**

The study assumes that the efficiency ( $E_{it}$ ) of ith branch of RRBs at time t, depends on the number of officers as a percentage of total employees of ith branch at time t ( $O_{it}$ ), market size of ith branch at time t ( $BSZ_{it}$ ) and revenue diversification of ith bank at t period ( $RDIV_{it}$ ), i.e.,

$$E_{it} = f(O_{it}, PSL_{it}, BSZ_{it}, RDIV_{it})$$

The linear regression equation based on the above function can be written as:

$$E_{it} = \alpha + \beta_1 O_{it} + \beta_2 BSZ_{it} + \beta_3 RDIV_{it} + u_{it} \dots \text{Equation No (ii).}$$

*Hypothetical Impact of Factors influencing Efficiency*

**Number of Officers as percentage of Total Employees ( $O_{it}$ ):** Greater the ratio of officers to total employees is expected to strengthen the efficiency of the bank. The number of officers as percentage of total employees of  $i$ th branch at time  $t$  is measured as the ratio of its total number of officer to its total employees at time  $t$ .

**Bank Size ( $BSZ_{it}$ ):** Size of a bank influences its efficiency in two ways. On the one hand, the larger banks can harvest the benefits of economies of scale and able to enhance their efficiency. On the other hand, banks with larger size may face the problem of X-inefficiency, which may affect the efficiency adversely. The nature of impact of size of a bank on efficiency, therefore, depends on how these diverse forces operate. In this study, bank size of  $i$ th branch at period  $t$  has been measured as the natural logarithm of its total business that is deposits plus advances.

**Revenue Diversification ( $RDIV_{it}$ ):** Diversification of operations enhances efficiency of a bank in terms of both costs and profit. (Landi and Venturelli, 2002) Very large, well capitalized and more efficient banks have more incentives to diversify. They perform better than the other or the specialized ones; traditional forms of intermediation are less profitable for them. Diversification gains are more than offset by the cost of increased exposure to the non-interest income, specifically by trading income volatility. Banking institutions can reap diversification benefits as long as they well-studied it depending on their specific characteristics, competences and risk levels, and as they choose the right niche (Gamra and Plihan, 2004). However, it is also possible that as the banks tilt their product mixes towards fee-based activities and move away from traditional intermediation activities, their earnings become more volatile. This earnings volatility may adversely affect the banking efficiency. Hence, the nature of impact of revenue diversification on efficiency of the bank depends on the relative strength of these diverse forces.

**(c) Estimation Techniques**

The equations specified above have been estimated by applying panel data estimation techniques for a set of 137 RRB branches operating in these three sample districts over the period from 2007 to 2012. Use of panel data not only helps in raising the sample size and hence the degrees of freedom considerably, it also incorporates the dynamics of banks' behavior in the market place. In panel data estimation, three models, namely the pooled regression model, fixed effects model (FEM) and random effect model (REM) are estimated for each analysis, i.e., multivariate profitability analysis and explaining efficiency variation. The choice amongst the pooled regression model, the FEM and the REM is very important as it largely influences the conclusions on the individual coefficients<sup>7</sup>. Three statistical tests, viz., the restricted F-test, the Breusch and Pagan (1980) Lagrange Multiplier test, and the Hausman (1978) test are

carried out to select the appropriate model. The restricted F-test is applied to make a choice between the pooled regression model and the FEM. If the computed F-value is greater than the critical F-value, choice of the FEM is made over the pooled regression model<sup>8</sup>. On the other hand, the Breusch and Pagan Lagrange Multiplier test<sup>9</sup> is carried out to make a choice between the pooled regression model and the REM. The test is based on the null hypothesis that the variance of the random disturbance term is zero and it uses a test statistic that follows  $\chi^2$  distribution. Rejection of the null hypothesis suggests that there are random effects in the relationships. Finally, if both the FEM and the REM are selected over the pooled regression model following the restricted F test and the Breusch and Pagan Lagrange Multiplier test respectively, the Hausman (1978) test<sup>10</sup> is applied to make a choice between the FEM and the REM. The test is based on the null hypothesis that the estimators of the FEM and the REM do not differ significantly and uses a test statistic that has an asymptotic  $\chi^2$  distribution. If the null hypothesis is not rejected, the REM is better suited as compared to the FEM. The severity of the problem of multi-collinearity across the independent variables is also examined in terms of the variance inflation factors (VIF).

## V. Empirical Estimation of Profitability and Efficiency of RRBs

Table 1 Distribution of Bank Branches by Level of Profitability of RRBs in three Districts of West Bengal, 2007-08

Level of Profitability (%) ( $Y_{it}$ )	2007	2008	2009	2010	2011	2012
$Y_{it} \leq 0$	4	2	3	3	2	2
$0 < Y_{it} \leq 1$	9	12	12	11	8	7
$1 < Y_{it} \leq 2$	25	30	28	32	43	46
$2 < Y_{it} \leq 3$	26	23	30	45	42	55
$3 < Y_{it} \leq 4$	31	32	37	34	34	20
$4 < Y_{it} \leq 5$	20	24	24	9	6	5
$Y_{it} > 5$	22	14	3	3	2	2
Total number of Bank Branches (N)	137	137	137	137	137	137

Source: Authors' calculation

Table 1 represents a vivid picture relating to the distribution of branch level profitability (i.e., net profit as a percentage of working fund) of RRBs during 2007 to 2012. It exhibits that branch level profitability has been improved across the years and most of the branches earn moderate level of profit over the years. The number of bank branches with relatively high share of profit (4 per cent and above) decreased over time - 7 branches in 2012 as compared

with 42 in 2007. The share of profit of the most of the bank branches lies between 1 to 4 per cent.

The branch level efficiency of RRBs that measured by DEA methodology is shown in Table 2. The efficiency of RRBs has been significantly improved over the study period. The number of bank branches with high efficiency scores (0.70 and above) increased from 91 in 2007 to 105 branches in 2012. Whereas the total factor productivity growth (TFPG) widely varied across bank branches during the study period. The distribution of bank branches in respect of TFPG is shown in Table 3.

**Table 2 Distribution of Bank Branches by Level of Efficiency in three Districts of West Bengal, 2007-2012**

Level of Efficiency ( $E_{it}$ )	2007	2008	2009	2010	2011	2012
$E_{it} \leq 0.40$	10	15	0	1	1	2
$0.40 < E_{it} \leq 0.50$	8	5	7	2	3	5
$0.50 < E_{it} \leq 0.60$	15	7	2	8	6	5
$0.60 < E_{it} \leq 0.70$	13	9	9	7	6	20
$0.70 < E_{it} \leq 0.80$	21	18	28	27	27	38
$0.80 < E_{it} \leq 0.90$	25	32	41	41	47	28
$0.90 < E_{it} \leq 1$	45	51	50	51	47	39
Total number of Bank Branches (N)	137	137	137	137	137	137

Source: Authors' calculation

**Table 3 Distribution of Bank Branches by Total Factor Productivity Growth of RRBs in three Districts of West Bengal, 2007-2012**

Total Factor Productivity Growth ( $TFPC_{it}$ )	2007	2008	2009	2010	2011	2012
$TFPC_{it} \leq 0.70$	0	3	6	0	0	12
$0.70 < TFPC_{it} \leq 0.90$	8	11	21	4	4	18
$0.90 < TFPC_{it} \leq 1$	66	44	43	43	42	41
$1 < TFPC_{it} \leq 1.10$	58	66	57	65	68	49
$1.10 < TFPC_{it} \leq 1.20$	4	7	8	15	15	5
$1.20 < TFPC_{it} \leq 1.30$	1	4	2	4	5	2
$TFPC_{it} > 1.30$	0	2	0	6	3	10
Total number of Bank Branches (N)	137	137	137	137	137	137

Source: Authors' calculation

**Estimation of Profitability: Multiple Regression Results**

The descriptive statistics of the variables used in the regression Model I are presented in Table 4. Table 5 represents the regression results for the OLS model, the FEM and the REM, showing the possible impact of factors influencing profitability .

**Table 4 Descriptive Statistics of Variables Used in Estimation of Profitability**

	$Y_{it}$	$E_{it}$	$TFPC_{it}$	$PSL_{it}$	$S_{it}$
Mean	0.0265	0.81	1.0113	0.3883	0.0369
Max	0.0671	1	2.388	0.8779	0.1238
Min	-0.016	0.202	0.194	0.1252	0.0032
SD	0.0140	0.1695	0.1595	0.1025	0.0118
N	822	822	822	822	822

**Table 5 Regression Results for Variations in Profitability:**

Ordinary Least Squares Model				Fixed Effects Model		Random Effects Model	
Variables	Coefficient	t-stat	VIF	Coefficient	t-stat	Coefficient	Z stat
Intercept	-.0421164	-12.73***		-.02508	-12.58***	-.0275474	-12.83***
$E_{it}$	.0519797	24.38***	1.11	.02366	13.35***	.0280114	16.06***
$TFPC_{it}$	.0051202	2.32**	1.05	.007827	6.78***	.0073012	6.14***
$PSL_{it}$	-.0034938	-1	1.09	.0146277	5.11***	.0117465	4.18***
$S_{it}$	.6155797	19.78***	1.14	.510532	20.40***	.5266122	21.42***
F-Stat	209.85***			F-Stat	244.45***	Wald $\chi^2$	1002.42***
$R^2$	.5068			$R^2$ within	.5895	$R^2$ within	0.5858
Adj $R^2$	.5043			$R^2$ Between	.3731	$R^2$ Between	0.4321
				$R^2$ Overall	.3970	$R^2$ Overall	0.4357
No. of Obs.	822			No. of Obs.	822	No. of Obs.	822

In order to select the appropriate model, the restricted F-test, the Breusch and Pagan Lagrange Multiplier test and the Hausman test are carried out and the value of the test statistics along with respective hypothesis are presented in Table 6. It is found that for the estimation of profitability all the three test statistics are statistically significant. Statistical significance of the test statistic in the Hausman (1978) suggests for choice of the FEM over the REM. Hence, the regression results of the FEM are used for statistical inference and further analysis of the individual coefficients. A scrutiny of VIF shows that the values of the VIF are relatively low for



each of the explanatory variables included in the model. This means that the estimated model does not suffer from severe multicollinearity problem.

**Table 6 Tests for Selection of Appropriate Model for Variations in Profitability**

Purpose	Null Hypothesis	Test Statistics
Selection between Pooled Regression Model and Fixed Effects Model (Restricted F Test)	All $u_i = 0$	F(136,681)=20.92***
Selection between Pooled Regression Model and Random Effects Model (Breusch-Pagan Lagrange Multiplier Test)	Var(u) =0	$\chi^2_{(4)} = 196.08***$
Selection between Fixed Effect Model and Random Effects Model (Hausman Test)	Difference in coefficients is not systematic	$\chi^2_{(4)} = 196.08***$

The estimation of fixed-effect model indicates that the branch efficiency ( $E_{it}$ ), total factor productivity growth ( $TFPC_{it}$ ), lending to priority sector as a percentage to total advances ( $PSL_{it}$ ) and subsidy as percentage of total business ( $S_{it}$ ) positively and significantly stimulate the branch profitability. In other words, the branches those have higher level of efficiency ( $E_{it}$ ), higher degree of total factor productivity growth ( $TFPC_{it}$ ) larger percentage of lending to priority sector to total advances ( $PSL_{it}$ ) and higher level of subsidy as percentage of total business ( $S_{it}$ ) experienced high level of profitability ( $Y_{it}$ ). The finding relating to priority sector lending, is therefore, contradictory to the general proposition that priority sector advances affect the profitability of the bank adversely. This may be because of better awareness level of the priority sector borrowers. Difference awareness programmes conducted by Govt., NGOs and also different banks lead to develop the alertness level of the poor and priority sector borrowers regarding effective utilization of loan and the need of its timely repayment. In case of SHGs members, loans are taking jointly and they are highly motivated by the group itself to repay the loans within the stipulated period.

***Explaining the Variation of Efficiency: Multiple Regression Results***

The descriptive statistics of the variables used in the regression model no (ii) for explaining efficiency variation across branches of RRBs and over time, are presented in Table 7.

**Table No 7 Descriptive Statistics of Variables in Explaining Efficiency Difference**

	$E_{it}$	$O_{it}$	$BSZ_{it}$	$RDIV_{it}$
MEAN	0.81	0.3543	11.693	0.1894
MAX	1	0.6	13.397	0.4524
MIN	0.202	0.125	9.7724	0.0264
SD	0.1695	0.1014	0.5617	0.071
N	822	822	822	822

Table 8 shows that the F statistics of the pooled regression model and the fixed-effect model, and the Wald- $\chi^2$  statistic of the random-effect model are statistically significant. Further, the value of adjusted  $R^2$  is reasonably high for each case. This means that the estimated models are statistically significant with reasonably high explanatory power.

**Table No 8 Regression Results for Explaining Efficiency Differences**

Ordinary Least Square Model				Fixed Effect Model		Random Effect Model	
Variables	Coefficient	t-stat	VIF	Coefficient	t-stat	Coefficient	Z stat
Intercept	0.1148	1.16		-0.6188	-4.47***	-0.2948	-2.55**
$O_{it}$	1.118	26.16***	1	0.7557	13.24***	0.9104	18.54***
$BSZ_{it}$	0.0274	3.41***	1.09	0.0978	8.41***	0.0664	6.96***
$RDIV_{it}$	-0.1113	-1.75*	1.08	0.0909	0.301	0.0314	0.43
F-Stat	237.98***			F-Stat	82.16***	Wald $\chi^2$	395.59***
$R^2$	0.4660			$R^2$ within	0.2655	$R^2$ within	0.2519
Adj. $R^2$	0.4641			$R^2$ Between	0.4275	$R^2$ Between	0.5420
				$R^2$ Overall	0.3733	$R^2$ Overall	0.4403
No. of Obs.	822			No. of Obs.	822	No. of Obs.	822

**Table 9 Tests for Selection of Appropriate Model for Explaining Efficiency Differences**

Purpose	Null Hypothesis	Test Statistics
Selection between Pooled Regression Model and Fixed Effects Model (Restricted F Test)	All $u_i = 0$	$F(136, 682) = 6.11***$
Selection between Pooled Regression Model and Random Effects Model (Breusch-Pagan Lagrange Multiplier Test)	$\text{Var}(u) = 0$	$\chi^2_{(1)} = 317.90***$
Selection between Fixed Effect Model and Random Effects Model (Hausman Test)	Difference in coefficients is not systematic	$\chi^2_{(4)} = 59.90***$

In order to select the appropriate model for explaining efficiency differences, the restricted F-test, the Lagrange Multiplier test and the Hausman test are carried out and the value of the test statistics along with respective hypothesis are presented in Table 9. It is found that all the three test statistics are statistically significant. Statistical significance of the test statistic in Hausman test suggests for choice of the FEM over the REM. Hence, the regression results of the FEM are used for statistical inference and further analysis of the individual coefficients. A scrutiny of VIF shows that the estimated model does not suffer from severe multi-collinearity problem. The study observed that the t statistics of all the independent variables except revenue diversification ( $RDIV_{it}$ ) are statistically significant under fixed-effect model. This means that the bank efficiency is positively and statistically significantly influenced by the number of officers as percentage of total employees ( $O_{it}$ ) and bank size ( $BSZ_{it}$ ). A rise in the percent of officers in total employees ( $O_{it}$ ) does appear to enhance efficiency significantly and that is not surprising. This enhancement in efficiency may be attributed to the officers' ability to work with modern technology. The statistically significant positive impact of bank size ( $BSZ_{it}$ ) on efficiency suggests that larger the bank size makes the bank more efficient in providing banking products and services. The branch with larger size can reap the benefits of economies of scale. In this study, the revenue diversification ( $RDIV_{it}$ ) has a positive but not significant impact on efficiency. This may be due to limited scope of diversifying their business specially in rural areas, where they are functioning. Infrastructural constraints of the bank branches may also be another important reason in this regard. It is also possible that these rural banks do not have necessary expertise or human resources in the line of diversification. This might have limited the impact of diversification on operational efficiency of these banks.

## VI. 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. Many of the banks have followed the route of diversifying their operations to reap more return. Obviously RRBs are not beyond this track. In this perspective, the present paper is an attempt to examine the impact of efficiency, total factor productivity growth and priority sector lending of RRBs on their profitability at branch based micro-level. The study further attempts to determine the factors that significantly influence the branch efficiency in either direction. The study has been conducted in three selected backward districts of West Bengal, namely, Paschim Medinipur, Bankura and Purulia during post-amalgamation period. Bank efficiency has been assessed by applying DEA methodology. Malmquist productivity index has been used to quantify the branch-wise total factor productivity growth over the study period. The basic Herfindhal-type approach has been followed to assess revenue diversification.

The regression analysis undertaken to measure the impact of selected variables on RRB's

profitability shows that the branches having higher level of efficiency, higher level of total factor productivity growth, larger percentage of lending to priority sector of total advances and higher level of subsidy as percentage of total business have experienced higher level of profitability. The finding relating to priority sector lending is contradictory to the general proposition that priority sector advances affect the profitability of the bank adversely. This may be because of better awareness level of poor and priority sector borrowers regarding timely repayment.

The regression analysis undertaken to explain efficiency variation across the bank branches shows that the efficiency is positively and significantly influenced by the number of officers as percentage of total employees and bank size. A rise in the percent of officers in total employees leads to enhance efficiency significantly. The positive and statistically significant impact of bank size on efficiency suggests that larger the bank size, the bank is likely to be more efficient. The branch with larger size can reap the benefits of economies of scale. In this study, the revenue diversification has a positive but not significant impact on efficiency. This may be due to limited scope of diversifying their business specially in rural areas, where they are functioning. It is also possible that these rural banks do not have necessary expertise or human resources in the line of diversification. This might have limited the impact of diversification on operational efficiency of these 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. In order to have a suitable indicator for evaluating current bank performance Mittal and Dhade (2007) have used the total volume of business in the denominator in their paper, "Profitability and Productivity in Indian Banks: A Comparative Study". In another study, entitled, "Employees' Productivity and Cost – A Comparative Study of Banks in India During 1997-2008", Sharad and Sreeramula (2007) have used total business of the bank as a base for measuring employee cost.

5. 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.
6. 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>.
7. This is so because when the number of cross-sectional units is large and the number of time-series units is small, as it is in the present case, the estimates obtained by the FEM and the REM can differ significantly (Gujarati and Sangeetha, 2009).
8. The fixed effect model uses the following test-statistic:

$$F = \frac{R_{UR}^2 - R_R^2 / d - 1}{1 - R_{UR}^2 / n - (d + k)} \sim F_{(d-1)(n-d-k)}$$

Here,  $R_{UR}^2$  stands for goodness-of-fit of the unrestricted model (the FEM),  $R_R^2$  for goodness-of-fit of the restricted model (the pooled regression model),  $d$  for the number of groups,  $n$  for the total number of observations, and  $k$  for the number of explanatory variables.

9. The random effect model uses the following test-statistic:

$$LM = \frac{nT}{2(T-1)} \left[ \frac{\sum_{i=1}^n \left[ \sum_{t=1}^T e_{it} \right]^2}{\sum_{i=1}^n \sum_{t=1}^T e_{it}^2} - 1 \right]^2$$

Under the null hypothesis, LM is distributed as chi-squared with one degree of freedom.

10. The Hausman test uses the following test-statistic:

$$W = \chi^2[K-1] = \frac{[b - \bar{\beta}]}{\bar{\Psi}^{-1} [b - \bar{\beta}]}$$

For  $\bar{\Psi}$ , we use the estimated covariance matrices of the slope estimator in the LSDV model and the estimated covariance matrix in the random effects model, excluding the constant term. Under the null hypothesis, W has a limiting chi-squared distribution with K-1 degrees of freedom.

11. It is observed that the F statistics of the OLS model and the fixed-effect model, and Wald- $\chi^2$  statistic of the random-effect model are statistically significant. Further, the value of adjusted  $R^2$  is reasonably high for each case. This means that the estimated models are statistically significant with reasonably high explanatory power.

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