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An Assessment Study on the Efficiency of Banks through Data Envelopment Analysis (DEA). Case Study: A Bank Based in Tehran

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Abstract *Due to their specific economic conditions, banks and financial institutions in Iran are among the most important economic entities. For that reason, the Iranian economic development involves how those institutions perform their activities. In many developing societies, the capital markets such as banks play, for various reasons, the leading role in financing the medium-term and long-term economic programs. Given the importance of how banks and financial institutions function in Iran, and the current situation where the banking system is surviving the crippling sanctions, it seems crucial to take appropriate measures for evaluating the efficiency of banks. In this study, the technical efficiency was evaluated through the data envelopment analysis (DEA) at One of Bank based in Tehran. This research was conducted on the basis of two input and output factors through the DEA-Solver. The factors were as follow: A) The inputs were the number of employees per branch, the DEA method at each branch, the value of assets for each branch, and the volume of deposits; and b) The outputs were the total facilities granted and the earnings per branch. In this study, any branch scoring 100 was rated as efficient, while the branches under that score were considered inefficient. Given the limitations of other methods and data available, the DEA was employed considering the output-based BCC. The results of assessing the mean technical efficiency assuming the difference between the variable and the scale indicated that the average efficiency of the total of 97 Tehran Branches in three years was about 38% in 2010, 46% in 2011 and 36% in 2012. Furthermore, the mean value for the three years was 36.5%. The results also showed that during the period under study at the output-based mode, an average 90% of Tehran branches were inefficient in 2010. In 2011 and 2012, the figure amounted to 95%, which implies that a great percentage of banks are inefficient. The average values for the entire period was about 92.5%. The principal management in Tehran can achieve the status of full efficiency by adding 64% to outputs without increasing their inputs. In other words, the principal management in Tehran indicated 64% inefficiency of the branch network within the three years assuming the difference between the variable and the scale. According to the results, it can be argued that 7 branches (Commodity Exchange, Headquarters, Vali-e-Asr, Jannat Abad, Aghanour, Shahid Motahari and Gheitarieh) attained full efficiency over the study period, whereas the other branches failed to obtain the full efficiency.*

Key words Data Envelopment Analysis (DEA), banks, efficiency

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1. Introduction

One of the major problems increasingly discussed in the economic literature today is how to assess the efficiency of production units, institutions and service organizations such as banks. In other words, banks lay an important role in a market-based economy, since they are a key component of the Iranian economy, capable of providing capital for economic activity. Moreover, banks can set the ground for investment, leading to higher employment rate and national output (Dadgar, Yadullah, Niknemat, 2007).

In recent years, threats and pressures posed by globalization, information technology and increasing competition in the banking system have compelled banks, non-bank financial institutions to survive the competition through creating research centers for evaluating their status versus that of other banks in terms of efficiency improvement within the domestic and foreign markets. In this context, the logical and highly effective solution can explain the status of banks in terms of overall efficiency, as well as efficiency benchmarking concerning their current situation in the market. In this procedure, they can identify their

strengths and weaknesses so as to improve their situation, to the extent that researchers have found out that efficiency assessment and subsequent ranking of branches involve the traditional methods based on financial ratios and financial indicators, which as challenged the issue of efficiency evaluation. Therefore, it might be problematic for an organization to rely merely on financial indicators as an efficiency assessment system (Sorayayee and Ahangar, 2009).

The methodology of data envelopment analysis (DEA) is one of the most widely used techniques in efficiency assessment. The DEA is a nonparametric technique using mathematical programming models so as to assess the relative efficiency of a decision-making unit (DMU). Since its introduction in 1978 by Charnes, WW Cooper, and E Rhodes, this technique has so far appeared in a variety of fields in theoretical aspects and in accordance with its unique features. The banking and financial institutions, healthcare, and higher education system can be the main origins of DEA aimed at assessing the efficiency of various operating units (Charles and Cooper, 1978).

This study intended to evaluate the technical efficiency of One of Bank based in Tehran through the data envelopment analysis (DEA). This research was conducted on the basis of two input and output factors through the DEA-Solver. The factors were as follow:

A) The inputs were the number of employees per branch, the DEA method at each branch, the value of assets for each branch, and the volume of deposits; and

B) The outputs were the total facilities granted and the earnings per branch.

In order to gain access to more information, the DEA was employed according to output-based BCC. The results of measuring the mean technical efficiency assuming variable returns to scale on 97 branches indicated that the average network efficiency at Tehran principal office in three years was about 38% in 2010, 46% in 2011 and about 36% in 2012.

2. Literature review

The first DEA project involved a doctoral thesis by Rhodes on the efficiency of American schools. Benker, Charnes and Cooper developed the idea in 1984. Afterwards, numerous studies made further developments in the DEA by insertion of technical efficiency and scale efficiency.

The first study on the banking units through DEA was conducted by Sherman and Gold in 1985. They examine 14 deposit bank branches in the US, concluding that only 6 cases attained fully efficiency. The reason for the inefficiency of other branches were poor management, branch size, number of staff and operational costs. Later on, several studies were done in this field. The study by Avil on 20 banks in Turkey, 17 banks by Hukas in Greece, 74 banks by Saha in India, and 291 banks by Rosen in Canada are examples of such studies. Sherman and Landino examined the efficiency of 33 bank branches in 1998. To do so, a total of 5 input and 5 outputs were used. The results showed that 23 branches were efficient. Saha and Ravisakar examined 25 branches in India, where the selected model was output-based CCR. Once the linear programming model was solved, the results indicated inefficiency of the majority of the banking units.

Similarly in Iran, the research efforts were initiated by Mohammad Reza Alirezaee whose doctoral dissertation concerned the issue. The data envelopment analysis has been employed in Iran so as to evaluate and compare the efficiency of hospitals, banks, exchange offices, universities, insurance companies, etc. Hussein Langeroodi Talachi conducted a number of studies on the factors contributing to productivity at One of Bank. He calculated the total productivity of One of Bank, finding out that the total productivity of factors over the period prior to development of the branch was 3.25%, while it was 28.41% following the development of the branch. Hadi Amiri defined and calculated the criteria of efficiency for commercial banks. His goal was to identify the deficiencies of previous plans devised in the banking system. The positive relationship between efficiency and structure of the banking system, poor monitoring and major weaknesses in the regulatory banking system and the positive relationship between the efficiency and efficiency of the banking system were approved in this study.

In Azimi's master thesis (2003), the allocated technical and economic efficiency of banks were examined. The sample contained 10 banks covering 3 inputs and 3 outputs. The results indicated that efficiency of specialized banks was higher than commercial banks during the period.

Ebrahimpour used the data envelopment analysis to evaluate the efficiency and productivity of 28 provincial commercial banks. According to the results, Tehran, Ilam, Chahar Mahal and Bakhtiari, Golestan

and Yazd were most efficient while Hormozgan was inefficient in terms of commercial banks. Hadian and Azimi examined and 10 specialized and unspecialized banks using DEA assuming the constant returns to scale at three banks, Melli, One of and Sanat which were efficient in terms of technical, professional and economic aspects, while Saderat Bank was efficient only in terms of technical aspect.

Mohammad Taghi Gilak Hakimabadi, A. Asnoshari and Hadi Ahmadpour examine the efficiency of 141 bank branches. They detected the inefficient branches so as to adjust the input and output so as to improve the efficiency of branches.

Sorayayee and Gharueyee carried out a research in 2007 so as to achieve five objectives such as rating the branches, specifying the reference branches, providing solutions to inefficient branches, and finally rating the efficient branches. Inadequate distribution of workforce in the branches and concentration of funds on specific branches were the factors contributing to inefficiency. Bahraini et al. examined the economic efficiency of both private and public banks, assuming variable returns to scale. The calculations showed that the economic efficiency of public banks was higher than that of private banks.

3. The concept of efficiency

Efficiency implies in a general sense the degree of achieving the desired goals. Hence, a manufacturer would be efficient when it can attain all the intended goals (Forster, Jeremy, 2005). The concept of efficiency is generally adopted at three different levels, i.e. micro-level and macro-level industry or organization.

4. Parametric and nonparametric methods of assessing efficiency

Several techniques have been devised over recent years to calculate the efficiency and the appropriate amount of increase in output and decrease in input in order to achieve one hundred percent efficiency. This is generally divided into two categories: parametric and non-parametric techniques. In parametric methods, a particular form is considered for the production function. Then, the statistical methods and econometrics are employed to estimate the unknown coefficients of the parameter function. It is called parametric since the method involves the estimation of parameters (coefficients). In nonparametric methods, there is no form considered for the production function, which is determined by the units themselves (Mehregan, 2004).

5. Data Envelopment Analysis

The Data Envelopment Analysis (DEA) is a method of linear programming for evaluating the efficiency of the decision-making units (DMUS). In 1957, Farrell 3 used a method similar to the efficiency measurement engineering to assess the efficiency of the production unit. The case examined by Farrell to measure the efficiency entailed one input and one output (Khajuyee Shokrollah et al., 2005). In this way, there is no need to specify the type of production function, since the efficient boundary curve is specified by a series of points determined by linear programming. The linear programming method specified after a series of optimization whether or not a single decision-making unit has been aligned on the efficiency line. Thereby, the efficient and inefficient units are separated, and the relative efficiency is obtained to be relative rather than absolute (Bahraini Hosseinaadeh *et al*., 2008).

The main DEA models can be classified based on the type of surface coating into CCR and BCC. Each of these models can be input-oriented and output-oriented within three fractional, multiple and coverage (Ahmadpur and Amin, 2007). The difference between BCC and CCR involves the assumption of constant or variable returns. Given the fact this paper uses multiple forms of output-oriented BCC to calculate efficiency, this model only described.

6. Ranking the bank branches by output-oriented BCC

In order to rank the Bank branches, the output-oriented BCC method was conducted based on the following model.

1. The coverage mode of output-oriented BCC will be as follow:

$$
\begin{aligned}
&Max\,\varphi \\
&s.t: X\lambda \le x_0 \\
&\quad Y\lambda \ge \varphi y_0 \\
&\quad \sum \lambda = 1 \\
&\quad \lambda \ge 0 \\
&\quad \theta : unrestricted\ in\ sign
\end{aligned}
\qquad (1)
$$

2. The multiple form of output-oriented BCC will be as follow:

$$
\begin{aligned}
&Min\, z = v^t x_0 - v_0 \\
&s.t: u^t y_0 \quad = 1 \\
&\quad v^t X - u^t Y - v_0 e \le 0 \\
&\quad u \ge 0, v \ge 0 \\
&\quad \theta : unrestricted\ in\ sign
\end{aligned}
\qquad (2)
$$

3. The fractional form of BCC will be as follow:

$$
\begin{aligned}
&Min \frac{v^t x_0 - v_0}{u^t y_0} \\
&s.t: \frac{v^t x_j - v_0}{u^t y_j} \quad \ge 1 \\
&\quad v \ge 0, u \ge 0 \\
&\quad \theta : unrestricted\ in\ sign
\end{aligned}
\qquad (3)
$$

7. Methodology of research

In methodological terms, this is a descriptive study involving a review of relevant literature. In this paper, the DEA models assuming constant and variable returns to scale were used through selection of BCC standard model. Moreover, a total of 97 bank branches were evaluated. Firstly, the efficiency measures were identified for the bank branches, and then the available information in the accounting department was examined through DEA-Solver.

8. The analysis of the findings

The branches were studied in 3 consecutive periods from 2010 to 2012. The results of mean technical efficiency with variable returns to scale reflect that the average network efficiency of the principal office in Tehran is 36% at output-oriented mode. The Tehran-based management can attain full efficiency by adding 64% to its outputs without increasing the inputs. In other words, the management network in Tehran was inefficient by 64% within the years under study based on the assumption of variable returns to scale.

Furthermore, the results also show that averagely 90% of branches were inefficient in 2010 during the period under study at output-oriented mode. In 2011 and 2012, the figure amounted to 95%, implying that a greater percentage of bank branches were inefficient. The mean figure for the entire period was about 92.5%.

According to the results, it can be argued that 7 branches (Commodity Exchange, Headquarters, Vali-e-Asr, Jannat Abad, Aghanour, Shahid Motahari and Gheitarieh) attained full efficiency over the study period, whereas the other branches failed to obtain the full efficiency. It indicates that about 7% of total branches in Tehran are efficient while the rest are relatively inefficient. Moreover, the table shows that

only 12 branches are efficient by over 50%. Nevertheless, the remaining 79 branches are below the level of 50% efficiency.

9. Conclusions and recommendations

According to the results, there are several suggestions to enhance the efficiency of inefficient branches of Bank in Tehran.

1. Given the average efficiency of the branches (0.249985714) in 2012 and the large number of branches under average ranking, it is recommended that effort be made to increase the revenues of branches through customer acquisition programs and utilization of entire capacities at each branch so as to attract more affordable deposits and provide more facilities, which will in turn bring about higher revenue.

2. Most of the branches (over 90 cases) have extreme input and disproportionate output, which originates most likely from certain portion of external resources have not been collected. Once the debts are collected, the management of financial resources will be facilitated, followed by more appropriate reallocation of resources. This will ultimately lead to greater output and higher efficiency.

3. Performing a sensitivity analysis on the factors contributing to the efficiency or inefficiency of branches and the degree of importance of each aimed at devising the action plans to improve the inefficient branches.

4. It is recommended that inefficient branches follow in the footsteps of efficient branches, i.e. compare their input and output so as to attain the efficiency boundary, thus improving their performance.

5. According to the optimal scale for the inefficient branches and the generated output.

6. It is recommended that the principal office of the bank employ the supplementary information so as to regularly evaluate the efficiency of each branch and its changes as the initial stage of the four-stage cycle in efficient management, i.e. assessment, analysis, planning and efficiency improvement.

7. The present study demonstrated that the assets in the branches are not effectively utilized, especially the fixed assets. Hence, it is suggested that control measures be taken to achieve this goal at any inefficient branch.

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