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Assessment of the Efficiency of Banks Accepted in Tehran Stock Exchange Using the Data Envelopment Analysis Technique

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ABSTRACT

The research provides a systematic method for assessing the financial performance of the banks. The analysis is based on a set of benchmarks related to the financial performance of the banks. In this regard, this research has explored a model for evaluating accepted banks in Tehran Stock Exchange using the data envelopment of analysis method. The purpose of this research is to apply the research method. In addition, the data collection method is a direct observation, interview and library method and a tool for collecting data from stock databases. The statistical population of this study is Tehran Stock Exchange member banks. Selection of inputs and outputs of this research has been done according to similar research. Inputs include public and administrative costs, income and output, including net profit. In addition, according to the analysis done by the DEA models, it is selected for performance evaluation. Finally, the unit is either efficient or inefficient, and efficient units with The Anderson and Pearson models were ranked and eventually the Bank of Pasargad and the Ghavamain Bank ranked.

1 Introduction

Any process that takes place requires the use of a series of data and resources and, naturally, a series of achievements and products. The importance and importance of evaluating the efficiency and effectiveness of the reflection and the effects of the activities performed is especially important [1, 2]. That strategic planning and performance-based goals and policies are at the heart of the heart. The banking system of the country is also required to evaluate its performance in order to survive and compete in this field, considering the issue of joining the WTO and the entry of foreign banks, starting private banks and increasing the scope of financial and credit institutions. It is diligent in its growth and prosperity and it will take the necessary measures to compensate for the disadvantages of its branches [3-5]. Considering the very important roles that are nowadays considered for banks, the issue of efficiency and productivity, and its measurement in the banks of the country, is a new debate that seeks to shape them in our growing and changing society. Measurement of efficiency and productivity in our country has been studied and evaluated mainly in the economic enterprises. Fortunately, good time for entry in this field has been provided in our country. Since banks are different in terms of their nature

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and type of work with single-purpose agricultural and industrial organizations, different methods should be used, therefore, appropriate methods should be used by multi-purpose organizations [7-9].

The subject of this research is to evaluate the efficiency of Tehran Stock Exchange banks. Since the existing methods of assessing and measuring the performance of bank, units are often empirical and without scientific support, as well as due to the non-standardization of these methods, their results cannot be used in other banks. In this study, to evaluate the efficiency and efficiency of companies the stock exchange is utilized in a scientific approach called data envelopment analysis. The Data Envelopment Analysis was first proposed and introduced as the CCR Model. Data Envelopment Analysis is a powerful tool for evaluating the performance of organizations in their relative performance conditions [10-14]. Considering that banks are almost similar in terms of structure, each bank has the same executive functions, and during certain operations, they provide a specific output using certain inputs. Therefore, they must be characterized by suitable criteria for determining their efficiency. Each of the banks has used for each level their outputs, levels of institutions, and thus their efficiency in the use of their limited resources, or vice versa, in output generation. Thus, by measuring the relative efficiency of each unit and identifying inefficient units, and comparing the efficiency of these banks in several different periods, it can be seen that there is a positive or negative growth in productivity, and providing appropriate strategies to improve the performance of these banks [15-19].

The Tehran Stock Exchange was established in February 1966 on the basis of the law approved in May of 1966. The period of activity of the stock exchange can be divided into four periods: the first period (1977-1978), the second period (1979-1999), the third period (2004-2005) and the fourth period (from 2005 to now). The trend of the second half of 2004, under the influence of various domestic and foreign events, and the excessive increase of indices in the previous years, had a decreasing trend, and this trend was significant except for a short period from December to the end of the year. However, since December 2005, the policies and efforts of the government and the stock exchange have slowed the downward trend in the stock-flow criteria. While the total index reached 9.459 at the end of 2005, it crossed 10,000 units during 2006 and eventually experienced 9,821 units at the end of the year. Also, a significant decrease in stock trading in 2005, due to the effective actions mentioned in 2006, reached a relative balance, so that the value of Rials. The number of listed companies in the stock market increased from 422 companies at the end of 2004 to 435 companies at the end of 2006. Among the banks accepted in the stock exchange are SADERAT BANK, PARSIAN BANK, PASARGAD BANK, IRAN ZAMBAN BANK, Development Bank, Post Bank of Iran, Sina Bank, New Economy Bank, Ansar Bank, Bank of Karafarin, Bank of Commerce, Bank Mellat, Bank Di, Saman Bank, Future Bank, Tourism Bank and Capital Bank. It is natural that the efficiency of inefficient banks, while reducing the cost of services provided and preventing the loss of scarce resources, can be expected in this case. National interests are more secured, the losses caused by inefficiency at the general level of banks will be minimized, and ultimately the banking system of the country will be more efficient overall. Therefore, present evaluation can clarify the efficiency and inefficiency of the studied banks and make the necessary arrangements. To improve their performance. For this reason, it can be considered as a negligible contribution to the study of efficiency and productivity literature in the domestic banking system.

2 Literature Review

In [20] 80 branches of a bank were analyzed. In these 80 branches, by reorganization, there was occurred about 30% reduction in the personnel costs without any reduction in the services. In this study,

following inputs applied for evaluating the efficiency: (1) cashiers; (2) services employees; (3) branch management; (4) bank operation costs (except personnel expenditures and rental); (5) infrastructure of the branch. There was considered also 15 outputs in this study and by removing some of them (because they had lower importance based on size and low number of operations recorded) and combining the similar outputs, we obtained following outputs:

1- Deposits, withdrawals and checks collected;
2- Bank checks and travel checks;
3- New accounts (long term, saving, deposit certificate);
4- Loans;
5- Nightly operation.

Results of this study indicated that 23 branches out of 33 bank branches were inefficiency and use outputs more than required. For any inefficient branch, there was indicated a set of efficient branches with closest input-output combination to above-mentioned branches and then the reduction in the inputs determined to attain efficiency. There was generally predicted that by efficiency of 23 inefficient branches, it resulted in about 9 million dollars reduction in the costs. This included 22% for cashier's personnel to 33% reduction in the variable banking operation costs. According to results obtained from this model, some branches had excessive use of some inputs and due to their efficiency, they haven considered until that time. According to related organization by applying some results proposed, the insurance company reduced its personnel about 20% during one year and in the next year; the costs reduced about 6 million dollars. In another study [21] the performance about branches include all activities turning a set of sources to a set of services and introducing the indices such as return on investment (ROI), efficiency and other financial ratios using for evaluating the performance of the branch and considering the drawbacks of such indices not considering the combination of sources and services were investigated. In [22] DEA technique for comparing the efficiency of 35 branches of an insurance company in Calgeri was used. In this study, there were considered about 13 inputs and 18 outputs with oblique line like evaluating the efficiency with such number of inputs and outputs. Therefore, by using a rhythmic pattern for collecting some inputs and outputs, their number reduced to six including: inputs, total number of full-time personnel, annual rent, space of branch, telephone cost and fixed costs, number of terminals, marketing activity rate. Outputs include number of operation, rate of opening commercial accounts, rate of opening the micro accounts, number of loan applications, rate of estimating the customer services, number of corrections. The annual rent has been used because it follows from two factors including local situation and infrastructure of the branch. The area of a part of the building in the branch that is the place of providing the customers with services ranked among 7 to 35. The marketing activity of the branch manager was also considered as an effective function for improving the activity of the branch and ranked between 0 and 5. Results for any branch expressed as determining the efficiency rate, inefficiency rate separated by inputs and a set of efficient branches as a model.

In [23] the DEA models for evaluating 575 branches of banks were used. Inputs used in this study include total number of employees, cost of building and furniture, cost of materials and supplies, twelve environmental variables indicating the type of insurance, commercially and financially, number of active branches to total area of deposits and loans. Outputs used in this study include number of demand deposit account, number of long-term deposit accounts, number of housing loans, and number of loans for installation and launch, number of commercial loans.

In [24] different branches and considered wide spectrum based on the size and various activities were evaluated. Other used systems that have been designed following the long studies include a system continuously applied on one of the great insurance companies in USA during 6 courses of 3 month. The inputs of this study included labor force related to the counter operation, labor force related to non-counter operation, space of branch, per capita cost per any customer, the rate of employment; and output of this study included (1) loans, (2) deposits; (3) number of accounts per customer; (4) customers' satisfaction.

3 Preliminaries

3.1 Efficiency

In the issues for making decision for efficiency, i.e. working well, the result is comparing the inter-organizational indices against efficiency, i.e. working good resulted from comparing the extra-organizational indices. Productivity is a function of efficiency and profitability and indicated as below:

Productivity= f(efficiency, profitability).

Where f is unknown.

The efficiency of any department is the result of comparing the indices of that department with standards. As the standard of indices could be from the external part or internal part of the community, there are defined the absolute and relative efficiency. We assume that for decision-making departments specific for global standard, for an input unit, the output is equal to y^*. Should a decision unit produces y_0 output unit by consuming an input unit, in this case efficiency is defined as below?

$Y_0.y^8$

By following reasons, the relative efficiency is usually used for evaluating the performance of decision units.

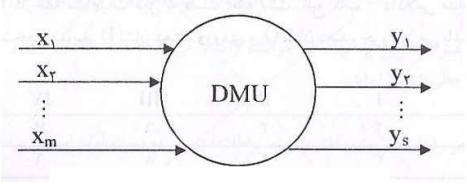
- The performance distance of actual units, particularly in developing countries such as Iran has usually long distance with international standards and providing an alternative to attain a standard level could not be performed; in this case, presenting it may make a disappointment.
- For most organizations there is neither a standard nor it is rational considering international standards for organizations.
- Such kind of evaluation as comparing the comparison with external part of the community would be unacceptable according to some managers and there is no actual model for inefficient units to become efficient.

According to all aforementioned disadvantages, one of the greatest advantages of absolute efficiency is that it could indicate the actual situation of units. Assume that decision-making unit, jth by spending x_j, produces output y_j. The relative efficiency for kth unit, as indicated with RE_k defined as below:

$$RE_{\mathrm{k}} = \frac{\frac{y_k}{x_k}}{Max\left\{\frac{y_j}{x_j} : j = 1, \dots n\right\}}$$

A decision making unit means a unit that could produce an output vector, $Y= (y_1,\dots,y_s)$ by receiving an input vector, $X=(x_1,\dots x_m)$. Homogenous decision-making unit means the units with similar function and producing similar outputs by receiving similar inputs. For example in the branches of a bank, this is homogenous units that collect the deposits, obtaining the profits and supplying services

by receiving facilities such as personnel, office space, computer and etc. As the managers of these units produce such outputs by their management and applying the policies and combining the inputs, they are called as decision maker. Therefore, word "Decision Maker" means how using X, combination and processing them could make decision. Now, consider decision making unit as below that by using input vector (x_1,…,x_m), it produces output vector (y_1,….y_s).



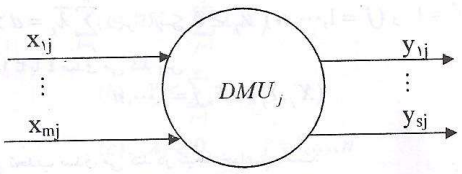
For above decision making unit, when the cost of all outputs is given and cost of all inputs in the unit is also known, its efficiency is calculated as below:

$$Efficiency = \frac{u_1 y_1 + \cdots + u_s y_s}{v_1 x_1 + \cdots + v_m x_m}$$

Where, u_1 is the price of ith output, i.e. y_r (=1,…,s), x_1 is the cost of ith input, i.e. x_i (i=1,…,m) and such efficiency called as "Economic Efficiency". Should decision making unit is such that one couldn't determine the cost of output, and cost of input is a sample of these decision making units in the universities, and inputs include members of faculty, labs, libraries,… and outputs include graduates, papers published, books written,…., to indicate how to determine the Us and Vs and how efficiency will be defined. For removing such problem, we define the concepts. Z vector dominate on z_2 vector if and only if $z_1 \geq z_2$ and $z_2 \neq z_1$, in this case we say that z_2 vector has been dominated by z_1 vector. On the other hand, z_1 vector is dominating on z_2 vector if $z_{2j} \geq z_{1j}$ (j=1,…,n) and inequality is at least considered for one component.

3.1 CCR Model

Assume that DMU_j (j=1,…,n) is n homogenous decision making units producing input vector X_j (j=1,…,n); R^(m≥0) ∈ X_(j) (j= 1,… ,n) and $R^{s\geq 0} \in y_j$ (j=1,…,n), i.e. X_j vector has m components and y_j vector has s components that exponent of DMU_j is such [23-25].



Assume that the objective is evaluating the performance DMU_o where $o \in \{1,2,\ldots,n\}$؛ for this reason, we say that if there isn't found the possibility of production like (X,Y) in T_c dominating on (X_o, Y_o), in this case, DMU_o will have a relative efficiency, otherwise, how one could say that it isn't possible to produce in T_c dominating on DMU_o? This could be done by three methods:

1) If one can find a production possibility in T_c that with input less than X_o, its output is higher than or equal to Y_o;

2) If one can find a production possibility in T_c that with input lower or equal to X_o, it has an output more than Y_o;

3) If one can find a production possibility in T_c that with input less than X_o, it has an output higher than Y_o.

Now, when we consider first state, i.e. we will reduce the input, X_o, we indeed intend to find minimum e>0 by which it is possible to produce $(\theta X_o, Y_o)$ on the boundary of T_c. in this case, if 0<θ<1, then $(\theta X_o, Y_o)$ dominates on (X_o, Y_o). Then we must find minimum θ that could be indicated in above properties, i.e. solving following model:

$Min\theta$

$\boldsymbol{s.t}$

$(\theta X_o, Y_o) \in T_C$

However, the condition for membership in T_c is that:

$$\theta X_o \geq \sum_{j=1}^{n} \lambda_j X_j$$

$$Y_o \leq \sum_{j=1}^{n} \lambda_j Y_j$$

$\lambda_j \geq 0 \qquad j = 1, \dots, n$

Then, solving the problem requires solving the linear planning as below:

$\mathrm{Min}\theta$

$$\mathrm{s.t} \sum_{\mathrm{j}=1}^{\mathrm{n}} \lambda_{\mathrm{j}} \mathrm{X}_{\mathrm{j}} \leq \theta \mathrm{X}_{\mathrm{o}}$$

$$\sum_{\mathrm{j}=1}^{\mathrm{n}} \lambda_{\mathrm{j}} \mathrm{Y}_{\mathrm{j}} \geq \mathrm{Y}_{\mathrm{o}}$$

$\lambda_{\mathrm{j}} \geq 0 \qquad \mathrm{j} = 1, \dots, \mathrm{n}$

Or

$Min \ \ \theta$

$$i = 1, .., m \quad s.t \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io}$$

$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad$ r =1,…,s

$\lambda_j \geq 0 \qquad j = 1, \dots, n$

The above equation is the CCR model in the input nature called as CCR Envelope case.

4 Methodology and Variables

Scientific studies divided into three classes based on objective of study, including applied, research and development. According to how obtaining the data required by study, they could be also divided into two categories: descriptive study and test study. In the test study, there is investigated the cause and effect relation between two or a few variables. Descriptive study also includes a set of methods aiming to describe the conditions or events. Implementing the descriptive study is merely for higher

recognizing the status quo or helping the decision making process [26-28]. According to what mentioned above, this study has applied objective and descriptive comparative according to data collection and is conducted based on logical and mathematical analyses.

a- Evaluating the efficiency by using DEA method;

b- Ranking the efficient branches by Anderson Peterson method.

Variables of this study have been selected according to their simplicity, perceiving the concept, being quantitative, accessibility of data, applicability and using the opinions of experts and consultants.

4.1 Standards for Selecting Variables

Selective variables include variables applied for evaluating and determining the efficiency of studied companies. One of the most important cases considered in determining the input and output variables include financial statements and indices effective in the shares market. As statements and indices indicate the annual performance of decision-making units (companies) and data indicated in them is one of the most important information sources of users of financial data for decision making, therefore, the input and output variables have been selected for evaluating the efficiency of companies from such statements and indices [29-31]. One of the main stages for doing this study is determining the inputs (input variables) and outputs (output variables) and must come with following specifications:

1- All inputs and outputs must be homogenous and with unique direction; on the other hand, inputs and outputs must be the same for whole institute. Unidirectional means inputs and outputs must change the efficiency in one direction. On the other hand, should any increase in the outputs may increase the efficiency, an undesirable output as if wastes must be such entered to the model that any increase in it may increase the efficiency.

2- All inputs and outputs must be calculated for a specific interval.

3- One of the limitations for selecting the inputs and outputs is that total variables may not exceed from a third of total decision making units.

According to above descriptions, for using DEA, it is necessary to classify the variables into two categories, “input” and “output” and in an operational definition of measure for such classification, the variables that companies will minimize it are considered as input and variables companies will maximize it are considered as outputs. According to above descriptions, the calculation variables of this study is defined and classified as below:

Input indices: general costs, administrative and financial costs;

Output indices: sales and net profit

4.2 Definition of Decision Making Units (DMU)

A DMU is an institute turning the inputs to outputs. DMUs are units conducting the same type of duties with the same objectives and ideals. DMUs that are being used in DEA must be homogenous with the same inputs and outputs. There are two essential guidelines for selecting DMUs:

1) Any DMU must be defined as an institute that is responsible for inputs used and outputs produced.

2) The number of inputs and outputs used in a study must be enough great [32-34].

4.3 Ranking of Effective Units

In the CCR model, the efficiency of the bank has been achieved. Using the Anderson-Patterson model, these four banks were reevaluated, with the results presented in Table (4-8).

Table 1: The efficiency based on AP model

RANKING	AP MODEL	name of the company	row
10	0.36	New Economy Bank	1
10	0.36	Ansar Bank	2
3	0.93	Iran Bank of the Earth	3
9	0.46	Parsian Bank	4
14	0.12	Tejarat Bank	5
13	0.16	Bank of Wisdom Iranians	6
1	1.36	Middle East Bank	7
8	0.48	Bank di	8
12	0.17	Saman Bank	9
6	0.63	Sina Bank	10
17	0.06	Saderat bank	11
5	0.73	Bank of Ghwamin	12
7	0.52	Tourism Bank	13
15	0.10	Mellat Bank	14
2	1.12	Pasargad bank	15
16	0.07	Bank tat	16
11	0.30	Capital Bank	17
4	0.76	Bank for business	18

5 Conclusion

Given that there was an input and two outputs, the number of decision-making units should be at least 9, in which we analyzed 18 banks in the stock exchange. The inputs include general and administrative costs, the output includes income and profit, which was done using the GAMS software, using CCR and BCC model inputs and outputs, and ranking the units, and the criterion of the CCR model was introduced. Then, we need to rank the effective units, which uses the Anderson Peterson model to rank effective units. Based on the results obtained in the CCR model, two Pasargad Banks, the Middle East, have a performance of 1, and 16 other banks have less than one performance, which has been the least efficient for the SADERAT BANK.

Also according to the BCC model, eight Pasargad banks, Parsian, Middle East and Sinai, Ghwamin Bank, Mellat, Entrepreneur and Iran Land have a performance of one, which means, in terms of re-

turns versus scale on the efficiency boundary, and the points that are on the border they do not have so-called inefficiencies. Also Ansar Bank with a performance of 1.63 and a new economy bank of 1.99 operate a bit short of efficiency, which is better than other banks. According to Banking Performance Ratings, with the Anderson Pyotr Sung Bank, Pasargad Bank was the first bank to be recognized as the first efficient bank, and Seps, respectively, Ansar, Middle East, Iran, Wisdom ranked second, third and fourth. Saman Bank and Qavamin are among the most inefficient banks. They are

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