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A Data Envelopment Analysis of Banks Performance in Iran

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ABSTRACT: This study applies Data Envelopment Analysis(DEA) under the input oriented CCR, BCC model, constant returns to scale(CRS) and variable returns to scale(VRS) assumptions to measure the Relative efficiency, Pure technical efficiency, Scale inefficiency and analysis of reference groups for 11 Iranian banks over the period of 4 years. Fixed assets and total deposits were used as the input variables while total loans and net income were used as the output variables. Empirical results shown that Sanat & Madan Bank was the most effective bank in its industry with CRS assumption. The analysis also revealed that Eghtesad novin, Parsian, Pasargad, Sina, Saderat, Mellat, Melli, Post bank and Sanat & Madan had Pure Technical Efficiency with VRS assumption. All banks except Sanat & Madan Bank had Scale inefficiency. This indicates that they did not have the optimal performance volume.

Keyword: Performance Evaluation, Efficiency, DEA, Bank, Iran

INTRODUCTION

There is the growing need for interest in the performance of financial institutions across economies the world over. Among financial intermediaries commercial banks play a vital role to attract savings from public and mobilize the same to development activities. An enduring and efficient banking sector provides a base for effective stabilization policies and investment prospects to achieve genuine earnings for developing economy. Therefore, efficiency of banking sector received a high priority for policy makers as development of the real sector depend on this sector. The earliest technique, which was used to measure performance changes, among companies in general and the banking sector in particular, was ratio analysis. This technique simply quantified variables such as return on turnover, return on investment, return on assets and etc. This was considered to be an inappropriate way to measure the performance of sensitive institutions like the banking industry. A part from the impossibility of consistent aggregation, the method does not identify the peculiarities of the banking sector in terms of using multiple inputs to produce multiple outputs. Furthermore, the non-parametric approach, popularly known as the DEA has received the attention of researchers as a tool for measuring efficiency and production changes. Aly et.al.(1990) Charnes et.al.(1997) Chan and Yeh (2000) are among the users of this method. In this study, the Data Envelopment Analysis (DEA) was used to measure the performance of a group of Iranian commercial banks during the period 2009-2012.

Literature Reviwe

Ferrier and Lovell(1990), Kapara Kis et.al (1994), Altunbas et.al (1995) Alam (2001), and Mukheerjee et al (2001); using the DEA methodology, studied commercial banks in the USA during the 1980's, their findings reveals a positive productivity growth among the banks studied. Berg et al (1993) made an attempt to compare banking efficiency in the Nordic countries. A non-parametric Data Envelopment Analysis and Malmquist productivity index have been adopted to measure the efficiency and productivity and productivity differences among countries. A total of 779 banks were considered for the analysis and necessary information were collected from the official bank statistics in Finland and Norway and published annual accounts reports in

Sweden for the year 1990.The study at individual country analysis identified that the efficiency spreads between banks were most important in Finland and Norway and least important in Sweden.

Vivas (1998) examined the effectiveness of deregulation in improving the cost efficiency of the Spanish banking industry by adopting Thick Frontier and Data Envelopment Analysis methods. Separate panel data for the years 1985-91 of 88 Spanish commercial banks and 55 savings banks have been considered for analysis. The study identified that deregulation was associated with a decrease in relative cost efficiency for commercial banks but no change for savings banks and in both types of institutions operating with cost inefficiency which was almost completely composed of technical rather than allocative. Drake (2001) investigated the efficiency and productivity change in UK banking by using Data Envelopment Analysis and Malmiquist productivity index. A panel data set consists of 9 UK banks for analysis has been obtained from the annual reports of the respective banks and statistics published by the British Banks Association for the period 1984-1995. The analysis revealed that increasing returns to scale were evident for smaller banks while decreasing returns to scale for large-scale throughout the sample period. Malmiquist productivity indices suggested that UK banks have exhibited positive productivity growth over the period. All U.K banks have been experienced with positive technical change due to increasing competition and product diversity.

Yildirim (2002) analyzed the efficiency performance of Turkey commercial banks during deregulated period by adopting Data Envelopment Analyses. The data used in the study have been obtained from various issues of reports of the Banks Association of Turkey for the years 1988-1999. The analysis revealed that the banks suffered with decreasing returns to scale and pure technical efficiency and scale inefficiency were positively related to size. Besides, the analysis observed that state-owned banks performed better than the private and foreign banks. Satye (2003) compared the efficiency of Indian commercial banks with the efficiency of foreign banks by employing a nonparametric approach of Data Envelopment Analysis. Annual data consists of 27 public sector commercial banks, 33 private sector commercial banks and 34 foreign banks were considered for the analysis have been obtained from the Indian Banks' Association for the year 1997-1998. The analysis revealed that public sector banks such as State Bank of India and Bank of Baroda have been recorded with higher mean efficiency. But most of the Indian banks had lower mean efficiency as compared to the foreign banks. The study recommended that the bringing down non-performing assets and curtailing the establishment expenditure and rationalization of rural branches could help Indian banks to improve their efficiency. Chen (2004) made an attempt to analyze the cost, technical and allocative efficiencies of public owned and private owned banks in Taiwan during the Asian financial crisis by employing the Data Envelopment Analysis. The study used data of 44 banks was collected from the official reports of Department of Finance, Central Bank, and the ROC Commission on National Corporations of the Ministry of Economic Affairs for the year 1994-2000. The analysis revealed that the Asian financial crisis depreciated cost, allocative and technical efficiencies in Taiwanese banks.

Ataullah et al (2004) compared the technical efficiency of commercial banks in India and Pakistan by employing the Data Envelopment Analysis for the period 1988-1998. The study identified that after 1995-1996 the overall technical efficiency of the banking in both countries improved. In the case of India, efficiency increased due to improvement in both pure technical efficiency and scale efficiency, while in Pakistan it was due to an improvement in scale efficiency. The analysis also revealed that due to high non-performing loans in the asset portfolios of banks in the two countries a gap in efficiency has been created and the implementation of the financial liberalization closed the efficiency gap between large and small banks. Yen (2005) studied the performance evaluation of Taiwan's non-financial holding companies during 2001 to 2004. The original DEA model was performed. This study explores the pure technical efficiency, technical efficiency and scale efficiency, and applied integrated DEA model to select inputs/output factors, including non-interest income, net interest expense, operating expenses, deposits, investments, and so on. The results found that the original DEA model with network through integrated nervous approach will actually improve the bank efficiency. Park and Weber (2006) studied bank inefficiency and productivity change of the Korean banking sector with the financial liberalization and the Asian financial crisis. By using the directional technology distance function, they found that technical progress has offset the declines in industry efficiency and that reforms generated productivity growth. Ariff and Can (2008) estimated cost and profit efficiency of Chinese banks by the nonparametric DEA approach and the second-stage Tobin regression. They found that private and medium-sized banks are the most efficient units.

MATERIALS AND METHODS

Research Design

Data envelopment analysis (DEA) is a linear programming methodology to measure the efficiency of multiple decision-making units (DMUs) when the production process presents a structure of multiple inputs and outputs. DEA is received increasing importance as a tool for evaluating and improving the performance of service operations. This study applies Data Envelopment Analysis under the input oriented CCR, BCC model, CRS and VRS assumptions to measure the Relative efficiency, Pure technical efficiency, Scale inefficiency and analysis of reference groups for 11 Iranian banks during the period 2009-2012.

The DEA Model

CCR Model

The terms of DEA and the CCR model were first coined in Charnes et al. (1978) and were followed by a phenomenal expansion of DEA in terms of its theory, methodology and application over the last few decades. DEA is a multi-factor productivity analysis model for measuring the relative efficiencies of a homogenous set of decision making units (DMUs). The efficiency score in the presence of multiple input and output factors is defined as:

Efficiency=weighted sum of outputs /weighted sum of inputs

DEA is a systematic programming approach for measuring relative efficiencies within a group of decision making units (DMUs), which utilize several inputs to produce a defined as the ratio of multiple weighted outputs to multiple weighted inputs. Within the DEA framework, the weights are chosen to give as much efficiency score of a DMU is equal to one, then the DMU is classified as efficient; otherwise, it is inefficient. In solving a DEA problem, researchers transformed the primal model into the dual problem to obtain the improvement targets of factors for inefficient DMUs. The Dual of the CCR model is given as follows.

$$Max \quad : \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \qquad (1)$$

$$s.t.$$

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1, \quad j = 1, 2, ..., \quad n$$

$$u_r \ge 0, v_i \ge 0$$

r = 1 to s,
i = 1 to m,
j = 1 to n,
yrj = amount of output k produced by DMUi,
xij = amount of output j produced by DMUi,
ur = weight given to output k,
vi = weight given to output j,

The fractional program shown as (1) can be converted to a linear program as shown in (2). For more details on model development see Charnes et al (1978).

(2)

$$Max \sum_{r=1}^{s} u_r y_{r\circ}$$

$$s.t.: \sum_{i=1}^{m} V_i x_{i\circ} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1, ..., n$$

$$u_r \ge 0 \qquad v_i \ge 0$$

BCC Model

Banker, Charnes & Cooper model (BCC) extended from the CCR model of pure technical efficiency and scale efficiency issues. CCR model assumes constant returns to scale under the DMU on the relative

efficiency. DEA also allows for computing the necessary improvements required in the inefficient unit's inputs and outputs to make it efficient. CCR model includes overall efficiency as follows.
Overall Efficiency = Pure Technical Efficiency × Scale Efficiency
BCC model relax the constant returns restriction on CCR. BCC includes $\sum \lambda_i = 1$ restriction and can be computed as shown in (3).

(3)

$$Max \sum_{r=1}^{s} u_r y_{r\circ} - c_k$$

$$s.t.: \sum_{i=1}^{m} V_i x_{i\circ} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} - c_k \le 0 \qquad j = 1,\dots,n$$

$$u_r \ge 0 \qquad v_i \ge 0$$

RESULTS AND DISCUSSION

In this study fixed assets and total deposits were used as the input variables while total loans and net income were used as the output variables. The input-output variables used to evaluate banks efficiency in this assessment are shown in Table1.

Table 1. Inputs and outputs used to assess efficiency

NO	Input/Output	Name	Indicators to Measure	Units
1	Input	Fixed assets	Average of net fixed assets over the period of 4 years	Million Rials
2		Total deposits	Average of total deposits(liability) over the period of 4 years	Million Rials
1	Output	Total loans	Average of Loans granted to governmental and Non-governmental sector over the period of 4 years	Million Rials
2		Net income	Average of after-tax earnings over the period of 4 years	Million Rials

The evolution of Relative efficiency, Pure technical efficiency, Scale inefficiency and reference groups for the entire sample is presented in Table 2. Our empirical analyses are as follows, one bank of the relative efficiency value are equal to 1 which represent these banks are relatively efficient with CRS assumption. Nine banks of the Pure technical efficiency value are equal to 1 which illustrates these banks are relatively efficient with CRS assumption.

Table 2. Efficiency analysis and identification of target groups' analysis

DMU	CCR Relative Efficiency CRS assumption	BCC Pure Technical Efficiency VRS assumption	Scale Inefficiency	Reference Groups	Numbers By Reference
EN Bank(B1)	0.2328	1	0.7672	B4 , B11	0
Parsian(B2)	0	1	1	B4 , B11	0
Karafarin(B3)	0.455	0.7186	0.2636	B3 , B4	0
Pasargad(B4)	0.3867	1	0.6133	B11	8
Tejarat(B5)	0.0943	0.8569	0.7626	B4 , B11	0
Sina(B6)	0.2298	1	0.7702	B4 , B11	0
Saderat(B7)	0.1413	1	0.8587	B4 , B11	0
Mellat(B8)	0.0835	1	0.9165	B4 , B11	0
Melli(B9)	0.575	1	0.425	B11	0
Post bank(B10)	0.0967	1	0.9033	B4 , B11	0
Sanat&Madan(B11)	1	1	0	-	9

DMU reference group analysis aim at examining the relative efficiency of the DMUs. Banks with good performance in relative efficiency can represent as benchmark banks and can used to be emulated by inefficient banks. As shown in Table 2, B11 has been treated as identification target for 9 times and represents as a benchmark bank. Namely, B11 is a good bank and can be emulate by other inefficient bank as target benchmark to improve their performance. Problematic banks are those that have low relative efficiency. Special attention should be addressed to these banks and action is needed to diagnose their problems and to improve their performance

This study applies Data Envelopment Analysis under the input oriented CCR, BCC model, CRS and VRS assumptions to measure the Relative efficiency, Pure technical efficiency, Scale inefficiency and analysis of reference groups for 11 Iranian banks over the period of 4 years. Empirical results shown that Sanat & Madan Bank was the most effective bank in its industry with CRS assumption. The analysis also revealed that Eghtesad novin, Parsian, Pasargad, Sina, Saderat, Mellat, Melli, Post bank and Sanat & Madan had Pure Technical Efficiency with VRS assumption. All banks except Sanat & Madan Bank had Scale inefficiency. This indicates that they did not have the optimal performance volume. A more detailed analysis of benchmark banks and problematic banks in Table 2 can be undertaken by analyzing difference in their overall efficiency. CCR Reference groups identified those benchmark banks which can be emulated by other inefficient banks. For example, B4 bank employs B11 as benchmark bank as shown in Table 2; B1 bank could employ B4 and B11 as a target banks and learn their successful experience on performance and efficient. Although benchmarking in DEA allows to be treated as targets for improving problematic bank performance, it has certain limitations. A difficulty addressed in the literature regarding this process is that an inefficient DMU and its benchmarks may not be inherently similar in their operating practices. Therefore, the problematic bank officers need to think further before they can take action to improve their performance.

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