Optimization
Iranian Journal of Optimization
Volume 10, Issue 2, 2018, 113-124
Research Paper
Online version is available on: www.ijo.iaurasht.ac.ir

Islamic Azad University
Rasht Branch
ISSN: 2588-5723
E-ISSN:2008-5427

Performance Evaluation of Bank Branches by the DEA-Tobit Model: The Case of Agricultural Bank Branches in Guilan Province

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Received: 21 December 2017
Accepted:19 January 2018

Abstract

This paper employed data envelopment analysis (DEA) to examine the technical, pure technical, and scale efficiencies of 12 branches of the agricultural bank in Guilan province, Iran over the period of 2012-2016. The first results indicated that scale inefficiency contributed more to overall technical inefficiency than pure technical inefficiency over the studied period. Results of return to scale revealed that the decreasing return to scale is the main form of the scale inefficiency. Then, overall technical efficiency scores obtained from DEA was regressed over four factors underpinning bank efficiency (including bank size, profitability, capital adequacy, and liquidity) by the Tobit method. These four variables influenced efficiency differently. Branch size showed a negative, insignificant relationship with technical efficiency. So, it had no impact on efficiency. Profitability was the main parameter in branch efficiency followed by liquidity. Profitability and liquidity influenced efficiency positively and significantly. In other words, larger and more profitable branches were found to have higher technical efficiency.

Keywords:
Data envelopment analysis
Tobit analysis
overall technical efficiency
banking

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INTRODUCTION

In a market-based economy, the banking system carries a tremendous burden of responsibility and is one of the most important components of the economy. A country's economic prosperity or stagnation closely relates to how the banking institutions work. The banking system provides services that are critical for the working of the economic system. The capital accumulated in the banks is the main resource for the purchase of goods and services, and the loans granted by them is the main resource of credit for all economic units including families, professions, enterprises, and the government. It can, therefore, be claimed that financial institutions have a mediator role, and if they perform this role efficiently, the total value of the economy will be enhanced. Thus, the performance of the banking system is crucially important and is a source of concern for all stakeholders.

Measuring the performance of banks is of utmost importance in all economies, whether developed economies or developing economies (Tsolas & Charles, 2015). By performance measurement, a bank can compare its performance in terms of profitability, capital adequacy, asset structure, and liquidity with those of the competing banks in order to gain an insight about its position and improve its performance (Secme et al., 2009). The performance of banks can be measured both by employing financial ratios and measuring their efficiency (Wanke et al., 2016). Efficiency refers to the ratio of the outputs of a given firm to its inputs. Invariably, the management teams in all firms expect the proper and efficient use of resources or inputs to achieve the desired quantity and quality of outputs.

Today, with the expansion of organizations and the managers' increased supervision scope, it has become necessary for managers to evaluate and control their respective organizational units (Wang et al., 2014). This is impossible without evaluating the efficiency of the branches under their supervision. In addition, bank managements have always been forced to improve the banking services, evaluate, budget, innovate in services, compete with other banks, and ultimately improve efficiency across their supervised branches with respect to the current and future economic conditions. To this end, they need to know the efficiency of their branches, investigate the causes of their efficiency and inefficiency, and properly plan to modify and direct inefficient units (Yang & Liu, 2012; Asmild & Zhu, 2016). Obviously, this would enable them to minimize the losses incurred by inefficiency and make the overall banking system of the country more efficient. Within this scenario, it seems imperative and vital to measure the technical efficiency of the banks.

The present study aims to analyze the technical efficiency of the agricultural bank branches in Guilan Province during 2012-2016 using data envelopment analysis (DEA) that is the most commonly used nonparametric method for assessing the efficiency of banks. Here, we analyze the technical efficiency of the agricultural bank branches in Guilan Province by dividing the technical efficiency score into two components: pure technical efficiency that evaluates management performance, and scale efficiency that measures the fitness of bank size. The study tries to measure the overall technical efficiency (OTE), pure technical efficiency (PTE), and scale efficiencies (SE) of the branches of the agricultural bank in Guilan province using DEA method in two phases. Phase 1 identifies the OTE, PTE and SE scores of individual banks. Dividing the OTE into PTE and SE helps us find the origin of inefficiencies. PTE is a measure of technical efficiency that shows the management's weakness in addressing resources used by the organization. SE is a measure of the management's capability in selecting an appropriate size for the bank, or, in other words, in selecting the suitable scale of production. Phase 2 regresses the OTE scores obtained in phase 1 over specific bank variables to help determine the factors influencing the bank's efficiency.

LITERATURE REVIEW

Extensive studies have already focused on measuring the efficiency of banks and financial institutions. Concerns about measuring the performance of financial institutions have garnered much attention in recent years. Many studies have analyzed the efficiency using DEA. The first attempts to apply DEA in studies on bank branches can be traced back to Sherman and Gold (1985) who explored 14 branches of saving banks in the US. They showed that only six branches had the efficiency of 1 and they implicated management weakness, branch size, number of employees and operational costs for the inefficiencies of remaining eight branches.

Reisman et al. (2003) used the DEA method to examine the effect of deregulation on the efficiencies of eleven Tunisian commercial banks during 1990-2001. They found that the deregulation influenced the overall efficiencies of Tunisian banks favorably. Drake and Hall (2003) investigated the efficiency of Japanese banks using DEA. They argued that loans have had many effects on the efficiency of banks in Japan so that very high debts have had a huge impact on the wave of merging of large banks in Japan. Halkos and Salamouris (2004) applied DEA technique to assess the performance of the banking sector in Greece. It was found that DEA technique can serve as an alternative and also as a complement to the financial ratios analysis methods in the evaluation of the organizational performance. Brown and Skully (2007) examined the efficiency of Islamic banks by DEA in 1998-2000. Their data included labor costs, capital, and outputs including total loans, non-lending assets, and total deposits. They concluded that Indonesia and Yemen were the most advanced countries and Asia was the best operational region in terms of the TFP index. Also, the United Arab Emirates as a country and the Middle East as a region have made the best use of inputs and outputs to enhance efficiency. Finally, the increase in the efficiency and the TFP index had a negative relationship with the history of the bank establishment.

Sufian (2009) used the DEA techniques to study the efficiency of the Malaysian banking sector during the 1997 Asian crisis in 1995-1999. The size, ownership, and profitability of the banks were the parameters affecting the efficiency of the banks positively and significantly. Efficiency showed a negative relationship with economic conditions and preference behavior. Kao and Liu (2009) employed DEA to measure the efficiency of commercial banks in Taiwan. They discussed how to measure the efficiency of the decision making units by computerized simulations. Fujii et al. (2013) investigated the efficiency and productivity of domestic and foreign banks in India using a hybrid approach. Their results demonstrated the lower efficiency of domestic banks as compared to foreign banks. Rahim et al. (2013) evaluated the efficiency of Islamic banks in the Middle East, North Africa, and Asian countries using the intermediation-based DEA method. They concluded that the scale of operations was the main source of technical inefficiency among Islamic banks.

We can also see research in which two-phase DEA analysis and the Tobit regression have been used because DEA alone does not suffice to achieve decisive results (Sufian & Shah Habibullah, 2010). These studies have mostly used the Tobit regression model to estimate the impact of specific banking and macroeconomic variables on bank efficiency. For example, Jackson and Fathi (2000) examined the determinants of the efficiency of the Turkish banking sector and revealed that bank size and operating profit were the important factors affecting technical efficiency, whilst capital adequacy ratio had a negative, significant effect on the performance of the banks. Naceur et al. (2011) worked on the impact of reforms in the financial sector on banking performance in some Middle Eastern and North African countries using the measurement of technical efficiency over 1993-2006. They also used the Tobit regression in the second phase of their analysis to address the influence of the institutional, financial, and banking variables on the performance of the banks. San et al. (2011) measured the relative efficiency of the domestic and foreign banks in Malaysia. This study was conducted on nine domestic and twelve foreign banks over the period of 2002-2009. They used intermediation method followed by the Tobit model to measure the efficiency determinants. They reported that the domestic banks operated at a higher level of efficiency than the foreign banks operating in Malaysia.

Using the DEA and Tobit regression, Noor and Ahmad (2012) evaluated the efficiency of the Islamic banking sectors in 25 countries over the period 1992-2009 with a focus on 78 Islamic banks and found that the World Islamic banks have enjoyed a high level of PTE. In addition, they reported that banks having a higher market share and lower non-performing loan ratio exhibited higher technical efficiency. These findings were supported by a multivariate analysis based on the Tobit model.

In a study on 14 commercial banks in China over the period 2002-2009, Han et al. (2014) employed the DEA and Tobit regression to assess the performance of these banks after China joined the WTO.

Tandon et al. (2014) carried out a study on 44 banks over the period of 2009-2012 to investigate the technical and pure efficiency of the Indian banks. They reported that the public and private sector banks had almost similar performance in terms of technical efficiency, but the foreign banks should work on improving their scale efficiency. The analysis in the second phase by the Tobit regression identified the non-interest income as the major factor underpinning the efficiency of the Indian banks. In a study on 23 commercial banks in Turkey over the period of 2003-2012, Kutlar et al. (2017) evaluated the technical efficiency and allocative efficiency of the banks by the DEA and Tobit regression. They derived more suitable results from Tobit analysis for allocative efficiency scores when compared to technical efficiency scores with the same output compound. Some other relevant research includes Das and Ghosh (2006), Sufian and Shah Habibullah (2010), Gardener et al. (2011), Ab-Rahim et al. (2012), Balfour et al. (2015) and Gulati (2015).

As we know, DEA is a relative study, and so, it may yield different results when the sample is changed. Therefore, the present study that was carried out on the agricultural bank branches in Guilan Province is relevant and can provide us with valuable insights towards the banking sector in Iran. Available literature on DEA and bank efficiency is not decisive as far as their input and output variables are concerned. Opinions vary about the determinants of bank efficiency. In particular, there are contradictory findings about the parameters like bank size and capital adequacy. As a result, we intend to contribute to the existing literature by presenting the recent empirical evidence about technical efficiency and its determinants in the agricultural bank branches in Guilan Province.

An overview of DEA

Data Envelopment Analysis (DEA) is a classic non-parametric technique based on mathematical programming that is used to compare the efficiency of similar decision-making units (DMUs). Its major advantage is that it does not require the determination of parametric specifications (like the production function) to obtain the efficiency scores (Siriopoulos & Tziogkidis, 2010). Charnes et al. (1978) proposed a DEA model that could measure the efficiency with multiple inputs and multiple outputs. The efficiency obtained by the DEA method is relative. In this method, an efficiency frontier is built by a convergent combination of efficient DMUs; hence, each DMU that is located on this frontier will be efficient; otherwise, it will be inefficient. In order to make an inefficient DMU efficient, its inputs and outputs should be changed (Paradi et al., 2012; Aggelopoulos & Georgopoulos, 2017). The efficiency frontiers can be specified assuming either constant returns to scale (CRS) or variable returns to scale (VRS). VRS was first put forth by Banker et al. (1984). They suggested the use of VRS that decomposes the overall technical efficiency (OTE) into the product of two components: pure technical efficiency (PTE) and scale efficiency (SE). Technical efficiency can be estimated in two directions: input-oriented view and output-oriented view. The input-oriented approach focuses on minimizing inputs without changing the outputs so that the DMU can approach the efficiency frontier. In the output-oriented view, we look for a ratio in that outputs can be increased so that the DMU can reach the efficiency frontier without changing the inputs. Under the assumption of the CRS, the input-oriented and output-oriented criteria always give us the same value. In the mathematical DEA model, the relative efficiency of the j^{th} unit is derived from Eq. 1 assuming that there are n DMUs with m inputs and s outputs. The objective function E_j is maximized under the constraint that none of the other banks of the sample can exceed the unit efficiency using the same weights.

$$Max\ E_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}.$$

$$s.t. \qquad (1)$$

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \qquad j=1,2,\ldots,n,$$

$$u_r \geq 0, \qquad r=1,2,\ldots,s,$$

$$v_i \geq 0, \qquad i=1,2,\ldots,m.$$

in which y_{ij} is the r^{th} output for the j^{th} DMU, x_{ij} is the ith input for the jth DMU, u_r is the weight assigned to the r^{th} output, v_i is the weight assigned to the i^{th} input, and E is the efficiency score of the unit. In this model, the efficiency score of a given DMU is calculated as the ratio of total weighted outputs to the total weighted inputs. This score is less than 1 (inefficient unit) or equal to 1 (efficient unit).

This model can be converted to linear program form by limiting the denominator of the objective function to the unit and its inclusion in the problem as a constraint. Therefore, the linear programming form is expressed as Eq. 2 whose solution will give the efficiency score (E_j) for bank j assuming 0≤E_j≤1.

$$Max\ E_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}.$$

$$s.t.$$

$$\sum_{i=1}^{m} v_i x_{ij} = 1,$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \qquad (2)$$

$$j=1,2,\ldots,n.$$

$$u_r \geq 0, \qquad r=1,2,\ldots,s,$$

$$v_i \geq 0, \qquad i=1,2,\ldots,m,$$

Technical, Pure technical and scale efficiencies

Under CRS assumption, technical efficiency shows OTE. But, CRS assumption is appropriate only when all DMUs operate at optimal scale. Nonetheless, various factors may cause DMUs to operate at non-optimal scale. Most studies have decomposed OTE scores derived from CRS into two components: one component pertaining to scale inefficiency and another pertaining to pure technical inefficiency. To do this, we can impose both CRS and VRS assumptions on similar databases. The efficiency measure corresponding to VRS assumption indicates PTE that measures the inefficiency arising merely from management underperformance. The equation $SE = OTE/PTE$ is a measure of scale efficiency. Fig. 1 depicts the technical efficiency, pure technical efficiency, and scale efficiency under one input and one output state.

Fig. 1 depicts the efficiency frontiers for CRS and VRS assumptions. The first frontier is shown by the OM line and the second frontier by the ABCDE line. When the inefficient DMU H is placed on VRS efficiency center (point I) by the input-oriented model (input minimization under constant output), its PTE is defined as X_I/X_H. The PTE for the output-oriented model (output maximization under constant input) is defined as Y_H/Y_G.

By focusing on the CRS efficiency frontier, the DMU E is situated on the point G in that input-oriented OTE is defined as X_J/X_H. Similarly, output-oriented OTE is defined as Y_H/Y_F. However, since the CRS efficiency frontier has a slope equal to 1, then we have $X_J/X_H = Y_H/Y_F$ which implies that orientation has no impact on the variation of OTE scores.

Extending this illustration to scale efficiency, the input-oriented and output-oriented SE measures are defined as $X_J/X_I = Y_G/Y_F$. Increasing return to scale means that the DMU can improve its efficiency by increasing the production Y (that is generally realized by production at ABC of VRS efficiency frontier), whereas decreasing return to scale implies that the decrease in scale can entail the improvement of efficiency (that occurs in CDE segment of VRS efficiency frontier). When a DMU has optimal production, the variation of production scale will do nothing to improve its efficiency. This can happen when the firm operates at point C, i.e. where two frontiers are tangent (OTE = PTE).

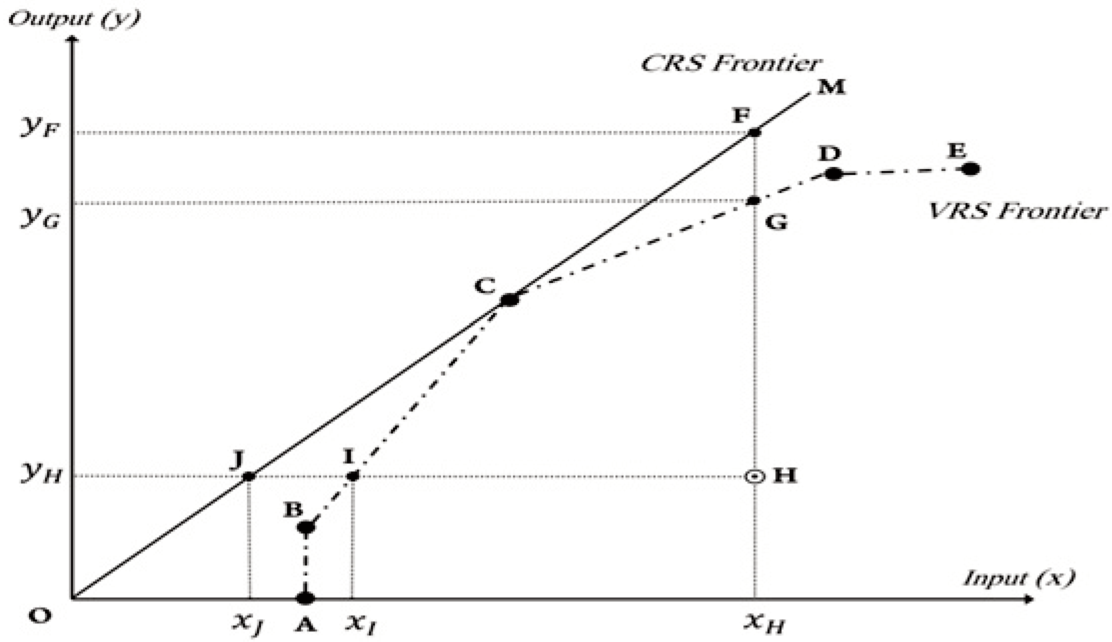

Fig. 1. The measures of overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE)

Tobit model

James Tobin introduced the model came to be named after him in 1958. It refers to the regression models in that the dependent variables are censored in some way. It means that the data are restricted resulting in their clustering at a lower threshold (left-censored), an upper threshold (right-censored), or both. This process differs from data truncation in the sense that during truncation, only non-limited values are available (indeed, censored data give us an insight to the limited data too) (Anastasopoulos et al., 2008).The Tobit model can be expressed (for bank i over period t) as:

$$Y_{it}^* = \beta_0 + \sum_{m=1}^{M} \beta_m X_{mit} + \varepsilon_{it},$$
$$Y_{it} = \begin{cases} Y_{it}^*, & if\ Y_{it}^* > 0, \\ 0, & if\ Y_{it}^* \leq 0. \end{cases}$$
$$i = 1, 2, \dots, N,$$
$$t = 1, 2, \dots, T. \quad (3)$$

where, X_{mit} is a vector of independent variables, and M, N and T represent the number of independent variables, observed banks, and periods, respectively. (For example, $X_{1\,it}$ is the size of bank i in year t.) Also, Y_{it} is the dependent variable measured using a latent variable Y_{it}^* for positive values and censored otherwise, β_0 is the constant, while β_m is a vector of estimable parameters, ε_{it} is a normally and independently distributed error term with zero mean and constant variance σ^2, and N is the number of observations (Liu et al., 2017). Since in our study, the dependent variable shows the relative efficiency scores varying between 0 and 1, it is censored from the left and right side of the equation. The Tobit regression model of the study is shown in Equaiton (4) in that Y_{it}^* denotes OTE scores derived from DEA for bank i in year t, and the independent variables $X_{1\,it}$, $X_{2\,it}$, $X_{3\,it}$ and $X_{4\,it}$ show the specific variables of the studied bank.

$$Y_{it}^* = \beta_0 + \beta_1 X_{1\,it} + \beta_2 X_{2\,it} + \beta_3 X_{3\,it} + \beta_4 X_{4\,it} + \varepsilon_{it},$$
$$Y_{it} = \begin{cases} Y_{it}^*, & if\ Y_{it}^* > 0, \\ 0, & if\ Y_{it}^* \leq 0, \end{cases}$$
$$i = 1, 2, \dots, N,$$
$$t = 1, 2, \dots, T, \quad (4)$$

Data and variables

The studies on the assessment of bank efficiency using the DEA model commonly apply two approaches for selecting inputs and outputs:

1) production approach, and 2) intermediation approach. But, the literature shows no consensus on what constitutes inputs and outputs of a bank (Sufian, 2007). The production approach assumes that banks are the producers of deposits, loans, and services using resources and such inputs as labor and capital. In the intermediation approach, banks are considered as intermediaries that channel funds from DMUs having fund surplus to those facing fund shortage by collecting funds from depositors and converting them into loans. Presented by Sealey and Lindley (1997), the intermediation approach is the most widely used method to select the input and output variables for estimating the efficiency of the banks. Therefore, we based the selection of input and output variables of the present study on the intermediation approach. Input variables include fixed assets and total deposits, and output variables include investments, loans, and advances. In the second phase and in the Tobit model, OTE obtained in the first phase was used as the censored dependent variable, and four variables of total assets, capital adequacy ratio, loan-to-deposit ratio and operating profit to total assets were chosen as the independent variables. The logarithm of the total assets was taken as the proxy of bank size, the capital adequacy ratio as the proxy of capital adequacy, and the loan-to-deposit ratio as the proxy of profitability. The DMUs assessed in this study included 12 branches (supervisory branches) of the agricultural bank in Guilan province during 2012-2016.

DATA ANALYSIS

Tables 1-5 present the evaluation of OTE, PTE, and SE by the DEA model for all sample branches over 2012-2016. They reveal that out of the 12 studied branches, only three branches including Golsar of Rasht (dmu_3), Motahari of Rasht (dmu_4) and Bandar Anzali (dmu_6) have operated at a technically efficient level over the whole period. The central branch of Rasht (dmu_1) is the largest branch of the agricultural bank in Guilan Province in terms of asset size and number of employees, but it is technically inefficient. When OTE was decomposed into two components of PTE and SE, it was found out that the central branch was efficient in terms of PTE but inefficient in terms of SE. In other words, the inputs of this bank are managed in a sound way – that is, there is no mismanagement – and the inappropriate size of its resources can be implicated for its low efficiency. Occasionally, the inappropriate size of a branch (whether too big or too small) is why it is technically inefficient. The scale inefficiency of the Central Branch of Rasht is of the decreasing return to scale type. It implies that the branch is too large to fully benefit from the scale.

The Lahijan branch (dmu_7) was found to be inefficient in terms of PTE and SE in 2012 and 2013, but it turned them into technical efficiency in 2014-2016. The Astara branch (dmu_{11}) was technically efficient in 2014 and 2015, but it was inefficient in other years due to scale inefficiency. This branch is small and enjoys increasing return to scale. Also, among the studied branches, the Fuman branch (dmu_8) had the lowest mean performance followed by the Talesh branch (dmu_9), Guilan Boulevard branch of Rasht (dmu_5), and Jahad-e Keshavarzi branch of Rasht (dmu_2).

The second phase regresses the efficiency scores estimated by DEA over the factors affecting the efficiency of the bank branches. In the past, several studies have tried to examine the factors influencing the efficiency of banks. Some studies have focused solely on bank-specific factors, while others have considered both bank-specific and environmental factors. The bank-specific factors often seen in the literature include size, profitability, capital size, and the ratio of loans to assets (Kasman & Mekenbayeva, 2016; Abbas et al., 2016). We regressed OTE scores that were obtained from DEA over four bank-specific factors. They included profitability measured as the ratio of operating profit to total assets, bank risk measured as the capital adequacy ratio, bank size measured as the logarithm of total bank assets, and liquidity measured as the ratio of loans to deposits which is a measure of risk and total assets that are, in turn, a measure of bank size. If the banking factor is significant, its sign will indicate the direction of the effect on the efficiency.

Table 6 shows the results of the Tobit regression in which OTE scores obtained in the first phase are the dependent variable. A significant and positive coefficient of an independent variable implies that its increase entails the improvement of efficiency, whilst a negative coefficient represents its impact on the reduction of efficiency. Regression results were statistically significant at the 95% level or higher. The four examined variables were found to have different effects on efficiency. The branch size has an insignificant, negative relationship with technical efficiency and, therefore, it does not influence the efficiency. As a result, it seems that the branches do not take any benefits from economy of scale. The capital adequacy ratio was also somewhat significant, indicating its small role in the efficiency of the branch. Unlike the branch size, this ratio had a positive coefficient. Profitability was the most important parameter in the efficiency of the branch followed by the branch liquidity. Bank profitability and branch liquidity influence efficiency significantly and positively. In other words, larger and more profitable branches have higher technical efficiency.

Table 1: Efficiency scores of the agricultural bank branches in Guilan Province in 2012

DMU	Branch (Code)	TE	PTE	SE	Return To Scale
dmu1	Rasht Central Branch (4289)	0.832	1	0.832	Decreasing
dmu2	Rasht Agriculture-Jihad (4852)	0.846	0.891	0.949	Decreasing
dmu3	Rasht Golsar Ave (5117)	1	1	1	Constant
dmu4	Rasht Motahari Ave (5009)	1	1	1	Constant
dmu5	Rasht Guilan Blvd. (4295)	0.745	0.836	0.891	Decreasing
dmu6	Anzali Port (4288)	1	1	1	Constant
dmu7	Lahijan (4416)	0.852	0.899	0.947	Increasing
dmu8	Fuman (4414)	0.722	0.794	0.909	Decreasing
dmu9	Talesh (4409)	0.761	0.796	0.956	Decreasing
dmu10	Langarud (4467)	0.713	0.859	0.83	Decreasing
dmu11	Astara (4287)	0.756	0.894	0.845	Decreasing
dmu12	Rudbar (4297)	0.724	0.816	0.887	Decreasing

Table 2: Efficiency scores of the agricultural bank branches in Guilan Province in 2013

DMU	Branch (Code)	TE	PTE	SE	Return To Scale
dmu1	Rasht Central Branch (4289)	0.791	1	0.791	Decreasing
dmu2	Rasht Agriculture-Jihad (4852)	0.747	0.865	0.863	Decreasing
dmu3	Rasht Golsar Ave (5117)	1	1	1	Constant
dmu4	Rasht Motahari Ave (5009)	1	1	1	Constant
dmu5	Rasht Guilan Blvd. (4295)	0.761	0.822	0.925	Decreasing
dmu6	Anzali Port (4288)	1	1	1	Constant
dmu7	Lahijan (4416)	0.821	0.883	0.929	Decreasing
dmu8	Fuman (4414)	0.664	0.793	0.837	Decreasing
dmu9	Talesh (4409)	0.628	0.793	0.791	Decreasing
dmu10	Langarud (4467)	0.846	0.973	0.869	Decreasing
dmu11	Astara (4287)	0.84	0.926	0.907	Decreasing
dmu12	Rudbar (4297)	0.865	0.895	0.966	Decreasing

Table 3: Efficiency scores of the agricultural bank branches in Guilan Province in 2014

DMU	Branch (Code)	TE	PTE	SE	Return To Scale
dmu1	Rasht Central Branch (4289)	0.801	1	0.801	Decreasing
dmu2	Rasht Agriculture-Jihad (4852)	0.815	0.872	0.934	Decreasing
dmu3	Rasht Golsar Ave (5117)	1	1	1	Constant
dmu4	Rasht Motahari Ave (5009)	1	1	1	Constant
dmu5	Rasht Guilan Blvd. (4295)	0.732	0.866	0.853	Decreasing
dmu6	Anzali Port (4288)	1	1	1	Constant
dmu7	Lahijan (4416)	1	1	1	Constant
dmu8	Fuman (4414)	0.579	0.681	0.85	Decreasing
dmu9	Talesh (4409)	0.834	0.881	0.946	Decreasing
dmu10	Langarud (4467)	0.909	1	0.909	Decreasing
dmu11	Astara (4287)	1	1	1	Constant
dmu12	Rudbar (4297)	0.951	1	0.951	Decreasing

Table 4: Efficiency scores of the agricultural bank branches in Guilan Province in 2015

DMU	Branch (Code)	TE	PTE	SE	Return To Scale
dmu1	Rasht Central Branch (4289)	0.914	1	0.914	Decreasing
dmu2	Rasht Agriculture-Jihad (4852)	0.852	0.906	0.94	Decreasing
dmu3	Rasht Golsar Ave (5117)	1	1	1	Constant
dmu4	Rasht Motahari Ave (5009)	1	1	1	Constant
dmu5	Rasht Guilan Blvd. (4295)	0.889	0.917	0.969	Decreasing
dmu6	Anzali Port (4288)	1	1	1	Constant
dmu7	Lahijan (4416)	1	1	1	Constant
dmu8	Fuman (4414)	0.619	0.762	0.812	Decreasing
dmu9	Talesh (4409)	0.861	0.915	0.94	Decreasing
dmu10	Langarud (4467)	0.925	1	0.925	Decreasing
dmu11	Astara (4287)	1	1	1	Constant
dmu12	Rudbar (4297)	0.934	0.968	0.964	Decreasing

Table 5.:Efficiency scores of the agricultural bank branches in Guilan Province in 2016

DMU	Branch (Code)	TE	PTE	SE	Return To Scale
dmu1	Rasht Central Branch (4289)	0.937		0.937	Decreasing
dmu2	Rasht Agriculture-Jihad (4852)	0.884	0.933	0.947	Decreasing
dmu3	Rasht Golsar Ave (5117)	1	1	1	Constant
dmu4	Rasht Motahari Ave (5009)	1	1	1	Constant
dmu5	Rasht Guilan Blvd. (4295)	0.938	0.975	0.962	Decreasing
dmu6	Anzali Port (4288)	1	1	1	Constant
dmu7	Lahijan (4416)	1	1	1	Constant
dmu8	Fuman (4414)	0.701	0.791	0.886	Decreasing
dmu9	Talesh (4409)	0.846	0.925	0.914	Decreasing
dmu10	Langarud (4467)	0.931	0.942	0.988	Decreasing
dmu11	Astara (4287)	0.976	1	0.976	Increasing
dmu12	Rudbar (4297)	0.902	0.918	0.982	Decreasing

Table 6: The results of the Tobit model

	Coefficient	p-value	Std. error
Constant	0.43825	0.5695	0.63184
Bank size	- 0.03715	0.3684	0.03921
Capital adequacy	0.35988	0.0501	0.02153
Liquidity	0.79362	0.0000	0.18656
Profitability	15.5825	0.0632	7.96522

CONCLUSION

The purpose of this study was to measure the technical efficiency of twelve branches of the agricultural bank in Guilan Province using a combination of DEA and Tobit models. This research first measured technical efficiency scores by using DEA. Then, the Tobit model was employed to examine the determinants of technical efficiency. Independent variables included in the regression analysis were the log of total assets, capital adequacy ratio, the loan-to-deposit ratio, and the ratio of operating profit to total assets. The technical efficiency of different branches shows that dmu_3, dmu_4 and dmu_6 had the highest efficiency in all years, whilst the Fuman branch (dmu_8) was the most inefficient throughout the whole period. The results indicated that technical inefficiencies in the branches of the agricultural bank in Guilan province were rooted in both poor exploitation of inputs and inability to operate at perfectly productive scale size. The analysis of the return to scale shows that, except for the Astara branch (dmu_{11}), other branches had a decreasing return to scale throughout the whole period of the study, and consequently, they need to downsize in order to enhance the efficiency of their operations. The Tobit analysis shows that the most important parameter for output efficiency is the ratio of operating profits to total assets followed by the loan-to-deposit ratio. The other two factors, namely capital adequacy ratio and total assets (branch size), have no significant effect on OTE of the agricultural bank branches in Guilan Province. The ratio of operating profit to total assets has a positive and significant impact on efficiency. Asset size is insignificant. Consequently, the idea that larger banks are more efficient does not seem to be true for the branches of the agricultural bank in Guilan Province. All in all, the study reveals that inefficient banks can properly improve their performance by choosing the correct input-output mix and scale size. It seems that the assessment of the profitability efficiency and quality efficiency of banking services, along with the measurement of technical efficiency and productivity growth of the branches, can give us a clear picture of the performance of the branches so as to improve the performance of the branches by adopting appropriate policies. Also, since inputs and outputs cannot properly distinguish efficient branches from inefficient branches, it is suggested that, in addition to this information, other data are used in deciding on branch efficiencies such as the perspectives of experts and branch managers, commercial status, geographical location, etc. The findings of this study are expected to help policy makers to improve and optimize the use of valuable resources at various banks.

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