Araştırma Makalesi ● Research Article

Measuring the Efficiency of the Azerbaijan Banking System with Data Envelopment Analysis (2015-2019)

Azerbaycan Bankacılık Sisteminin Etkinliğinin Veri Zarflama Analizi ile Ölçülmesi (2015-2019)

Fuad Selamzade[*], Alig Baghirov [**]

Öz: Azerbaycan'da bankacılık sisteminin gelişmesi için para politikası uygulamak Azerbaycan Cumhuriyet Merkez Bankası'nın görevidir. Merkez Bankası, ülke genelinde ekonominin büyümesi için banka kaynaklarının dengeli ve verimli kullanılmasından sorumludur. Bu çalışmanın amacı, 2015-2019 yılları arasında Azerbaycan'da faaliyet gösteren 25 bankanın tamamının verimliliğinin girdi yönelimli Veri Zarflama Analizinin ölçeğe gore sabit getiri, ölçeğe gore değişken getiri ve Süper Etkinlik modelleri ile ölçülmesidir. Analiz sonucuna göre verimli ve verimsiz bankalar belirlenmiş ve karşılaştırılmış ve verimsiz bankalar için potansiyel iyileştirme önerileri geliştirilmiştir. Bununla bankacılık sistemine yönelik kaynakların daha verimli kullanılabileceği düşünülmüştür. Bu çalışma sonucunda yıllar içinde bankacılık sisteminin etkinliğinin arttığı görülmüştür. Etkin olmayan bankalara, referans olarak Günay Bank, Bank VTB, AFB Bank ve Bank of Baku gibi etkin bankalardan etkinlik oranlarına göre etkinliklerini artırmaları önerilmiştir. Müşterilerden alınacak mevduat hacmini artırmak için de mevduat maliyetlerinin düşürülmesi önerilir. Azerbaycan'da faaliyet gösteren bankaların ortalama etkinlik puanı 2015 yılında 0,75, 2019 yılında 0,95 olarak gerçekleşmiştir. Bu araştırmanın, gelecekteki araştırmacılar, bankalar ve banka çalışanları ve analistler için bir kaynak kaynağı olması beklenmektedir.

Anahtar Kelimeler: VZA, CCR Modeli, BCC Modeli, Süper Etkinlik, Azerbaycan, Bank Sistemi

Abstract: It is the duty of the Central Bank of the Azerbaijan Republic to apply monetary policy for the development of the banking system in the country. The Central Bank is responsible for the balanced and efficient use of banks' resources for the growth of the economy throughout Azerbaijan. In this study, the measurement of the efficiency of all 25 banks operating in Azerbaijan between 2015 - 2019 was investigated with constant return to scale, variable return to scale and Super efficiency models of an input-oriented Data Envelopment Analysis.

[*] Asst.Prof. Dr., Muş Alparslan University, Faculty of Health Sciences, Departament of Health Management
ORCID: 0000-0002-8995-2192, f.salamov@alparslan.edu.tr (Sorumlu Yazar)
[**] Member of UNEC Reserch for Monetary Economics, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan. PhD Candidate at Istanbul University, Economics Department, Turkey
ORCID: 0000-0003-3016-165X, alig.baghirov@ogr.iu.edu.tr

According to the analysis results, efficient and inefficient banks were identified and compared, and potential improvement suggestions were developed for inefficient banks. With this, it was thought that the resources for the banking system could be used more efficiently. It has been recommended to the inefficient banks that they should increase their efficiency based on the effectiveness rates from the efficient banks such as Gunay Bank, Bank VTB, AFB Bank and Bank of Baku as reference. It is also recommended to reduce deposit costs in order to increase the volume of deposits to be received from customers. According to the findings, the efficiency of the banking system has increased over the years, and as a result, the average efficiency score of banks operating in Azerbaijan was 75 in 2015 and 95 in 2019. This research will be a source of resources for future researchers, banks, and bank employees and analysts.

Keywords: DEA, CCR model, BCC Model, Super efficiency, Azerbaijan, Banking System

Introduction

The first regulations in the economies that have passed from a centrally planned economy to a market economy are in the field of banking, and these economies are moving from a single bank system to a two-section bank structure. Azerbaijan also followed a similar path and put into effect without delay the regulations on banking and central banking, which constitute one of the most important steps towards transitioning to a free market economy. Moreover, a two-section banking system was formed with the central bank in the first section and commercial banks in the second section (Mikayilov and Mukhtarov, 2013:75-76). Before obtaining its independence on October 18, 1991, the Republic of Azerbaijan established the legal infrastructure related to the banking system and central banking with the "Law on the Principles of Economic Independence of the Republic of Azerbaijan" on May 25, 1991. In this law, the independent banking system, the circulation of the national currency, and the powers and status of the central bank were determined. Accordingly, the central bank of Azerbaijan is defined as the top emission administration that carries out the state policy on money circulation, credit and foreign exchange transactions and regulates banking activities. The structure of the newly formed Azerbaijani banking system consists of the Central Bank of the Republic of Azerbaijan, the Interbank Foreign Exchange Market, state bank (Azerbaijan International Bank), and private banks. (Aras and Suleymanov, 2006:17). In the first years of the transition to the free market economy, there was no strong control and supervision over the banks, since the banking system could not provide the necessary formation.

The number of banks benefiting from legal loopholes has increased rapidly. These established banks generally concentrated on speculative activities. While there were 210 banks in Azerbaijan in 1994, this was reduced to 44 banks in 2010 and to 25 banks in 2020 with new laws and inspections (Memmedov, 1997:12). In the new laws adopted in June-July 1996, the opportunity to modernize the banking system and develop credit organizations in the country was created. According to the new law, a minimum capital requirement is stipulated for the development of the banking system, for the establishment of new banks and for the old banks to continue their activities. All functions that banks must perform in a free-market economy are adopted to the banking legislation of the Republic of Azerbaijan. Operating commercial banks perform all functions specified in the legislation. As the State Bank of Azerbaijan, the International Bank of Azerbaijan performs the same function as other commercial banks. Since 1993, foreign exchange markets in Azerbaijan have been operating and their transactions are carried out through the Baku Interbank Foreign Exchange (Interbank), the Consolidated Interbank Foreign Exchange Market (Non-Interbank) and the Free Interbank Foreign Exchange Market. These transactions are regulated by the law of "On Regulation of Foreign Exchange Transactions" adopted on October 21, 1994. Baku Interbank Currency Exchange was established in 1994. In this exchange, banks make their purchases and sales at the exchange rate determined by the Central Bank of the Republic of Azerbaijan (Memmedov, 2011:541). In this market, the number of sales and the exchange rate are completely under the control of the Central Bank and purchases are transferred to the accounts at the Central Bank or the Azerbaijan International Bank with spot value. In this regard, foreign banks have to make their transactions in the stock exchange through International

Bank. Moreover, banks can make spot or forward foreign exchange transactions in secondary markets such as the Interbank Foreign Exchange Market and the Free Interbank Foreign Exchange Market. In these markets, the Central Bank regulates the market as a buyer or seller (Selçuk, 2004: 51-52).

It can be seen that the analysis of banks' efficiency is carried out using service delivery or production approach and entity approach (Humphrey 1985; Hjalmarsson et al. 2000). The production approach, pioneered by Benston (1965), views banks as service providers to the customers (Kumar and Gulati, 2008: 48). According to this approach, the services provided to customers are used as outputs and physical variables such as labor, materials, area or information systems are used as inputs (Kumar and Gulati, 2008: 48). In the entity approach to assets proposed by Seeley and Lindley (1977), banks' operating expenses and interest expenses are used as inputs and service income is used as an output. Berger and Humphrey (1997) have argued that neither of these two approaches is ideal, but the asset approach is best suited for analyzing performance at the bank level. The management at the bank level strives to reduce not only non-interest expenses but also overall costs at the branch level. Moreover, banks in Azerbaijan often keep many customer service operations and the bank's financing and investment decisions under control.

The subject of this study is to analyse the efficiency of banks in Azerbaijan with the data from 2015 to 2019. The subject of this study is to analyse the efficiency with available data of 25 local and foreign capitalized banks operating in Azerbaijan between 2015 -2019 years. Two models were used in this study. Charnes, Cooper and Rhodes (CCR) model with fixed return to scale and Banker, Charnes, Cooper (BCC) model with variable return to scale were selected as methods of DEA in the study. Furthermore, the Super Efficiency scores of the active banks have also been determined. In determining the efficiency, as input variables interest expenditures, personnel expenditures, general and private expenditures and deposits, and as output variables - loans, interest income and non-interest income have used and the values of these data are given in Azerbaijani Manat. In the first part an investigation of the efficiency analysis of the banking system of Azerbaijan and in the second part, information about the theoretical background of the methods used in the study were presented. In the third part, banks and input - output variables that are within the scope of the study are introduced and in the fourth part, the analysis findings are presented and interpreted. Finally, in the last section, discussion and conclusion are given.

Literature Review

There are many efficiency analysis in the literature to examine the banking sector. Most of these studies were examined for the selection of the model and variables to be applied in the research.

In the study conducted by Kumar and Gulati in 2008, the extent of technical, pure technical, and scale efficiencies of 27 public banks operating in India in 2004 and 2005 by using the data envelopment analysis (DEA) has been determined. Empirical findings have revealed that PSBs operate at 88.5 % of overall technical efficiency, that is, if all banks were efficient as the 7 reference banks determined by DEA, inputs could be decreased by 11.5% without sacrificing output.

In the study conducted by Drake, Hall, and Simper in 2009, the efficiency of the Japanese banking system was investigated with DEA. Safarli and Gumush (2012) have investigated the performance of Azerbaijan banking system and to measure the relationship between macroeconomic indicators and bank performance between 2003-2008, a period characterized by high economic growth and strict superintendence by the Central Bank of Azerbaijan Republic. The analysis of the study consists of two sections. In the first section it has measured the performance of the Azerbaijani banking system with CAMELS analysis by using capital, asset, management, earnings, liquidity, and sensitivity to market risks and in the second section, with the CAMELS performance measurement system, the performance values of the banking system have been determined. Then the relationship between the performance values of the banking system and the macroeconomic indicators of GDP and inflation have been analysed with the panel data analysis. In the empirical study, according to the CAMEL analysis result, the performance values of the banks have decreased from 2005 to 2008 and

according to the panel data analysis results, inflation and GDP has been negatively related to the performance of the banking system.

In a study conducted by Kucukaksoy and Selcan in 2013, with the balance sheet and income statement data of the years 2004 and 2011 of 10 private capital deposit banks and 5 foreign capital deposit banks operating in the Turkish banking sector, efficiency of banks by using DEA model has been analysed. As a result of the study, it was determined that 7 banks in 2004, 2005, 2008, 2010, and 2011, 6 banks in 2006, 8 banks in 2007 and 5 banks in 2009 were technically efficient under the assumption of variable returns by scale.

Yuksel, Mukhtarov, and Mammadov (2016) conducted a study using bank data between 2010-2014 to measure and compare the performance of 10 major banks operating in Turkey and Azerbaijan using DEA. As a result of the study, it has been determined that Turkish banks are more efficient than Azerbaijani banks. Therefore, except for Turkey Ekonomi bank in 2011, Turkish banks have been efficient and similarly 4 Azerbaijan banks have been efficient throughout the years and other 6 banks were followed to be inefficient for some years.

In the study of Beridze and Anbar (2019), the efficiency of 15 commercial banks operating in the banking sector in 2013-2017 was examined by using the DEA. As a result of the study, it has been determined that the efficiency levels of banks have been generally high and that 5 banks have been fully efficient in each year of the analysis period. Also, it has been observed that efficiency in the banking sector of Georgia tended to increase in 2013-2015 and declined in 2016-2017.

Dutta, Jain, and Gupta (2020) analyzed the performance of non-banking financial companies (NBFCs) in the Indian context by using DEA. In the first stage, panel data for the years 2014-2018 were taken to calculate super efficiencies and in the second stage, in order to find exogenous factors significantly affecting the model, Tobit regression analysis was used. As a result of the study where total assets and employee cost are considered as input, interest income, non-interest income and operating profit as output, according to the mentioned models, the total number of efficient decision-making units is 8 out of 43 and considering the super efficiency algorithm 15 units were found. Malmquist Indices, productivity indices of NBFCs in 5 years, have been found to have a maximum productivity increase of 8.53%.

Hammam et al. (2020) has ranked the Euclid common weight set (ECSW) with DEA and applied it to the banking sector in the euro area. In this research, data set consisting of 59 of 67 banks commercing in 17 countries in the Euro Area in 2014-2018 was obtained. As a result of the ECSW approach, it has been observed to perform better than other common weight approaches in terms of ranking consistent with banks' credit ratings in and both numerical and real life examples.

Tsionas (2020) measured the efficiency of 285 banks in the USA and similarly Li and others' (2020), study analyzed the efficiency of 32 banks operating in China between 2014 -2018. Also, Balcı and Ayvaz (2020) have measured the efficiency of 15 deposit banks operating in the Turkish banking sector between 2014-2018 with the DEA and the Malmquist approach. As a result of the study, 4 banks in terms of the assumption of constant return to scale and 8 banks in terms of assumption of the variable return to scale have been efficient in the period of 2014-2018.

In their study, Yagubov and Yagubov (2020) investigated the efficiency of ten commercial banks with the highest total number of assets in Azerbaijan in 2016, by using the DEA method in the period 2011-2016. As a result, it was determined that only Turan Bank was efficient in the period before the devaluation that took place in 2015, while the banks in the post-devaluation period were generally efficient and Pasha Bank achieved the highest efficiency.

In many of these studies, total assets, total equity, interest expenses, and the number of employees as input variables, interest income, non-interest income, and net profit as output variables were used.

Methodology

In this study, 3 models of Data Envelopment Analysis (DEA) - CCR Model, BBC Model, and Super Efficiency models were used to measure the efficiency of banks.

The CCR model used in the analysis was the first tool that provided the development of DEA approach by Charnes, Cooper, and Rhodes in 1978. In this method, the variable weight approach is used and the weights are created directly from the data obtained as a result of multiple assumptions and selected calculations with fixed weight are avoided. (Kutlar & Salamov. 2016: 5-6). In determining these weights with three constraints through linear programming.

1) All data and weights must be positive

2) The ratio of weighted outputs to weighted inputs should take a value between zero and one.

3) Weights must be used for all DMUs included in the model (Cooper et al., 2011: 13).

Mathematical representation of the model is shown below (Cooper et al., 2011: 13)

$$\frac{\text{virtual output}}{\text{virtual input}} = \frac{u_1 y_{1o} + u_2 y_{2o} + \ldots + u_s y_{so}}{v_1 x_{1o} + v_2 x_{2o} + \ldots + v_m x_{mo}} \tag{1}$$

Any DMUs that are efficient in the analysis made with the input-oriented CCR model are definitely efficient in the output-oriented analysis. This model is divided into two input and output-oriented CCR models according to the control of inputs and outputs (Yuksel, 2021:445). In this analysis, the input-oriented CCR model will be discussed. The input-oriented CCR model is a model solution aimed at minimizing the input level by determining the most appropriate input set to bring a certain output set to the most efficient rate (Torun, 2020: 47). The purpose of the CCR model is the ratio of single virtual output to virtual input for DMU by maximizing the ratio of output and input. It is to provide the efficiency measure which is a function of the factors. If j is the efficiency of the decision unit hj, the goal should be to maximize this value. In this case, the input-oriented function can be expressed in the formula below (Charnes et.al., 1978: 430).

$$\text{Max} h_j = \frac{\sum_{s=1}^{n} u_s y_s}{\sum_{i=1}^{m} v_i x_i} \tag{2}$$

The following constraint has been imposed so that the efficiency rate of DMU does not exceed 1. (Charnes et al., 1978: 430).

$$\frac{\sum_{s=1}^{n} u_s y_s}{\sum_{i=1}^{m} v_i x_i} \leq 1 \tag{3}$$

The following constraint has been introduced so that the weights of the inputs and outputs to be used are not negative (Yüksel & Yiğit, 2020:485)

$u_r \geq 0$; $v_i \geq 0$; j : DMU number, j = 1,2..,s; s : Output number, s = 1,2...n; i : Input number, i = 1,2...m

In the formula; y_s : j`th, the value of the s'th output produced by the DMU, $x_r$ : j'th the value of the r`th input produced by the DMU, u_r : weight given to r`th output, v_i : weight given to the i'th input (Yeşilyurt & Salamov, 2017:130).

If the efficiency scores are 1, the KVB included in the analysis is efficient, if it is less than 1, it indicates that it is not efficient. (Kutlar & Babacan, 2008: 150).

The assumption of return on the scale has been conducted by Banker, Charnes, and Cooper in 1984 and it was named BCC formulation. This model was developed on the basis of the CCR model based on the assumption of constant return to scale, and a model based on the assumption of variable return to scale was created (Cooper, Seiford, & Tone, 2007: 87). BCC method measures efficiency by

considering only technical efficiency. The BCC model's efficiency score limits will always be less than or equal to the CCR efficiency score limits. As in the CCR model, the BCC model also uses two methods of input-oriented and output-oriented (Banker, Charnes, & Cooper, 1984: 1079). In this study, the input-oriented BCC model will be used. In order to provide the intended output to determine the best amount of input, the Input Oriented BCC Model has been created. The function of the input-oriented BCC model is as follows (Banker, Charnes, & Cooper, 1984: 1079):

$$MaxZ = \sum_{r=1}^{s} u_r y_{r0} - \mu_0 \qquad (4)$$

According to the following conditions:

$$\sum_{i=1}^{m} v_i x_{i0} = 1; j = 1, \dots, n: \quad \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} - \mu_0 \leq 0; r = 1, \dots, p; i = 1, \dots, m;$$

$$u_r \geq \varepsilon; v_i \geq \varepsilon \; \mu_0 : \text{unrestricted}$$

Here; u_r: The weight given to the r`th output by DMU, $v_i$: The weight given to the i`th input by DMU, y_{r0}: i'th input used by DMU, y_{rj}: r`th output produced by the j`th DMU, x_{ij}: i'th input used by the j`th DMU, ε: a small enough positive number, μ_0: the return to the scale is defined as variable. The efficiency value of the efficient DMUs in the Input Oriented BCC model is equal to 1. In the case of efficiency, it is impossible to make any changes to the input and output vectors. The efficiency value of in efficient DMUs is less than 1 (Cooper, Seiford, &Tone, 2007: 89).

3.3 Super Efficiency

In DEA model analysis, "Super Efficiency" (SE) is a model that is measured in cases where DMUs get a value higher than 1. Because not every company allows it to be used as equal. With the assumption of n number of DMU, each DMUj (j = 1,2, ..., n) consumes Xj input to produce Yj output. The input-oriented super-efficiency DEA model created on the basis of the basic DEA models predicted by Seiford and Thrall in 1990 can be expressed as follows. (Seiford & Thrall, 1990, s. 9):

$$\text{Max } \rho \qquad (5)$$

Restrictions $\sum_{\substack{j=1 \\ j \neq 0}}^{n} \lambda_j x_j \leq \rho x_0; \sum_{\substack{j=1 \\ j \neq 0}}^{n} \lambda_j y_j \geq y_0; \rho, \lambda_j \geq 0, j \neq 0;$

With this linear programming, no plug-ins is needed when the super efficiency is used for the CCR model, but when BCC is used for model, $\sum_{\substack{j=1 \\ j \neq 0}}^{n} \lambda_j = 1$ is added to the model. Here x_0 and y_0 represent DMU_0. The model was created for the firm "j", which is the linear programmatic input oriented fixed scale, return DEA expressed by the above formula. In order to calculate the super efficiency scores of "j" company the data of "j" DMU is extracted from X (N x I) and Y (MxI) matrices. As a result, matrices take the form of Nx (I-1) and Mx (I-1). In this case, when linear programming is run, it cannot be part of the j-th firm's reference boundary and therefore if it is a DMU that is at full efficiency limit in the original standard DEA model, now his efficiency score is expected to be more than one. This linear programming is calculated for each firm in the sample, and each linear programming contains reference set (I-1) DMU (Coelli, Prasada, & Battese, 1998: 201).

Determination of Decision Units and Variables

In order to meet the minimum conditions of the analysis and to come to a clear result, the number of banks we take part in determining the Determination of Decision Units and Variables of all public, private, and foreign banks operating in the Republic of Azerbaijan are included in the analysis. The input and output data used in this study were collected on the basis of the banks' year-end independent audit reports. In the analysis, efficiency scores of DMUs were calculated without making any distinction between banks. In the study, input-oriented DEA was conducted for 25 banks in Azerbaijan with the data of 2015-2019. The input-oriented analysis method is to calculate how much

the inputs are minimized to produce the current outputs of DMUs. According to Ariff and Can (2008) Profit efficiency refers to a firm's maximization of profit and involves both the cost and revenue effects on the changes in output scale and scope. Profit efficiency considers how successful a bank is in achieving maximum profit based on a given level of inputs and outputs and a level of their prices. Therefore, the profit efficiency of a bank describes how it is able to reduce costs and increase revenue (Ariff & Can, 2008:206-273). Fixed-return to scale Charnes, Cooper, Rhodes (CCR) and variable return to scale Banker, Charnes, Cooper (BCC) models were used in the analysis. As a result of these models, the Super Efficiency scores of the efficient banks were obtained. The names of the banks included in the study are shown in the table below.

Table 1. Names of Banks Included in the Analysis

	Bank Names		Bank Names
1	Kapital Bank	14	Uni Bank
2	Access Bank	15	Xalq Bank
3	AFB Bank	16	Yapi Kredi Bank
4	Azer-Turk Bank	17	Yelo Bank
5	Bank BTB	18	Ziraat Bank
6	Express Bank	19	Bank of Baku
7	Bank Avrasiya	20	Bank Respublika
8	Gunay Bank	21	Bank VTB
9	Mugan Bank	22	Rabite Bank
10	Pasha Bank	23	Senaye Bank
11	Premium Bank	24	Beynelxalq Bank
12	Bank Melli Iran	25	National Bank of Pakistan
13	Turan Bank		

Due to the lack of Data on Personnel Expenditures and General and Disciplinary Expenditures, which are among the input variables of Rabite Bank for 2015 and 2016, were not included in the analyses in these years.

Table 2. Input and Output Variables

Inputs			
Interest Expenditures	Personnel Expenditures	General and Retained Expenditures	Deposits
Outputs			
Loans	Interest Income	Non-Interest Income	

As in most of the empirical literature, the input and output variables shown in Table 2 were used to analyze the efficiency of banks operating in the Azerbaijani banking system. In the study, 4 inputs (interest expenditures, personnel expenditures, general and private expenditures and deposits) and 3 outputs (loans, interest income and non-interest income) were used for efficiency analysis. All the data included in the analysis are given on the basis of Azerbaijani national currency Manat, and analyzed with the DEA-Solver program.

Research Findings

Efficiency scores and averages for 25 banks in 2015-2016, and 25 banks in other years with fixed return CCR model of input-oriented DEA to scale are shown in Table 3. The ranking is based on the annual performance average of the banks.

Table 3 shows that 3 banks: Gunay Bank, Bank VTB, and Bank Melli Iran have been efficient and except 2015 AFB Bank, Xalq Bank, and Bank Avrasiya and except 2016 National Bank of

Pakistan have been a efficient score between 2015-2019. The efficiency score of most of the banks included in the analysis has been realized above 50%. The banks with an efficiency rate of less than 50% in 2015 have been Bank Respublika (46%), Yapı Kredi Bank (45%), and Azer-Turk Bank (33%). According to Table 3, the numbers of efficient banks have increased from 7 banks to 18 banks in 2019 compared to 2015 and that is, 7 banks in 2015, 9 banks in 2016, 12 banks in 2017, 13 banks in 2018, and 16 banks in 2019 have been efficient.

Table 3. CCR Efficiency Scores (2015-2019)

Bank Names	2015	2016	2017	2018	2019	Aver.
Gunay Bank	1	1	1	1	1	**1**
Bank VTB	1	1	1	1	1	**1**
Bank Melli Iran	1	1	1	1	1	**1**
Bank Avrasiya	0.85	1	1	1	1	**0.97**
Bank of Baku	1	1	0.83	0.88	1	**0.94**
Premium Bank	0.93	0.76	1	1	1	**0.94**
AFB Bank	0.67	1	1	1	1	**0.93**
Access Bank	1	0.92	1	0.91	0.77	**0.92**
National Bank of Pakistan	1	0.59	1	1	1	**0.92**
Xalq Bank	0.57	1	1	1	1	**0.91**
Yelo Bank	0.67	1	1	1	0.86	**0.91**
Senaye Bank	1	0.57	0.81	1	1	**0.88**
Uni Bank	0.78	1	0.96	0.65	0.98	**0.87**
Mugan Bank	0.74	0.83	0.96	0.92	0.89	**0.87**
Ziraat Bank	0.80	0.84	0.80	0.89	1	**0.87**
Beynelxalq Bank	0.57	0.76	1	1	1	**0.87**
Yapi Kredi Bank	0.45	0.61	1	1	1	**0.81**
Express bank	0.77	0.89	0.81	0.71	0.88	**0.81**
Turan Bank	0.50	0.69	0.90	0.95	1	**0.81**
Kapital Bank	0.51	0.60	0.92	1	1	**0.81**
Pasha Bank	0.72	0.75	0.88	0.83	0.78	**0.79**
Rabite Bank	-	-	0.82	0.71	0.73	**0.75**
Bank BTB	0.64	0.54	0.75	0.88	0.84	**0.73**
Bank Respublika	0.46	0.51	0.74	0.63	1	**0.67**
Azer-Turk Bank	0.33	0.76	0.66	0.56	0.95	**0.65**
Average score	**0.75**	**0.82**	**0.91**	**0.90**	**0.95**	

The banks that got the closest to the full efficiency score in 2015 have been Premium Bank (0.93), Access Bank (0.92) in 2016, Uni Bank and Mugan Bank (0.96) in 2017, Turan Bank (0.95) in 2018 and Uni Bank (0,98). The banks with the lowest efficiency scores in the analysis made by the CCR method have been

- In 2015, Bank Respublika (0.46), Yapı Kredi Bank (0.45), Azer-Turk Bank (0.33);

- In 2016, Azerbaijan Beynelxalq Bank (57%), Bank BTB (54%), Bank Respublika (51%);

- In 2017, Bank BTB (75%), Bank Respublika (74%) and Azer-Turk Bank (66%);

- In 2018, Uni Bank (65%), Bank Republik (63%), Azer-Turk Bank (56%);

- In 2019, Pasha Bank (78%), AccessBank (77%), Rabitebank (73%)

Efficiency analysis shows that Azer-Turk Bank received the least efficiency score in 2015, 2017 and 2018, Bank Republika in 2016 and Rabite Bank in 2019.

The efficiency score average of 25 banks included in the analysis between 2015 and 2019 is shown in Figure1. It has been followed a linear increase in the average efficiency scores of banks

between 2015-2019 and while the efficiency score has been 75% in 2015 and has been 95% in 2019. In 2019, it was observed that the average efficiency increased by about 27% compared to 2015. Thus, the banks operating in Azerbaijan improve day by day and this means that more efficient operations have been realized.
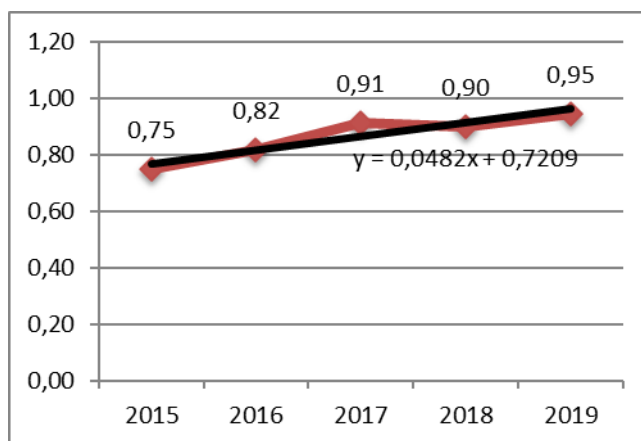
Figure 1: Average Efficiency of the CCR Model of Banks by Years (%)

For 24 banks in 2015-2016 and 25 banks in other years with variable return BCC model of input-oriented DEA to scale, the efficiency score and averages are shown in Table 4. The ranking is made according to the annual performance average of the banks. According to the result of the analysis made with the variable return to scale BCC model, 12 banks: National Bank of Pakistan, Beynelxalq Bank, Bank VTB, Xalq Bank, Bank Melli Iran, Premium Bank, Pasha Bank, Gunay Bank, Bank Avrasiya, AFB Bank, Access Bank, and Uni Bank have been efficient between 2015-2019. The efficiency score of eight banks: Express Bank, Yelo Bank, Kapital Bank, Mugan Bank, Bank of Baku, Ziraat Bank, Senaye Bank, and Turan Bank have changed between 90% and 99%, the efficiency score of Yapı Kredi Bank Azerbaijan has been 87% and the efficiency score of other 6 banks have realized between 72% -78%. Express Bank except 2018 and Kapital Bank except 2015 have been efficient in other years. Yelo Bank, Mugan Bank, Bank of Baku, Senaye Bank, and Yapi Kredi Bank have been efficient in 3 different years.

According to Table 4 in 2019, compared to 2015, the number of efficient banks increased from 16 to 20. The efficiency score of all banks included in the analysis has realized above 50%. 16 banks in 2015 and 2016, 17 banks in 2017, 18 banks in 2018 and 20 banks in 2019 have been efficient. Yelo Bank (97%) in 2015, Mugan Bank (89%) in 2016, Turan Bank (93%) in 2017, Express Bank (93%) in 2018, and Azer-Turk Bank (95%) in 2019 have received the closest full efficiency score. The 4 banks having the lowest average score have been Rabita Bank (78%), Bank BTB (77%), Bank Respublika (75%), and Azer-Turk Bank (72%). The banks having the lowest efficiency scores by years in the analysis made with the BCC method have been:

- in 2015, Bank Respublika (%65), Yapi Kredi Bank (%63), Azer-Turk Bank (%57);

- in 2016, Senaye Bank (%65), Bank Respublika (%59), Bank BTB (%57);

- in 2017, Bank BTB (%75), Bank Respublika (%74), Azer-Turk Bank (%66);

- in 2018, Bank Respublika (%77), Rabite Bank (%72), Azer-Turk Bank (%57);

- in 2019, Yelo Bank (%92), Bank BTB (%91), Rabite Bank (%76).

The efficacy analysis shows that Azer-Turk Bank in 2015, 2017 and 2018, the Bank BTB in 2016, and Rabite Bank in 2019 have received the lowest efficiency score. As a result of the analysis made with CCR and BCC methods in Table 4, the characteristics of banks' return to scale are also

presented. The number of banks with constant returns on scale and without scale inefficiency have been 6 banks in 2015, 10 banks in 2016, 12 banks in 2017, 14 banks in 2018 (Bank of Baku), and 16 banks in 2019.

Table 4. BCC Efficiency Score (2015-2019)

Banks Names	2015		2016		2017		2018		2019		Ave.
	Score	Scale	Score	Scale	Score	Scale	Score	Scale	Score	Scale	
Access Bank	1	C	1	D	1	C	1	D	1	D	1
AFB Bank	1	D	1	C	1	C	1	C	1	C	1
Beynelxalq Bank	1	D	1	D	1	C	1	C	1	C	1
Bank Melli Iran	1	C	1	C	1	C	1	C	1	C	1
Bank Avrasiya	1	D	1	C	1	C	1	C	1	C	1
Bank VTB	1	C	1	C	1	C	1	C	1	C	1
Gunay Bank	1	C	1	C	1	C	1	C	1	C	1
National Bank of Pakistan	1	I	1	I	1	C	1	C	1	C	1
Pasha Bank	1	D	1	D	1	D	1	D	1	D	1
Premium Bank	1	D	1	D	1	C	1	C	1	C	1
Uni Bank	1	D	1	C	1	D	1	D	1	D	1
Xalq Bank	1	D	1	C	1	C	1	C	1	C	1
Express Bank	1	D	1	D	1	D	0,93	D	1	D	0,99
Yelo Bank	0,97	D	1	C	1	C	1	C	0,92	D	0,98
Kapital Bank	0,76	D	1	D	1	D	1	C	1	C	0,95
Mugan Bank	0,85	D	0,89	D	1	D	1	D	1	D	0,95
Bank of Baku	1	C	1	C	0,83	D	0,90	C	1	C	0,95
Ziraat Bank	1	D	0,87	D	0,81	I	0,92	I	1	C	0,92
Senaye Bank	1	C	0,65	C	0,86	I	1	C	1	C	0,90
Turan Bank	0,72	D	0,85	D	0,93	D	1	D	1	C	0,90
Yapı Kredi Bank	0,63	D	0,74	D	1	C	1	C	1	C	0,87
Rabite bank	-	-	-	-	0,86	I	0,72	I	0,76	D	0,78
Bank BTB	0,72	D	0,57	D	0,75	I	0,89	D	0,91	D	0,77
Bank Respublika	0,65	D	0,59	D	0,74	I	0,77	D	1	C	0,75
Azer-Turk Bank	0,57	D	0,85	D	0,66	I	0,57	D	0,95	I	0,72
Efficiency Average	0,91		0,92		0,94		0,95		0,98		

"C" - Constant Return to Scale, "I" - Increasing Return to Scale, "D" - Increasing Return to Scale

Most of the banks with constant returns on scale are efficient in the analysis made with both CCR and BCC methods and it can be said that there is no need to change the variables. In the analysis performed by the Senaye Bank in 2016 and the Bank of Baku in 2018 with the CCR and BCC methods, it was determined that although they were not efficient, their scales did not change. The number of banks with increasing returns on scale was 1 in 2015, 2016 and 2019, 6 in 2017, and 2 in 2018. The banks with increasing returns on scale show that they produce less output while they should produce more output with current inputs. It could be claimed that this situation is due to the economic structure of the country, political decisions, and the unknown situation of war, geographical situation, and external factors. In the analysis made with the CCR method, it is seen that most of the inefficient banks in all years have the feature of decreasing returns to scale. In order to make it efficient, the banks should reduce the capacity and use efficient resources, in other words, it can be said that the banks could be efficient when they produce available outputs with lesser inputs.

The efficiency score average of 25 banks included in the analysis between 2015 and 2019 is shown in Figure 2. According to Figure 2, in 2015-2019, a linear increase in the average efficiency scores of banks has been followed, while the average score has been 91% in 2015 and 98% in 2019. In 2019, it was observed that the average efficiency increased by approximately 8% compared to 2015. These results show that the banks operating in Azerbaijan are improving and working more efficiently day by day.
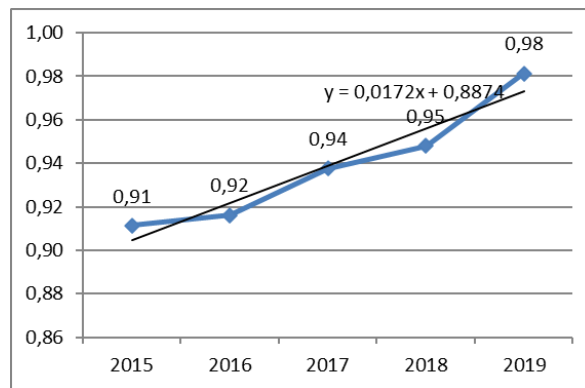
Figure 2: Average Efficiency of the BCC Model of Banks by Years (%)

The results of the super efficiency analysis of the banks are effective in the analysis made by CCR method which is shown in Table 6 below.

Table 5. Super Efficiency Analysis Predictions (CCR)

No	2015		2016		2017		2018		2019	
	Bank Names	Score	Bank Names	Score	Bank Names	Score	Bank Names	Score	Bank Names	Score
1	Senaye Bank	227.89	Bank Melli Iran	11.70	National Bank of Pakistan	17.64	National Bank of Pakistan	21.01	National Bank of Pakistan	96.25
2	Bank Melli Iran	11.82	Uni Bank	4.63	Beynelxalq Bank	3.59	Bank VTB	2.31	Premium Bank	2.64
3	Gunay Bank	4.68	Gunay Bank	3.70	Bank VTB	3.30	Premium Bank	2.05	Xalq Bank	2.13
4	National Bank of Pakistan	1.53	Bank VTB	2.03	Premium Bank	2.09	Gunay Bank	1.96	Bank VTB	2.05
5	Bank VTB	1.13	AFB Bank	1.40	AFB Bank	1.87	Xalq Bank	1.95	Senaye Bank	1.78
6	Access Bank	1.08	Bank of Baku	1.40	Bank Melli Iran	1.76	Bank Melli Iran	1.58	Bank Melli Iran	1.73
7	Bank of Baku	1.02	Yelo Bank	1.37	Xalq Bank	1.76	Senaye Bank	1.54	AFB Bank	1.34
8			Bank Avrasiya	1.07	Gunay Bank	1.70	AFB Bank	1.50	Bank Avrasiya	1.31
9			Xalq Bank	1.01	Bank Avrasiya	1.36	Yelo Bank	1.27	Beynelxalq Bank	1.27
10					Yelo Bank	1.19	BEynelxaq Bank	1.26	Gunay Bank	1.21
11					Yapi Kredi Bank	1.12	Bank Avrasiya	1.18	Bank of Baku	1.13

No	2017	Score	2018	Score	2019	Score
12	Access Bank	1.04	Kapital Bank	1.16	Kapital Bank	1.12
13			Yapi Kredi Bank	1.05	Yapi Kredi Bank	1.11
14					Bank Respublika	1.06
15					Ziraat Bank	1.03
16					Turan Bank	1.03

Banks with the highest Super efficiency scores obtained by CCR method has been Industry Bank in 2015 (227.89), Bank Melli Iran in 2016 (11.70), and National Bank of Pakistan in 2017-2019 (17.64, 21.01, 96.25). Banks with the least super efficiency score by years have respectively been Bank of Baku (1.02), Xalq Bank (1.01), Access Bank (1.04), Yapi Kredi Bank (1.05), Ziraat Bank (1.03), and Turan Bank (1.03).

The results of the super efficiency analysis of the banks are effective in the analysis made by BCC method, which is shown in Table 6 below.

Table 6. Super Efficiency Analysis Predictions (CCR)

No	2015		2016		2017		2018		2019	
	Bank Names	Score	Bank Names	Score	Bank Names	Score	Bank Names	Score	Bank Names	Score
1	Bank Melli Iran	16.29	Bank Melli Iran	33.76	National Bank of Pakistan	27.00	National Bank of Pakistan	56.00	National Bank of Pakistan	100.99
2	National Bank of Pakistan	7.46	Uni Bank	15.16	Bank Melli Iran	7.22	Premium Bank	3.11	Premium Bank	5.18
3	Gunay Bank	5.81	Gunay Bank	4.30	Bank VTB	3.34	Bank VTB	2.74	Bank VTB	2.56
4	Access Bank	2.50	National Bank of Pakistan	3.54	Xalq Bank	2.71	Xalq Bank	2.02	Xalq Bank	2.52
5	Xalq Bank	1.71	Bank VTB	2.64	Pasha Bank	2.56	Gunay Bank	1.97	Bank Melli Iran	2.00
6	Bank VTB	1.62	Bank of Baku	2.44	Premium Bank	2.09	Yelo Bank	1.93	Seneye Bank	1.80
7	Premium Bank	1.61	Xalq Bank	2.25	AFB Bank	1.95	Bank Melli Iran	1.89	Bank Respublika	1.77
8	Pasha Bank	1.53	AFB Bank	2.20	Yelo Bank	1.77	AFB Bank	1.74	Kapital Bank	1.60
9	Bank of Baku	1.42	Access Bank	1.86	Gunay Bank	1.71	Senaye Bank	1.58	Gunay Bank	1.42
10	Express Bank	1.29	Yelo Bank	1.62	AccessBank	1.56	Access Bank	1.41	Express Bank	1.42
11	AFB Bank	1.11	Premium Bank	1.50	Bank Avrasiya	1.37	Pasha Bank	1.40	Uni Bank	1.38
12	Ziraat Bank	1.07	Pasha Bank	1.45	Yapi Kredi Bank	1.35	Bank Avrasiya	1.25	AFB Bank	1.35
13	Bank Avrasiya	1.06	Express Bank	1.16	Uni Bank	1.19	Mugan Bank	1.23	Bank Avrasiya	1.32
14	Senaye Bank	1	Kapital Bank	1.13	Kapital Bank	1.16	Yapi Kredi Bank	1.15	Access Bank	1.30
15	Beynelxaq Bank	1	Bank Avrasiya	1.12	Express Bank	1.12	Uni Bank	1.11	Yapi Kredi Bank	1.29

16	Beynelxalq Bank	1	Mugan Bank	1.05	Turan Bank	1.01	Mugan Bank	1.24
17			Beynelxalq Bank	1	Kapital Bank	1	Bank of Baku	1.15
18					Beynelxalq Bank	1	Turan Bank	1.14
19							Ziraat Bank	1.07
20							Paşha Bank	1
21							Beynelxalq Bank	1

In Table 6 according to a result of the Super Efficiency analysis made with the variable return to scale BCC method, Bank Melli Iran (16.29 and 33.76) in 2015 and 2016, and the National Bank of Pakistan (27.00, 56.00 and 100.99) in 2017-2019 have been got the highest score. Super Efficiency of the Beynelxalq Bank in all years, Senaye Bank in 2015, Kapital Bank in 2018, and Pasha Bank in 2019 have got the least score (1.00). Furthermore, 5 banks in 2015 and 2018, 9 banks in 2016, 7 banks in 2017, 6 banks in 2019 have got a score of 2 or more.

The banks which have been the reference banks and have not been efficient in the analysis of input-oriented constant returns scale performed for the years 2015-2019 of banks operating in Azerbaijan is presented in Table 7.

Table 7. Reference Numbers of Efficient Banks (CCR)

Bank Names	2015	2016	2017	2018	2019
Access Bank	3	-	0	0	-
AFB Bank	-	6	4	3	0
Senaye Bank	1	-	-	-	1
Beynelxalq Bank	-	-	5	-	1
Bank Melli Iran	16	12	8	2	3
Bank of Baku	5	7	-	-	6
Bank Respublika	-	-	-	-	0
Bank Avrasiya	-	5	9	5	6
Bana VTB	6	5	4	5	1
Gunay Bank	17	12	11	11	3
Kapital Bank	-	-	-	3	3
National Bank of Pakistan	0	-	3	3	6
Premium Bank	-	-	2	2	0
Turan Bank	-	-	-	-	0
Uni Bank	-	4	-	-	-
Xalq Bank	-	2	4	5	4
Yapı Kredi Bank	-	-	-	-	1
Yelo Bank	-	2	2	5	-
Ziraat Bank	-	-	-	-	0

"-" banks that are not efficient in the current year

Tablo 7 illustrates that Bank Melli Iran, Bank VTB, and Gunay Bank during the period have been full efficient and have been shown reference for inefficient banks. Although, National Bank of Pakistan in 2015, Access Bank in 2017, and 2018, AFB Bank, Bank Respublika Premium Bank, Turan Bank, and Ziraat Bank in 2019 have been efficient but have not been referenced.

Banks referenced to inefficient banks as a result of the analysis made with BCC method are presented in Table 8.

According to Tablo 8, Bank Avrasiya, Bank VTB, Gunay Bank, and Xalq Bank have been efficient during the years and have been shown reference to inefficient banks. Although, Access Bank, Bank Melli Iran, and Senaye Bank in 2018 and 2019, AFB Bank and Ziraat Bank in 2015 and 2019, Bank Respublika in 2019, Express Bank and Mugan bank in 2017 and 2019, Kapital Bank in 2016 and 2017, Pasha Bank in 2016-2019, Premium Bank, Turan Bank and Yapı Kredi Bank in 2018, Beynelxalq Bank in 2016, 2018 and 2019, Uni Bank in 2017 have been efficient but have not been referenced.

Table 8. Reference Numbers of Efficient Banks (BCC)

Bank Names	2015	2016	2017	2018	2019
Access Bank	2	1	1	0	0
AFB Bank	0	5	3	2	0
Bank Melli Iran	2	5	2	0	0
Bank of Baku	7	6	-	-	4
Bank Respublika	-	-	-	-	0
Bank Avrasiya	1	1	6	3	3
Bank VTB	3	3	2	3	2
Expressbank	4	3	0	-	0
Gunay Bank	5	3	7	7	2
Xalq Bank	4	7	3	3	2
Kapital Bank	-	0	0	2	2
Mugan Bank	-	-	0	1	0
National Bank of Pakistan	0	0	1	3	1
Pasha Bank	3	0	0	0	0
Premium Bank	5	0	5	3	2
Senaye Bank	5	-	-	0	0
Turan Bank	-	-	-	0	1
Beynelxalq	4	0	3	0	0
Uni Bank	-	0	1	1	3
Yapı Kredi Bank	-	-	2	0	1
Yelo Bank	-	2	2	5	-
Ziraat Bank	0	-	-	-	0

"-" banks that are not efficient in the current year

As a result of input-oriented analysis made with both CCR and BCC methods, it has been observed that inefficient banks should use available output and input variables of reference banks. Inefficient banks should use every variable efficiently in order to be efficient, and it could be said that the variables should be reduced at approximately the same rate.

Conclusion

The importance of the banking system in a globalizing world is increasing day by day. In this study, comparison of selected decision-making units have been examined with measurement of CCR, BCC and Super efficiency model of input-oriented DEA for the period between 2015-2019. In the input-oriented DEA model, what level of inputs has been aimed to minimize in order to produce maximum outputs. The entity approach proposed by Seeley and Lindley (1977) was used in the study. The main reason for using this approach is to measure the effectiveness of banks operating in Azerbaijan in using their assets.

Inputs and outputs providing the minimum conditions for analysis in the selection of decision-making units have been investigated and all 25 banks operating in Azerbaijan were selected as decision-making units. In order to analyze efficiency of banks, 24 banks in 2015-2016, 25 banks in 2017-2019 have been included in the study. The restriction of the study is due to the fact that the data of Rabita Bank for the years 2015-2016 cannot be obtained from the Statistical Institute of the

Republic of Azerbaijan and the annual reports of the bank. In the study, 4 variables as input - interest expenditures, personnel expenditures, general and private expenditures, and deposits; 3 variables as output - loans, interest income, and non-interest income have been used as a thousand Manat. In order to determine in which year is more efficient at analysis made with CCR and BCC models, Super efficiency, analysis has been made and Improvement suggestions have been developed for the inefficient years.

In input oriented CCR model, 7 banks in 2015, 9 in 2016, 12 in 2017, 13 in 2018, and 16 in 2019 have been efficient. The efficiency score averages of banks in 2015-2019 have changed between 0.65-1. Gunay Bank, Bank VTB, and Bank Melli Iran have been efficient in all years. The average efficiency score has increased linearly from 0.75 in 2015 to 0.95 in 2019. As a result of the analysis, Gunay Bank, Bank VTB, and Bank Melli Iran have been chosen as the reference for inefficient banks.

On BCC model 16 banks in 2015-2016, 17 in 2017, 18 in 2018, and 20 in 2019 have been efficient. The average efficiency scores of the banks included in the analysis during these years have changed between 0.72-1. 12 banks: Access Bank, AFB Bank, Beynelxalq Bank, Bank Melli Iran, Bank Avrasiya, Bank VTB, Gunay Bank, National Bank of Pakistan, Pasha Bank, Premium Bank, Uni Bank, and Xalq Bank have been efficient in all years. The average efficiency score of banks has increased linearly over the years. The average efficiency score of banks increased from 0.91 to 0.98 in 2019 compared to 2015. The fact that the average efficiency score of the banks are over 90% indicates that most of the banks are technically efficient.

In a result of the analysis, Senaye Bank in 2015, Bank Melli Iran in 2016, and the National Bank of Pakistan in 2017-2019 received the highest Super efficiency score (CCR and BCC). Banks with the least Super Efficiency score by years have been Bank of Baku, Xalq Bank, Access Bank, Yapi Kredi Bank, and Turan Bank.

According to the results acquired from the multivariate regression analysis, it was observed that banks with better capitalization and higher credit concentration tend to exhibit higher productivity levels. In the period under review, the results show that foreign banks exhibited higher levels of efficiency than their domestic counterparts.

In the study investigated by Kumar and Gulati (2008) for 27 banks in India, 7 banks were found to be technically efficient, which shows that approximately 25.9% of the banks are efficient. In the studies by Kucukaksoy and Selcan (2013), by Yuksel, Mukhtarov, and Mammadov (2016), by Balcı and Ayvaz (2020) in Turkey, by Beridze and Anbar (2019) in Georgia, by Dutta, Jain, and Gupta (2020) in India, by Tsionas (2020) in the US and by Li and others (2020) in China, it is seen that similar results were obtained. In other studies, using CAMELS by Safarli and Gumush (2012) and DEA method by Yagubov and Yagubov (2020) it was found that the performance and profitability of banks in Azerbaijan increased in 2003-2008 and 2011-2016. In our study conducted for the years 2015-2019, the same result is reached with the increase in the number of efficient banks over the years.

As a result of the study, it has been seen that banks in Azerbaijan have increased their efficiency and performance over the years. It has been recommended to the inefficient banks that they should increase their efficiency based on the effectiveness rates from the efficient banks such as Gunay Bank, Bank VTB, AFB Bank and Bank of Baku as reference. It is also recommended to reduce deposit costs in order to increase the volume of deposits to be received from customers. Since the data obtained from this study are relative, it is hoped that it will be useful in future studies for researchers, banks, bank employees, and analysis.

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2. No potential conflict of interest was reported by the authors.

Extended Abstract

The first regulations in the economies that have passed from a centrally planned economy to a market economy are in the field of banking, and these economies are moving from a single bank system to a two-section bank structure. Azerbaijan also followed a similar path and put into effect without delay the regulations on banking and central banking, which constitute one of the most important steps towards transitioning to a free market economy. Moreover, a two-section banking system was formed with the central bank in the first section and commercial banks in the second section (Mikayilov and Mukhtarov, 2013:75-76). Before obtaining its independence on October 18, 1991, the Republic of Azerbaijan established the legal infrastructure related to the banking system and central banking with the "Law on the Principles of Economic Independence of the Republic of Azerbaijan" on May 25, 1991. In this law, the independent banking system, the circulation of the national currency, and the powers and status of the central bank were determined. Accordingly, the central bank of Azerbaijan is defined as the top emission administration that carries out the state policy on money circulation, credit and foreign exchange transactions and regulates banking activities. The structure of the newly formed Azerbaijani banking system consists of the Central Bank of the Republic of Azerbaijan, the Interbank Foreign Exchange Market, state bank (Azerbaijan International Bank), and private banks. (Aras and Suleymanov, 2006:17). In the first years of the transition to the free market economy, there was no strong control and supervision over the banks, since the banking system could not provide the necessary formation.

The importance of the banking system in a globalizing world is increasing day by day. In this study, comparison of selected decision-making units have been examined with measurement of CCR, BCC and Super efficiency model of input-oriented DEA for the period between 2015-2019. In the input-oriented DEA model, what level of inputs has been aimed to minimize in order to produce maximum outputs. The entity approach proposed by Seeley and Lindley (1977) was used in the study. The main reason for using this approach is to measure the effectiveness of banks operating in Azerbaijan in using their assets.

In this study, 3 models of Data Envelopment Analysis (DEA) - CCR Model, BBC Model, and Super Efficiency models were used to measure the efficiency of banks.

The CCR model used in the analysis was the first tool that provided the development of DEA approach by Charnes, Cooper, and Rhodes in 1978. In this method, the variable weight approach is used and the weights are created directly from the data obtained as a result of multiple assumptions and selected calculations with fixed weight are avoided. (Charnes, Cooper, Rhodes, 1978:432). In determining these weights with three constraints through linear programming.

1) All data and weights must be positive

2) The ratio of weighted outputs to weighted inputs should take a value between zero and one.

3) Weights must be used for all DMUs included in the model (Cooper et al., 2011: 13).

Inputs and outputs providing the minimum conditions for analysis in the selection of decision-making units have been investigated and all 25 banks operating in Azerbaijan were selected as decision-making units. In order to analyze efficiency of banks, 24 banks in 2015-2016, 25 banks in 2017-2019 have been included in the study. The restriction of the study is due to the fact that the data of Rabita Bank for the years 2015-2016 cannot be obtained from the Statistical Institute of the Republic of Azerbaijan and the annual reports of the bank. In the study, 4 variables as input - interest expenditures, personnel expenditures, general and private expenditures, and deposits; 3 variables as output - loans, interest income, and non-interest income have been used as a thousand Manat. In order to determine in which year is more efficient at analysis made with CCR and BCC models, Super efficiency, analysis has been made and Improvement suggestions have been developed for the inefficient years.

In input oriented CCR model, 7 banks in 2015, 9 in 2016, 12 in 2017, 13 in 2018, and 16 in 2019 have been efficient. The efficiency score averages of banks in 2015-2019 have changed between 0.65-1. Gunay Bank, Bank VTB, and Bank Melli Iran have been efficient in all years. The average efficiency score has increased linearly from 0.75 in 2015 to 0.95 in 2019. As a result of the analysis, Gunay Bank, Bank VTB, and Bank Melli Iran have been chosen as the reference for inefficient banks.

On BCC model 16 banks in 2015-2016, 17 in 2017, 18 in 2018, and 20 in 2019 have been efficient. The average efficiency scores of the banks included in the analysis during these years have changed between 0.72-1. 12 banks: Access Bank, AFB Bank, Beynelxalq Bank, Bank Melli Iran, Bank Avrasiya, Bank VTB, Gunay Bank, National Bank of Pakistan, Pasha Bank, Premium Bank, Uni Bank, and Xalq Bank have been efficient in all years. The average efficiency score of banks has increased linearly over the years. The average efficiency

score of banks increased from 0.91 to 0.98 in 2019 compared to 2015. The fact that the average efficiency score of the banks are over 90% indicates that most of the banks are technically efficient.

In a result of the analysis, Senaye Bank in 2015, Bank Melli Iran in 2016, and the National Bank of Pakistan in 2017-2019 received the highest Super efficiency score (CCR and BCC). Banks with the least Super Efficiency score by years have been Bank of Baku, Xalq Bank, Access Bank, Yapi Kredi Bank, and Turan Bank.

According to the results acquired from the multivariate regression analysis, it was observed that banks with better capitalization and higher credit concentration tend to exhibit higher productivity levels. In the period under review, the results show that foreign banks exhibited higher levels of efficiency than their domestic counterparts.

As a result of the study, it has been seen that banks in Azerbaijan have increased their efficiency and performance over the years. It has been recommended to the inefficient banks that they should increase their efficiency based on the effectiveness rates from the efficient banks such as Gunay Bank, Bank VTB, AFB Bank and Bank of Baku as reference. It is also recommended to reduce deposit costs in order to increase the volume of deposits to be received from customers. Since the data obtained from this study are relative, it is hoped that it will be useful in future studies for researchers, banks, bank employees, and analysis.