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Research Article

Measuring the Efficiency of the Banking System of the Republic of Azerbaijan during the Devaluation Period

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ABSTRACT

Between 2011 and 2016, global oil prices experienced a significant decline, leading to two major currency devaluations in Azerbaijan in 2015, which in turn had a profound impact on the country's economy. This study aims to evaluate the efficiency of the ten largest Azerbaijani banks by assets in 2016, specifically in the aftermath of these devaluations. To achieve this, we employ the Data Envelopment Analysis (DEA) method using the CCR model, which operates under the assumption of constant returns to scale. The choice between an input- or output-oriented approach is contingent upon the data structure of the Decision-Making Units (DMUs). Since the CCR model assesses total efficiency, the efficiency scores of all DMUs fall within the range of 0.0 to 1.0, with the upper efficiency limit in DEA established at 1.0. The analysis incorporates three input variables—Total Assets, Total Capital, and Interest Expense—alongside two output variables—Interest Income and Net Profit—extracted from the annual financial statements of each bank.

The findings reveal that, in the period preceding the devaluation, the banks with the lowest efficiency scores were Bank of Baku, Unibank, and Bank Republic, whereas the highest efficiency indicators were observed exclusively in Pasha Bank and Turan Bank. However, when examining the period during and after the devaluation, two of the four most efficient banks remained Pasha Bank and Turan Bank. Notably, it is unsurprising that Bank Republic and Bank of Baku, which had demonstrated the lowest efficiency levels prior to the devaluation, emerged among the most efficient banks in the post-devaluation period.

Keywords: Data Envelopment Analysis, Efficiency, Banks.

JEL Classification Codes: G14, G20, G21.

INTRODUCTION

The banking sector, a key pillar of a country's economy, is expanding rapidly in international trade, with increasing prospects for technological advancements in a globalized world. As a result, any challenges within the banking system can negatively affect the broader economy. The performance of this sector significantly influences all economic entities within a country, making it essential to assess and check the sector's efficiency.

To evaluate banks' efficiency, methods like ratio analysis and regression analysis are commonly used. However, these methods have limitations, particularly when it comes to benchmarking and finding the most efficient banks, which has led policymakers and decision-makers to explore alternative approaches. This shift has prompted the adoption of the Data Envelopment Analysis (DEA) technique for measuring interbank efficiency and productivity. DEA is a mathematical programming method that assesses relative efficiency by comparing inputs and outputs among banks in the same sector, and it is widely applied across various industries. By proving the highest-performing decision-making units as benchmarks, DEA can find areas where banks can reduce inputs or increase outputs, providing insights for potential improvements. This helps bank managers make informed decisions to enhance efficiency and productivity. Between 2011 and 2016, global oil prices declined, and Azerbaijan experienced two significant currency devaluations in 2015, which affected its economy. The primary goal of this study is to assess the efficiency of the top 10 Azerbaijani banks by assets in 2016, in the wake of these devaluations. This research contributes to the literature by analyzing the efficiency of Azerbaijani banks during the devaluation period and offers a basis for comparing bank performance before and after these economic events.

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LITERATURE REVIEW

Data Envelopment Analysis (DEA) was first introduced in the literature in 1957 through Farrell's study, which focused on a single input and output model. Building on this, Charnes, Cooper, and Rhodes developed the multiple input and multiple output CCR model in 1978, applying it to measure the efficiency of public schools in the United States. Another advancement in DEA came with the development of the BCC (Banker, Charnes, Cooper) model by Banker, Charnes, and Cooper in 1984, which incorporated scaled variables.

DEA has been widely used across various fields for measuring financial efficiency. Several key studies in the literature are worth highlighting:

First, Vassiloglou and Giokas (1990) conducted a DEA study on commercial banks in Greece to measure relative efficiency in the banking sector. Using 1987 data for 20 decision-making units, they found that 9 of the 20 commercial banks were efficient. Similarly, Tarim and Cingi (2000) provided significant contributions to the study of the Turkish banking sector. Their research examined the relative efficiency of 21 public and private banks, which accounted for 93.8% of deposits between 1989 and 1996, using DEA and the Malmquist Productivity Index within the Total Factor Productivity approach. They considered outputs like total profit, total loans, and total deposits, while inputs included total profit, total loans, total deposits, and loan return rates. Their findings wrote down that private sector banks were more efficient than public banks, largely due to scale efficiency.

In another study, Bozdağ, Altan, and Atan (2001) applied DEA to measure the efficiency of 21 public and private banks in Turkey, using 2000 data and six input ratios. They concluded that eight private banks were efficient. Gascon, Fidalgo, and Alvarez (2002), analyzing data from 142 financial institutions in 18 countries between 1989 and 1998, found that global commercial bank productivity increased by 19.6% during this period. Similarly, Casu and Molyneux (2003) examined the European banking sector and seen that banking efficiency saw minimal improvement following Europe's Single Market Program.

Luo (2003) used DEA to assess the efficiency and profitability of large U.S. banks. His study of 245 banks revealed that larger banks had lower marketing efficiency compared to smaller ones. Additionally, 34 banks (1.4%) were highly profitable but showed lower marketing effectiveness, with no significant geographical impact on profitability or marketing efficiency.

Sufian (2007) investigated the productivity of Malaysian Islamic banks from 2001 to 2005 using the nonparametric DEA method. His findings wrote down that scale efficiency was more significant than pure technical efficiency, with domestic Islamic banks performing better in terms of technical efficiency than foreign Islamic banks. The inefficiency of foreign banks was mainly attributed to poor technical efficiency.

Öner (2008) studied the efficiency of domestic and foreign banks in Turkey's financial sector during the January-June 2007 period, employing DEA to identify efficient banks and develop strategies for inefficient ones. Conversely, Ertuğrul and Tuş Işık (2008) analyzed the efficiency of 13 firms in the metal industry listed on the Istanbul Stock Exchange between 2003 and 2007, using a CCR model with two inputs and two outputs. They found that the number of efficient firms varied each year.

Similarly, Behdioğlu and Özcan (2009) used DEA to assess the efficiency of 29 Turkish commercial banks. Their analysis, conducted using the DEA Solver program, found that foreign banks were the most efficient. Staub, Souza, and Tabak (2010) investigated the cost, technical, and resource efficiency of Brazilian banks from 2000 to 2007, revealing that Brazilian banks had lower cost efficiency than their European and American counterparts, particularly during the 2000-2002 economic downturn. The inefficiency of Brazilian banks was largely due to technical inadequacies and resource shortages, with state-owned banks being more costly than domestic private and foreign banks.

Küçükaksoy and Selcan (2013) evaluated the performance of 10 private and 5 foreign banks in Turkey from 2004 to 2011 using the DEA method. Their findings shown that a varying number of decision-making units (DMUs) were technically inefficient across the years. On average, technical efficiency ranged between 90% and 98% during this period.

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Recently, Ada and Dalkiliç (2014) compared scale efficiency, efficiency changes, and total factor productivity in 22 Islamic banks in Turkey and Malaysia between 2009 and 2011. They found that Turkish banks showed higher scale efficiency than Malaysian banks in 2009, though they lagged in 2010 and 2011. Additionally, the total factor productivity of Turkish banks declined from 2009 to 2010, while most Malaysian banks experienced improvements.

Yüksel, Mukhtarov, and Mammadov (2016) conducted a comparative study on the efficiency of Turkish and Azerbaijani banks. Using DEA to analyze the 10 largest banks in both countries from 2010 to 2014, they found that Turkish banks were generally more efficient than Azerbaijani banks. Only Turkish Economy Bank was inefficient in 2011, while other Turkish banks were efficient throughout the study period. In contrast, only four Azerbaijani banks were efficient across all years, while the remaining six were inefficient in several years.

METHODOLOGY

The Data Envelopment Analysis (DEA) technique is a nonparametric method based on linear programming that enables the comparison of the relative efficiency of activities across organizations. It is an analytical approach that assesses relative efficiency by comparing institutions or organizations—referred to as Decision Making Units (DMUs)—that produce similar outputs using similar inputs.

A related definition describes DEA as a linear programming-based technique designed to measure the relative performance of decision units, especially in cases where multiple inputs and outputs, measured in different scales or units, make direct comparison difficult. From these definitions, DEA can be understood as a method grounded in linear programming used to evaluate the relative efficiency of decision units responsible for generating outputs from similar inputs. What sets DEA apart from other methods is its ability to manage situations involving numerous inputs and outputs. The analysis provides insights into the efficiency of each decision unit, offers guidance on how inefficient units can improve their input-output ratios, and names decision units that can serve as benchmarks for others.

DEA, which measures the relative efficiency of decision-making units, allows for comparative efficiency analysis when multiple inputs and outputs are involved. One key advantage of DEA is its ability to define an efficiency frontier based on the performance of decision-making units, thereby easing comparative analysis.

The CCR model, developed by Charnes, Cooper, and Rhodes (named after their initials), calculates the efficiency frontier under the assumption of constant returns to scale (CRS). The CCR model evaluates total efficiency, with the efficiency scores of all DMUs ranging between 0.0 and 1.0, as the upper efficiency limit in DEA is set at 1.0.

In this study, we apply the DEA method using the CCR model, which assumes constant returns to scale. The decision to use an input- or output-oriented approach depends on the structure of the data for the DMUs. Since input usage is often the primary focus in decision-making processes, many DEA studies in the banking sector adopt an input-oriented approach. Therefore, this study will use an input-oriented CCR model.

MEASUREMENT OF EFFICIENCY IN BANKING SYSTEM

According to the Data Envelopment Analysis (DEA) method, inputs and outputs must be clearly defined to accurately measure efficiency. However, defining these inputs and outputs in the banking sector can be challenging. To address this, I reviewed relevant studies in the literature and selected three inputs and two outputs for this study. The inputs chosen are Total Assets, Total Equity, and Interest Expenses, while the outputs are Interest Income and Net Profit.

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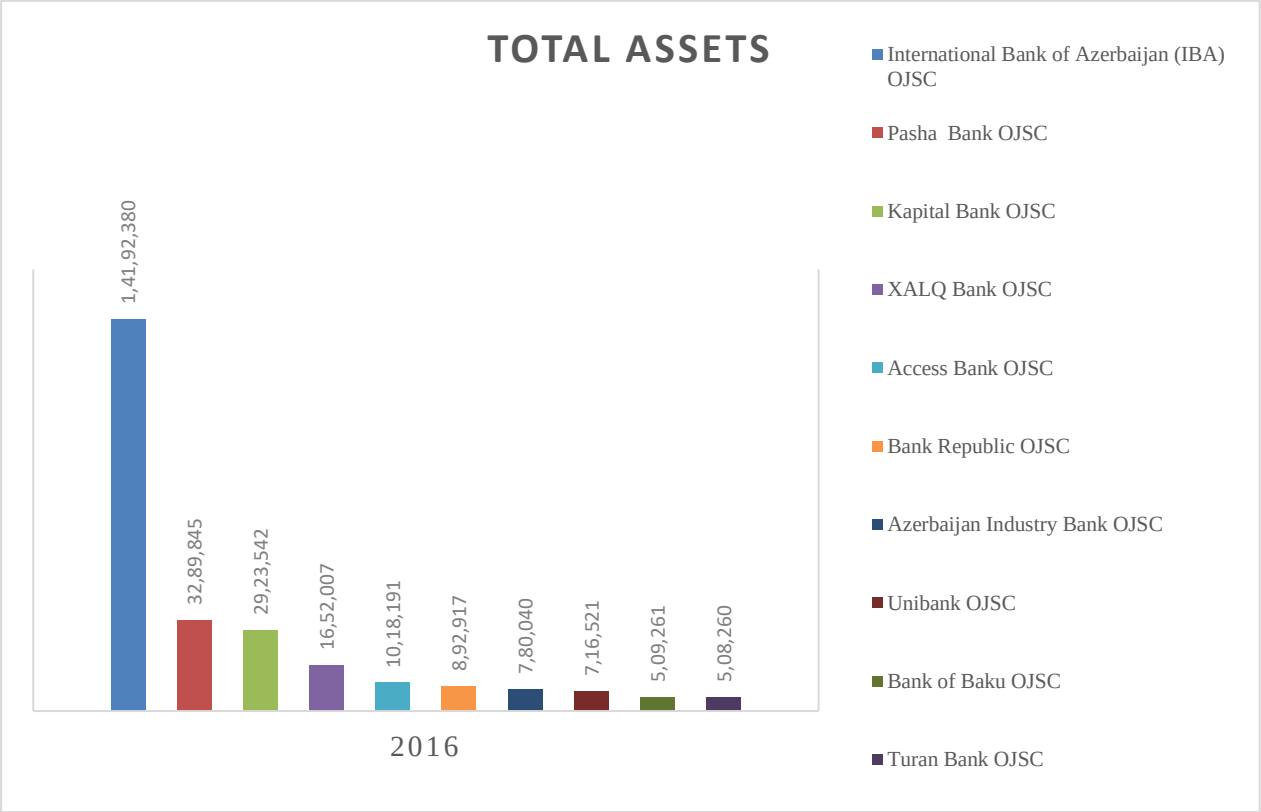

Figure 1: Total assets

Source: Mamadi, S. Y., & Makhdut, U. Y. (2020). The efficiency of Azerbaijani banks: an empiric analysis. Economic and Social Development: Book of Proceedings, 3, 581-587.

It is important to note that two significant devaluations occurred in 2015. The primary goal of this study is to assess the efficiency of the top 10 banks, based on their assets, in the year following the devaluation. Furthermore, this study aims to evaluate how efficiently these 10 banks are running and to analyze the impact of the devaluation on their efficiency. For this reason, after the devaluation, we will select the 10 largest banks according to their assets in 2016 and measure their effectiveness both for 2016 and for previous years.

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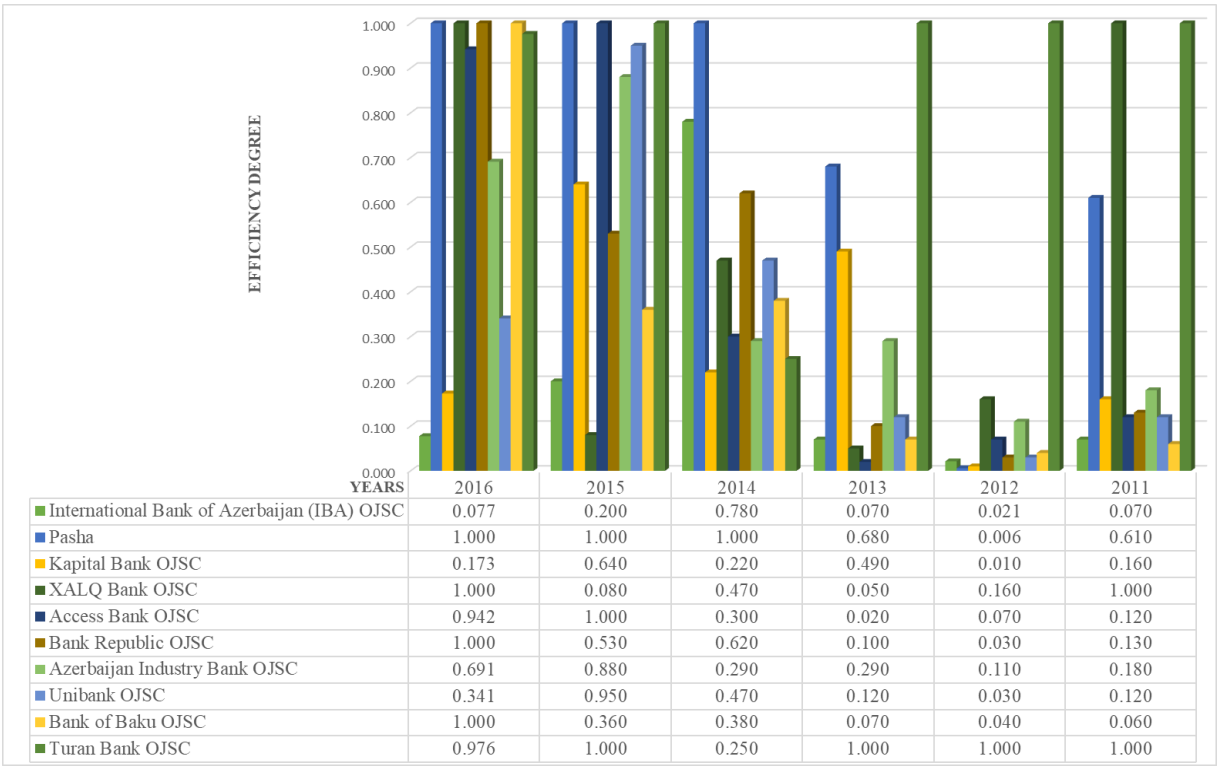

YEARS	2016	2015	2014	2013	2012	2011
International Bank of Azerbaijan (IBA) OJSC	0.077	0.200	0.780	0.070	0.021	0.070
Pasha	1.000	1.000	1.000	0.680	0.006	0.610
Kapital Bank OJSC	0.173	0.640	0.220	0.490	0.010	0.160
XALQ Bank OJSC	1.000	0.080	0.470	0.050	0.160	1.000
Access Bank OJSC	0.942	1.000	0.300	0.020	0.070	0.120
Bank Republic OJSC	1.000	0.530	0.620	0.100	0.030	0.130
Azerbaijan Industry Bank OJSC	0.691	0.880	0.290	0.290	0.110	0.180
Unibank OJSC	0.341	0.950	0.470	0.120	0.030	0.120
Bank of Baku OJSC	1.000	0.360	0.380	0.070	0.040	0.060
Turan Bank OJSC	0.976	1.000	0.250	1.000	1.000	1.000

Figure 2: Efficiency degree

Source: Mamadi, S. Y., & Makhdut, U. Y. (2020). The efficiency of Azerbaijani banks: an empiric analysis. Economic and Social Development: Book of Proceedings, 3, 581-587.

Figure 2 illustrates the efficiency rates of the banks over a six-year period. During the first three years, Turan Bank consistently showed the highest efficiency and was the only efficient bank, apart from 2011, when Xalq Bank also achieved efficiency. In 2014, Pasha Bank surpassed Turan Bank, which experienced a significant decline in efficiency.

In 2015, a year marked by two severe economic devaluations, there was a notable increase in the overall efficiency of the banks. During this year, three banks—Pasha Bank, Access Bank, and Turan Bank—reached the highest efficiency levels. By 2016, Pasha Bank supported its efficiency, and added banks, including Xalq Bank, Bank Republic, and Bank of Baku, also achieved the highest efficiency levels.

Interestingly, despite having the largest total assets exceeding ten billion manats, the International Bank of Azerbaijan was the least efficient bank throughout the entire period of analysis.

CONCLUSION

Following the 2008 Global Financial Crisis, the oversight of banks and risk management practices became significantly more critical in Azerbaijan. In this context, the banking sector underwent a restructuring process, focusing on risk management, following the standards set by the Central Bank of Azerbaijan, aligning with international criteria. A review of the relevant literature reveals that recent regulations in the banking sector have prioritized the performance, effective supervision, and regulation of the industry.

Global developments in the banking sector, combined with the increasing importance of banks in the global economy, have underscored the need to measure their performance and efficiency. As in other sectors, assessing bank efficiency is crucial for bank owners, customers, and investors. To effectively check the sector's performance in terms of banking activities, it is essential to conduct periodic analyses using diverse parameters.

This study applies Data Envelopment Analysis (DEA) to 10 commercial banks with the highest total assets in 2016, all of which run continuously in Azerbaijan between 2011 and 2016. During the model-solving phase, DEA Solver, a specialized software for DEA, was employed. The analysis used three inputs and two outputs, all sourced from the

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banks' annual financial reports. The results show that Turan Bank and Xalq Bank were efficient during the first three years of the study period. In 2014, Pasha Bank rose to the top of the rankings, although Turan Bank's efficiency

significantly declined. In 2015, three banks—Pasha Bank, Access Bank, and Turan Bank—achieved the highest efficiency rates. By 2016, Pasha Bank, Xalq Bank, Bank Republic, and Bank of Baku all showed the highest levels of efficiency.

When interpreting the model's results, it is essential to understand that the findings represent relative efficiency values. A bank deemed 100% efficient is only considered fully efficient in comparison to other banks, based on the specific inputs and outputs analyzed. The inputs and outputs used in this study were taken from each bank's annual financial reports.

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