



Comparing the Efficiency of Turkish and Azerbaijani Banks: An Application with Data Envelopment Analysis

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ABSTRACT

In this paper, we made a comparison about the efficiency of Turkish and Azerbaijani banks. Within this scope, we analyzed 10 biggest banks of both countries regarding asset size. Furthermore, data envelopment analysis (DEA) was used for the data between 2010 and 2014 in this study. As a result of analyzing 5 inputs and 3 outputs, it was determined that Turkish banks are more efficient than Azerbaijani banks. Out of 10 Turkish banks, only Türkiye Ekonomi Bankası was not efficient in 2011 whereas other banks were efficient for all years. On the other hand, it was defined that only 4 Azerbaijani banks were efficient for all years whereas other 6 banks were not efficient for some years during this period.

Keywords: Data Envelopment Analysis, Turkey, Azerbaijan, Banks, Efficiency

JEL Classifications: G21, H21

1. INTRODUCTION

The main function of banking sector in financial system is to receive the savings of depositors and provide these funds to the households or institutions (Freixas and Rochet, 1997). Owing to this situation, depositors can gain interest while investors can obtain finance for their investments easily. That is to say, it can be said that banks play a crucial role in financing business and trade development. Therefore, if the banks have financial problems, this situation will affect the economy of the country negatively as well. Thus, the efficiency of the banks should be improved. Because of this aspect, the studies, which evaluated the efficiency of the banks, are very important.

Turkey and Azerbaijan are important developing countries in which banking sector has a significant size in financial sector. Especially over the last two decades, the importance of the banking system in those countries increased dramatically due to the effects of globalization and improvement in financial sector. Because these two countries aim to grow in the following years, the efficiency of the banking sectors in these countries should be increased.

By considering these aspects, we tried to compare the efficiency of banking sector in Turkey and Azerbaijan in this study. In order to

achieve this purposes, we used data envelopment analysis (DEA) to the data for the period between 2010 and 2014. A major motive to compare performance of both countries' operated banks is geographical proximity and similarity in nation. In the literature, no any comparing study was found regarding the efficiencies of Turkish banks with Azerbaijani banks. Beside, the studies related to measure the efficiencies of Azerbaijani banks is not enough. Therefore, our study will give significant contribution to the literature in this way.

The study consists of six sections and structured as follows. After giving the introduction in Section 1, we briefly review a recent literature on efficiencies of banking sector. Section 3 and 4 provide general overview of Turkish and Azerbaijani banking system. Then, Section 5 outlines applications DEA as an estimation methodology, describes our variables and displays our estimation results. Finally, our findings were discussed in conclusion part.

2. LITERATURE REVIEW

In the literature, there are many studies related to the efficiency of the banking sector. Some of these studies were depicted on Table 1.

Table 1: Summary of the literature on banking efficiency

Authors	Scope	Period	Variables	Methods	Empirical results
Berg, et al. (1991)	Norway	1985	Deposits, loans, labor, machine, buildings	DEA	They reached a conclusion that large banks are more efficient in Norway
Kraft and Tirtiroğlu (1998)	Croatia	1994-1995	The number of employees, inflation, loans, deposits, capital	SFA	It was determined that private banks and old banks are more efficient than new banks
Chen and Yeh (2000)	Taiwan	1996	Loans, net income, total assets, the number of personnel, total deposits	DEA	They identified that the efficiency of banking sector is increasing in Taiwan
Staub et al. (2000)	Brazil	2000-2002	Personnel expense, capital, interest expense, deposits	DEA	They concluded that state banks are more efficient than foreign and private banks
Sathye (2003)	India	1997-1998	Interest expense, non-interest expense, deposit, staff numbers	DEA	It was analyzed that private banks are more efficient in India
Yudistira (2003)	18 Islamic banks	1997-2000	Total assets, fixed assets, total deposits, total loans, liquid assets	DEA	It was defined that there is a positive relationship between size and efficiency for Islamic banks
Drake and Hall (2003)	Japan	1997	Loans, liquid assets, administrative expense, fixed assets, deposits	DEA	They concluded that the size is positively related with the efficiency
Girardone et al., (2004)	Italy	1993-1996	Number of banks, cost efficiency index, ROA, non-interest income, staff expenses, loans, deposits, capital, fixed assets	Logit	It was determined that there is a negative relationship between personnel expenses and efficiency of Italian banks
Halkos and Salamouris (2004)	Greece	1997-1999	Net profit, interest expense, interest income, total assets	DEA	It was identified that banks with higher size are more efficient than the others in Greece
Galagedera and Edirisuriya (2005)	Indian	1995-2002	Total deposits, total operating expenses, total loans, other earning assets	DEA	In general, smaller banks are less efficient in India
Bos and Kool (2006)	Netherlands	1998-1999	Total loans, profit, capital, number of branches and ATMs	Regression	They concluded that the number of the branches and ATMs are important factors with respect to the efficiency of the banks
Şen (2006)	Turkey	1960-2004	Deposit, total expense, profit, total loans	DEA, Tobit	It was concluded that Turkish banking sector is not efficient between 1960 and 2004
Önal and Sevimeser (2006)	Turkey	1980-2004	Deposit, non-interest income, interest expense, interest income, loans	DEA	It was analyzed that foreign banks are the most efficient banks in Turkey
Eleren and Özgür (2006)	Turkey	2001-2005	Total deposits, interest expenses, total loans, Interest incomes	DEA	They concluded that increase in consumer loans and decrease in interest rate leads to rise efficiency of Turkish banks
Ataullah (2007)	India and Pakistan	1988-1998	ROA, total revenue, total cost, total assets	DEA	Public sector banks in Pakistan are more efficient than Indian banks
Sufian (2007)	Malaysia	2001-2005	Total loans, investments, total deposits, non-performing loans	DEA	Foreign banks have demonstrated higher efficiency in comparison to their domestic competitors
Lensink et al. (2008)	105 countries	1998-2003	Total costs, price of funds, price of labor, operating income	SFA	It was analyzed that foreign banks are less efficient than other type of banks in Turkey
Mamatzakis et al. (2008)	10 EU countries	1998-2003	Total assets, profit, total loans, capital, fixed assets	SFA	It was defined that foreign banks are more efficient than state and domestic banks
Behdioğlu and Özcan (2009)	Turkey	1999–2005	The number of personnel, non-interest expense, interest income, the number of branches, deposits, loans, net profit	DEA	It was identified that foreign banks are more efficient than other banks in Turkey

(Contd....)

Table 1: Continued....

Authors	Scope	Period	Variables	Methods	Empirical results
Chiu and Chen (2009)	Taiwan	2002-2004	Total loans, total investment, non-interest revenue, number of the personnel, total deposits, fixed assets	DEA	It was determined that public banks are more efficient than private banks
Delis and Papanikolaou (2009)	10 EU countries	1994-2005	Total loans, inflation, GDP, type of the ownership, total assets	Tobit	They concluded that bank size is positively correlated with the efficiency
Kao and Liu (2009)	Taiwan	1997-2001	Capital, labor, deposits, total loans	DEA	It was defined that many banks in Taiwan are not efficient whereas they have the chance to be efficient
Demirbaş and Sezgin (2010)	USA, EU and Turkey	2006-2010	Personnel expense, non-interest expense, the number of branches, loans, deposits, non-interest income	DEA	They determined that Turkish banks are more efficient than American and European banks in 2006
Tecles and Tabak (2010)	Brazil	2000-2007	Personnel, expenses/total assets, Operating expenses/total assets, Interest expenses/total funds, Investments, Total loans and deposits	SFA	It was defined that foreign banks in Brazil are more efficient than other banks
Seyrek and Ata (2010)	Turkey	2003-2008	Total loans, interest income, non-interest income, total deposit, interest expense, non-interest expense	DEA	It was determined that the ratio of total loans to total deposit is the most significant criteria with respect to the efficiency of Turkish banks
Budak (2011)	Turkey	2008-2010	The number of branches, the number of personnel, net income, deposits, loans, net profit	DEA	It was identified that Turkish banking sector has a decreasing trend regarding efficiency
Er and Uysal (2012)	Turkey	2005-2010	Number of personnel, Capital, Total assets, Total deposits/total funds, Total credits/used capital, Net profit	BCC and DEA	The efficient level of participation banks are more than commercial bank during this period
Behdioğlu and Özcan (2009)	Turkey	2007-2011	Total deposit, interest expense, non-interest income, total loans, interest income, non-interest expense	DEA	It was defined that Turkish banking sector is efficient after 2005
Akbalık and Sırma (2013)	Turkey	2008-2012	Loans, operating revenue, deposits, operating expense	DEA	It was determined that efficiency of foreign banks decreased in Turkey
Bektaş (2013)	Turkey	2007-2011	Total deposits, interest expense, non-interest expense, loans, interest income, non-interest income	DEA	It was concluded that private and foreign banks are efficient in Turkey
Küçükaksoy and Önal (2013)	Turkey	2004-2011	Total deposits, interest expense, personnel expense, loans, interest income	DEA	They identified that the efficiency of Turkish banks is the lowest in 2009 and 2010
Ada and Dalkılıç (2014)	Turkey and Malaysia	2009-2011	Total asset, Total equity, Period net income/loss, Total deposits	DEA	Malaysian banks are less efficient Turkish banks in 2009, but more efficient in 2010 and 2011
Cam (2015)	Turkey	2013-2014	Number of personnel, capital, Total assets, deposit, Net profit, loans	DEA	Private banks are more effectively operated than deposit banks

SFA: Stochastic frontier analysis, DEA: Data envelopment analysis

As it can be seen from the Table 1, DEA is the most popular method in the studies which analyze the efficiency of the banks. In addition to that, stochastic frontier analysis is also another popular method for this subject. Moreover, there are also some studies in which Tobit, regression analysis and logit methods were used.

Some of these studies resulted that there is a positive relationship between the size and the efficiency of the banks. In other words, it was determined that banks with higher amount of assets are more efficient than other banks (Berg et al., 1991), (Yudistira, 2003), (Drake and Hall, 2003), (Halkos and Salamouris, 2004), (Galagedera and Edirisuriya, 2005), (Delis

and Papanikolaou, 2009). Furthermore, there are also some studies which concluded that private banks are more efficient than the others (Kraft and Tirtiroğlu, 1998), (Sathye, 2003), (Cam, 2015), (Ataullah et al., 2004).

Moreover, according to some studies, state banks are more efficient (Staub et al., 2010), (Ataullah, 2004), (Chiu and Chen, 2009), (Bektaş, 2013) whereas some other studies resulted that the most efficient banks are foreign banks (Önal and Sevimeser, 2006), (Sufian, 2007), (Lensink et al., 2008), (Mamatzakis et al., 2008), (Behdioğlu and Özcan, 2009), (Teclès and Tabak, 2010). As a result of some studies, the important ratio in order to increase the efficiency of the banks was analyzed (Girardone et al., 2004), (Bos and Kool, 2006), (Eleren and Özgür, 2006), (Seyrek and Ata, 2010).

On the other hand, only 3 of these studies compared the efficiency of different countries' banks. Ataullah (2007) used DEA in order to compare the efficiency of the banks in India and Pakistan. So as to achieve this objective, the data for the period between 1988 and 1998 was used in this study. As a result, it was determined that Pakistani banks are more efficient than Indian banks. Similar to this study, Demirbaş and Sezgin (2010) compared the efficiency of American, European and Turkish banks and identified that Turkish banks are the most efficient ones. Ada and Dalkılıç (2014) also compared Turkish and Malaysian banks. It was concluded that Malaysian bank are more efficient in 2010 and 2011 whereas less efficient in 2009.

3. TURKISH BANKING SECTOR

Turkey is a country which suffered from 2 different banking crises occurred in 1994 and 2001. Because of these crises, many banks went bankruptcy and lots of people lost their jobs (Oktar and Yüksel, 2015). As a result, Turkish economy had important losses in these crises. After this period, Turkey made important regulations regarding banking sector. Banking Regulation and Supervision Agency was founded in 1999 in order to make an effective internal control system in banking sector (Bakır and Öniş, 2010).

In Table 2, there is general information about Turkish banking sector.

Graph 1 gives information about the asset size in Turkish banking sector over the years.

As it can be seen from Graph 1, there is an important increase in total assets of Turkish banking sectors from 2000 to 2014. In other words, it was defined that the size of Turkish banking sector increased very much. Moreover, Graph 2 demonstrates the situation of banking sector in Turkey with respect to profit.

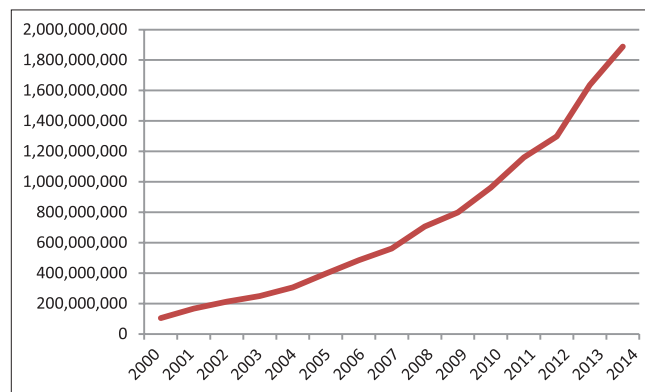
It is shown in Graph 2 that the profit of Turkish banking sector in increasing over the years. In 2000 and 2001, there was a loss in the sector. The main reason behind this situation is the banking crisis occurred in 2000. On the other hand, there is a significant increase in total profit of the banks after 2002.

Table 2: General information about Turkish banks

Type of the banks	2008	2009	2010	2011	2012	2013	2014
Total banks	45	45	45	44	45	45	47
State banks	3	3	3	3	3	3	3
Private banks	11	11	11	11	12	11	11
Foreign banks	17	17	17	16	16	17	19
Investment and development banks	13	13	13	13	13	13	13
Banks in SDIF	1	1	1	1	1	1	1
Number of branches	8,790	9,027	9,465	9,834	10,234	11,021	11,223

Source: Turkish Banking Association

Graph 1: Total profit or loss in Turkish banking sector between 2000 and 2014



Sources: Turkey Banking Association

Graph 2: Total assets in Turkish banking sector between 2000 and 2014



Sources: Turkey Banking Association

4. BANKING SECTOR OF AZERBAIJAN

Azerbaijan gained its independence in 1991. After this year, it defined a purpose of transition from central planning economy to free market economy. Because it is not possible to realize this process with the procedures remained from the communist system, they started to create new procedures. After this process, 2 different type of banking systems were created, such as central bank and commercial banks (Mikayılov and Muxtarov, 2013).

During the first years of independence, both political instability and Armenian hostile invasion brought about deep recession for Azerbaijan economy. After obtaining political stability in 1994, with implementing the relevant policies economy started to recover. As a result of adequate legal steps, banking sector, which

is one of the main cornerstones of the economy, started to provide significant supports to the real sector to develop (Mikayılov and Muxtarov, 2013).

At the first years of free market economy, there was not strong internal control and audit environment on the banks. Because of this deficiency, the number of commercial banks increased quickly and they usually made speculative transactions. After that, some new rules were determined, such as increasing founding capital amount. Owing to these new rules and significant audit of the banking sector, the number of the banks decreased.

According to Table 3, as of 31.12.2014, there are 45 banks in Azerbaijan. 2 of them are state banks whereas 20 of them are private banks. In addition to them, there are also 23 foreign banks. Another important point related to Azerbaijani banking sector is that after 2004, there is an increase in the number of foreign banks. Graph 3 gives information about the assets of Azerbaijani banks over the years.

As it can be seen from Graph 3, from 2010 to 2014, there is an increase in the percentage of total loans. Nonetheless, the ratio of liquid assets went down during this period. In addition to this situation, Graph 4 demonstrates total liabilities.

As it can be understood from Graph 4, deposit has the highest percentage in total deposits for all years. This ratio went up from 38.9% in 2010 to 44.03% in 2014. Having more deposit makes economy less vulnerable to any shocks. Moreover, non-deposit liabilities have the second biggest percentage during this period. Table 4 gives information about the profitability of the banks.

According to Table 4, it was understood that ROA increased 1.69 in 2014 from 1.2 in 2010. Similar to this ratio, there was also increase in return on equity. In addition to them, net interest margin also rose during this period.

5. RESEARCH AND APPLICATION

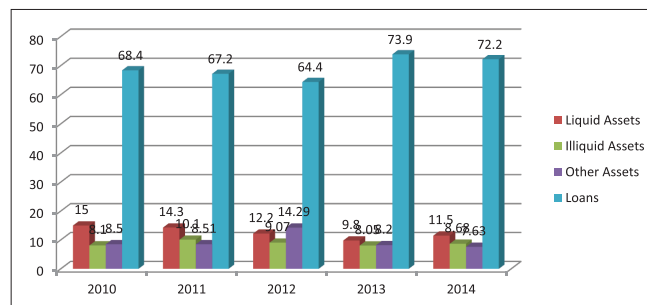
5.1. The Scope and the Constraints of the Study

It was aimed to compare the efficiency of Turkish and Azerbaijani banks. Within this scope, 10 biggest banks of both countries with respect to total assets were analyzed. Moreover, the data for the periods between 2010 and 2014 was used in this study. The data was provided from the financial reports of the banks. However, because financial reports of 2015 were not prepared while writing this journal, they could not be used in this study. In addition to them, DEA Solver software was used in order to calculate the efficiency of the banks.

The banks, which were analyzed in this study, were demonstrated on Table 5.

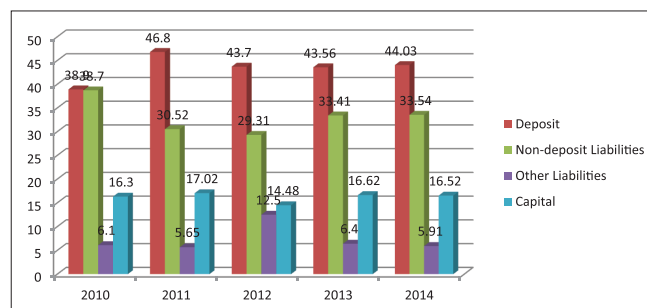
As it can be seen on Table 5, the size of Turkish banks is much higher than the size of Azerbaijani banks. It was also understood that 85.38% of Turkish banking sector and 81.78% of Azerbaijani banking sector was analyzed in this study.

Graph 3: Total assets in Azerbaijan banking sector between 2000 and 2014



Sources: The Central Bank of Republic of Azerbaijan

Graph 4: Total deposit in Azerbaijan banking sector between 2000 and 2014



Sources: The Central Bank of Republic of Azerbaijan

Table 3: General information about Azerbaijani banks

Type of the banks	2008	2009	2010	2011	2012	2013	2014
Total banks	46	47	45	44	43	43	45
State banks	2	1	1	1	1	1	2
Private banks	44	46	44	43	42	42	43
Foreign banks	23	23	22	22	23	22	23
Number of branches	605	666	684	706	682	700	752

Source: The Central Bank of Republic of Azerbaijan

Table 4: Profitability ratios of Azerbaijani banks

Profitability ratios	2010	2011	2012	2013	2014
ROA	1.2	1.12	0.87	1.54	1.69
ROE	8.6	6.62	7.05	11.75	11.60
NIM	3.8	3.6	4.86	5.39	6.60

Sources: The Central Bank of Republic of Azerbaijan. ROA: Return on asset, ROE: Return on equity, NIM: Net interest margin

5.2. DEA

DEA is a nonparametric analysis that measures the efficiency of the units that are similar to each other. This method is useful for the situation in which there are many inputs and outputs of those units. DEA is mostly used in order to evaluate the efficiency of the branches of the banks and restaurants. In addition to them, there are also some studies related to health and education (Ray, 2004).

There are many advantages of DEA. First of all, many inputs and outputs can be considered in efficiency analysis at the same time. This situation is helpful so as to reach more accurate results. Moreover, these variables, which have different unit of measure, can be used in this analysis. Therefore, there is no need to make calculation in order to have the same unit of measure (Ji and Lee, 2010).

Table 5: List of banks analyzed in this study

Bank	Total asset (mil USD)	Asset size (% of total banks)	Bank	Total asset (mil USD)	Asset size (% of total banks)
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	106,775	13.11	Azerbaijan International Bank (IBA)	10,697	42.48
Türkiye İş Bankası A.Ş.	102,537	12.59	Kapital bank	1,716	6.81
Türkiye Garanti Bankası A.Ş.	94,406	11.59	Xalq bank	1,552	6.16
Akbank T.A.Ş.	88,598	10.88	Pasha bank	1,370	5.44
Yapı ve Kredi Bankası A.Ş.	78,141	9.60	Access bank	1,275	5.06
Türkiye Vakıflar Bankası T.A.O.	68,230	8.38	UniBank	1,051	4.17
Türkiye Halk Bankası A.Ş.	67,024	8.23	Bank of Baku	901	3.58
Finans Bank A.Ş.	32,432	3.98	Bank technique	745	2.96
Denizbank A.Ş.	29,960	3.68	AGBank	654	2.60
Türk Ekonomi Bankası A.Ş.	27,165	3.34	Bank respublika	633	2.51
Total	695,267	85.38	Total	20,594	81.78

Sources: Financial Reports of the Banks

On the other hand, there are also some disadvantages of DEA. Firstly, this analysis is very sensitive to the variables. Thus, choosing the suitable inputs and outputs is very significant. Additionally, because the efficiency of each unit is calculated separately, an analysis on the high number of units takes too much time (Seiford and Thrall, 1990).

The process of DEA consists of 3 different stages. The first stage of this analysis is determining the units to be compared. After that, inputs and outputs that are used to calculate the efficiency are chosen. The final stage of DEA is the calculation of the efficiency for each unit.

At the end of the calculation, each unit takes an efficiency score between “0” and “1”. Those units which take “1” are accepted as efficient. On the other side, if the units take a value less than “1” is considered as inefficient. Moreover, when this score is small, it means that inefficiency level of this unit increases.

There are 2 different DEA models, which are CCR and BCC models. CCR model was created by Charnes et al., in 1978. It was developed under the assumption of constant returns to scale. There are also 2 different CCR models, which are named as “input oriented” and “output oriented.” With respect to the input oriented CCR model, it was aimed to determine how much input should be changed in order to achieve a determined output level. On the other hand, in output oriented CCR model, there is not any change in input level. In this model, it was intended to decide how much the output level should be increased so as to achieve the input level determined before (Charnes et al., 1978).

Moreover, BCC model is the second model of DEA. It was created by Banker et al., in 1984. This model is the improved form of CCR model. It was developed under the assumption of variable returns to scale. In other words, differently from CCR model, in BCC model, there is a constraint related to the convexity. Owing to this constraint, better results can be achieved by using BCC model (Banker et al., 1984).

5.3. Variables

According to the DEA, inputs and outputs should be defined in order to measure the efficiency. However, for banking sector defining inputs and outputs is not easy. For this process, first of all we analyzed the similar studies in the literature and decided to

use 5 inputs and 3 outputs in this study. These inputs and outputs and related studies are demonstrated on Table 6.

5.4. Results of the Model

In order to measure the efficiency of Turkish and Azerbaijani banks, we used 6 inputs and 3 outputs. By using DEA, following results are obtained.

As it can be analyzed from Table 7, most of Turkish banks have the value of “1.” In other words, it can be said that they were efficiently managed. Only Türkiye Ekonomi Bankası has the value of “0.9573” for the year of 2011. This issue shows us that this bank was not efficient for 2011.

On the other hand, it was determined that Azerbaijani banks have lower banks than Turkish banks. Out of these 10 banks, 4 banks (Kapital Bank, Access Bank, Bank of Baku, Bank Respublika) have the value of “1” for all years. This situation demonstrates that these banks were managed efficiently.

Azerbaijan International Bank has the value of “1” for 4 years, but the value of this bank is “0.9887” in 2011. This means that except 2011, this bank was managed efficiently. Furthermore, Xalq Bank has the value of “0.9192” in 2012 and “1” in other years. In other words, this bank was inefficient in 2012 and efficient in other 4 years. Moreover, AG Bank took the value of “0.8059” in 2012. This result shows that this bank was only inefficient in that year. Also, Pasha Bank got the inefficient value (0.9860) only in 2014.

In addition to these results, UniBank has the value of “1” in 2010, 2013 and 2014. Nevertheless, it took the value “0.7598” in 2011 and “0.8018” in 2012. These results refer that UniBank was efficient in 2010, 2013 and 2014, but it was inefficient in other 2 years. Similar to UniBank, Bank Technique was efficient in 3 different years whereas it was inefficient in 2010 and 2014.

6. DISCUSSION AND CONCLUSION

We tried to compare the efficiency of Turkish and Azerbaijani banks in this study. Within this context, 10 biggest banks of both these countries with respect to the asset size were analyzed.

Table 6: List of inputs and outputs

Input/output	Variables	References
Inputs	Total assets	Ada and Dalkılıç (2014), Chen and Yeh (2000), Chiu and Chen (2009), Delis and Papanikolaou (2009), Er and Uysal (2012), Halkos and Salamouris (2004), Seyrek and Ata (2010), Périco et al. (2008), Tabak et al. (2005), Yüdistira (2003), Sufian (2007)
	Total equity (capital)	Ada and Dalkılıç (2014), Périco et al. (2008), Silva and Jorge Neto (2002), Demirbaş and Sezgin (2010), Er and Uysal (2012), Kao and Liu (2009), Sufian (2009), Chabalgoity et al. (2007), Ruiz et al. (2008), Souza et al. (2006), Sufian (2007)
	Total deposit	Akbalık and Sırma (2013), Şen (2006), Bauer et al. (1998), Bektaş (2013), Chen and Yeh (2000), Chiu and Chen (2009), Delis and Papanikolaou (2009), Demirbaş and Sezgin (2010), Eleren and Özgür (2006), Gilbert and Wilson (1998), Isik and Hassan (2002), Maudos and Pastor (2003), Casu and Girardone (2004), Havrylchuk (2006), Kao and Liu (2009), Küçükaksoy and Önal (2013), Önal and Sevimeser (2006), Özgür (2007), Sufian (2009), Périco et al. (2008), Silva and Jorge Neto (2002), Ruiz et al. (2008), Sathye (2003)
	Number of personnel	Behdioğlu and Özcan (2009), Budak (2011), Chen and Yeh (2000), Chiu and Chen (2009), Demirbaş and Sezgin (2010), Er and Uysal (2012), Isik and Hassan (2002), Maudos and Pastor (2003), Casu and Girardone (2004), Havrylchuk (2006), Girardone et al. (2004), Halkos and Salamouris (2004), Kao and Liu (2009), Küçükaksoy and Önal (2013), Özgür (2007), Staub et al. (2010), Tabak et al. (2005), Vassiloglou and Giokas (1990), Berg et al. (1991), Sathye (2003), Yüdistira (2003)
	Interest expenses	Behdioğlu and Özcan (2009), Budak (2011), Chen et al. (2005), Demirbaş and Sezgin (2010), Eleren and Özgür (2006), Maudos et al. (2002), Girardone et al. (2004), Halkos and Salamouris (2004), Küçükaksoy and Önal (2013), Önal and Sevimeser (2006), Özgür (2007), Seyrek and Ata (2010), Staub et al. (2010), Sathye (2003)
	Number of branches	Behdioğlu and Özcan (2009), Budak (2011), Chen (2001), Demirbaş and Sezgin (2010), Canhoto and Dermine (2003), Becker et al. (2003)
	Outputs	Net profit
Interest income		Akbalık and Sırma (2013), Bektaş (2013), Budak (2011), Chen and Yeh (2000), Demirbaş and Sezgin (2010), Eleren and Özgür (2006), Halkos and Salamouris (2004), Küçükaksoy and Önal (2013), Önal and Sevimeser (2006), Özgür (2007), Seyrek and Ata (2010), Sufian (2009), Sathye (2003)
Non-interest income		Akbalık and Sırma (2013), Bektaş (2013), Budak (2011), Chen and Yeh (2000), Chiu and Chen (2009), Demirbaş and Sezgin (2010), Önal and Sevimeser (2006), Seyrek and Ata (2010), Sufian (2009), Becker et al. (2003), Chabalgoity et al. (2007), Sathye (2003), Drake and Hall (2003), Yüdistira (2003)

Sources: Authors

Table 7: Results of DEA

Country	Bank	2014	2013	2012	2011	2010
Turkey	Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	1	1	1	1
	Türkiye İş Bankası A.Ş.	1	1	1	1	1
	Türkiye Garanti Bankası A.Ş.	1	1	1	1	1
	Akbank T.A.Ş.	1	1	1	1	1
	Yapı ve Kredi Bankası A.Ş.	1	1	1	1	1
	Türkiye Vakıflar Bankası T.A.O.	1	1	1	1	1
	Türkiye Halk Bankası A.Ş.	1	1	1	1	1
	Finans Bank A.Ş.	1	1	1	1	1
	Denizbank A.Ş.	1	1	1	1	1
	Türk Ekonomi Bankası A.Ş.	1	1	1	0.9573	1
Average	1	1	1	0.9957	1	
Azerbaijan	Azerbaijan International Bank (IBA)	1	1	1	0.9887	1
	Kapital bank	1	1	1	1	1
	Xalq bank	1	1	0.919234	1	1
	Pasha bank	0.9860987	1	1	1	1
	Access bank	1	1	1	1	1
	UniBank	1	1	0.8018472	0.7598	1
	Bank of Baku	1	1	1	1	1
	Bank technique	0.9969367	1	1	1	0.7337274
	AGBank	1	1	0.8059688	1	1
	Bank Respublika	1	1	1	1	1
Total	0.9983035	1	0.952705	0.9749	0.9733727	

Sources: Authors. DEA: Data envelopment analysis

Moreover, DEA was also used in this study so as to achieve this objective.

In order to assess the performance of the banks, first of all, 5 inputs and 3 outputs were defined. The inputs in the study are total assets,

total equity, total deposits, the number of the personnel in the banks and the number of branches. On the other hand, net profit, interest income and non-interest income are the outputs. Furthermore, we tested the annual data for the years between 2010 and 2014.

As a result of DEA, it was determined that Turkish banks are more efficient than Azerbaijani banks. It was defined that out of 10 banks, 9 Turkish banks were efficient for each of 5 years. However, only Türkiye Ekonomi Bankası was not efficient in 2011. On the other hand, it was identified that only 4 Azerbaijani banks were efficient for all years. Nonetheless, other 4 banks were inefficient for 1 year in the period. In addition to them, it was also determined that UniBank and Bank Technique were inefficient for 2 different years for the period between 2010 and 2014.

REFERENCES

- Ada, A.A., Dalkılıç, N. (2014), Efficiency analysis in Islamic banks: A study for Malaysia and Turkey. *Journal of BRSA Banking and Financial Markets*, 8(1), 9-33.
- Akbalık, M., Sırma, İ. (2013), Türkiye'de yabancı bankaların etkinliği; Veri zarflama analiz uygulaması. *Finansal Arastirmalar ve Calismalar Dergisi*, 4(8), 1-16.
- Ataullah, A., Cockerill, T., Le, H. (2004), Financial liberalization and bank efficiency: A comparative analysis of India and Pakistan. *Applied Economics*, 36(17), 1915-1924.
- Bakir, C., Öniş, Z. (2010), The regulatory state and turkish banking reforms in the age of post-washington consensus. *Development and Change*, 41(1), 77-106.
- Banker, R.D., Charnes, A., Cooper, W.W. (1984), Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078-1092.
- Bauer, P.W., Berger, A.N., Ferrier, G.D., Humphrey, D.B. (1998), Consistency conditions for regulatory analysis of financial institutions: A comparison of frontier efficiency methods. *Journal of Economics and business*, 50(2), 85-114.
- Becker, J.L., Lunardi, G.L., Maçada, A.C. (2003), Análise de eficiência dos bancos brasileiros: Um enfoque nos investimentos realizados em tecnologia de informação (TI). *Revista Produção*, 13(2), 70-81.
- Behdioğlu, S., Özcan, A.G.G. (2009), Veri zarflama analizi ve bankacılık sektöründe bir uygulama. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 14(3), 301-326.
- Bektaş, H. (2013), Türk bankacılık sektöründe etkinlik analizi. *Sosyoekonomi*, 19(19), 277-294.
- Berg, S.A., Førsund, F.R., Jansen, E.S. (1991), Technical efficiency of Norwegian banks: The non-parametric approach to efficiency measurement. *Journal of Productivity Analysis*, 2(2), 127-142.
- Bos, J.W., Kool, C.J. (2006), Bank efficiency: The role of bank strategy and local market conditions. *Journal of Banking and Finance*, 30(7), 1953-1974.
- Budak, H. (2011), Veri zarflama analizi ve Türk bankacılık sektöründe uygulaması. *Marmara Üniversitesi Fen Bilimleri Dergisi*, 23(3), 95-110.
- Çam, A.V. (2015), The Determination of Deposit and Participation Banks' Efficiency by Data Envelopment Analysis: A Research on Banks in Turkey. *Turkish Economic Review*, 2(3), 152-159.
- Canhoto, A., Dermine, J. (2003), A note on banking efficiency in Portugal, new vs. old banks. *Journal of Banking and Finance*, 27(11), 2087-2098.
- Casu, B., Girardone, C. (2004), Financial conglomeration: Efficiency, productivity and strategic drive. *Applied Financial Economics*, 14(10), 687-696.
- Chabalgoity, L., Marinho, E., Benegas, M., Neto, P. J. (2007), Eficiência Técnica, Produtividade e Liderança Tecnológica na Indústria Bancária Brasileira. 75-112.
- Charnes, A., Cooper, W.W., Rhodes, E. (1978), Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429-444.
- Chen, T.Y., Yeh, T.L. (2000), A measurement of bank efficiency, ownership and productivity changes in Taiwan. *Service Industries Journal*, 20(1), 95-109.
- Chen, T.Y. (2001), An estimation of X-inefficiency in Taiwan's banks. *Applied Financial Economics*, 11(3), 237-242.
- Chen, X., Skully, M., Brown, K. (2005), Banking efficiency in China: Application of DEA to pre-and post-deregulation eras: 1993-2000. *China Economic Review*, 16(3), 229-245.
- Chiu, Y.H., Chen, Y.C. (2009), The analysis of Taiwanese bank efficiency: Incorporating both external environment risk and internal risk. *Economic Modelling*, 26(2), 456-463.
- Delis, M.D., Papanikolaou, N.I. (2009), Determinants of bank efficiency: Evidence from a semi-parametric methodology. *Managerial Finance*, 35(3), 260-275.
- Demirbaş, M., Sezgin, F.H. (2010), Likidite krizi sürecinde Amerika Birleşik Devletleri, Avrupa Birliği'ne Üye Ülkeler ve Türkiye'deki Bankacılık Sektörünün Karşılaştırmalı Etkinlik Analizi: 2006-2010 Dönemi. *İktisadi ve İdari Bilimler Fakültesi Dergisi*, 12(3), 1-24.
- Drake, L., Hall, M.J. (2003), Efficiency in Japanese banking: An empirical analysis. *Journal of Banking and Finance*, 27(5), 891-917.
- Er, B., Uysal, M. (2012), Türkiye'deki ticari bankalar ve katılım bankalarının karşılaştırmalı etkinlik analizi: 2005-2010 dönemi değerlendirilmesi. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 26(3-4), 365-387.
- Eleren, A., Özgür, E. (2006), Türkiye'de yabancı sermayeli mevduat bankalarının veri zarflama yöntemi ile etkinlik analizlerinin yapılması. *Afyon Kocatepe Üniversitesi, İ.İ.B.F. Dergisi*, 8(2), 53-76.
- Freixas, X., Rochet, J.C. (1997), *Microeconomics of Banking*. Vol. 2. Cambridge, MA: MIT Press.
- Gilbert, R.A., Wilson, P.W. (1998), Effects of deregulation on the productivity of Korean banks. *Journal of Economics and Business*, 50(2), 133-155.
- Girardone, C., Molyneux, P., Gardener, E.P. (2004), Analysing the determinants of bank efficiency: The case of Italian banks. *Applied Economics*, 36(3), 215-227.
- Halkos, G.E., Salamouris, D.S. (2004), Efficiency measurement of the Greek commercial banks with the use of financial ratios: A data envelopment analysis approach. *Management Accounting Research*, 15(2), 201-224.
- Havrylychuk, O. (2006), Efficiency of the Polish banking industry: Foreign versus domestic banks. *Journal of Banking and Finance*, 30(7), 1975-1996.
- Isik, I., Hassan, M.K. (2002), Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking and Finance*, 26(4), 719-766.
- Ji, Y.B., Lee, C. (2010), Data envelopment analysis. *The Stata Journal*, 10(2), 267-280.
- Kao, C., Liu, S.T. (2009), Stochastic data envelopment analysis in measuring the efficiency of Taiwan commercial banks. *European Journal of Operational Research*, 196(1), 312-322.
- Kraft, E., Tırtıroğlu, D. (1998), Bank efficiency in Croatia: A stochastic-frontier analysis. *Journal of comparative economics*, 26(2), 282-300.
- Küçükaksoy, I., Önal, S. (2013), Türk bankacılık sektöründe faaliyet gösteren bankaların etkinliklerinin veri zarflama analizi yöntemi ile ölçülmesi: 2004-2011 Yılları Uygulaması. *Ekonometri ve İstatistik Dergisi*, (18), 56.

- Mamatzakakis, E., Staikouras, C., Koutsomanoli-Filippaki, A. (2008), Bank efficiency in the new European Union member states: Is there convergence?. *International Review of Financial Analysis*, 17(5), 1156-1172.
- Maudos, J., Pastor, J.M. (2003), Cost and profit efficiency in the Spanish banking sector (1985-1996): A non-parametric approach. *Applied Financial Economics*, 13(1), 1-12.
- Maudos, J., Pastor, J.M., Perez, F. (2002), Competition and efficiency in the Spanish banking sector: The importance of specialization. *Applied Financial Economics*, 12(7), 505-516.
- Mikayılov, Q., Muxtarov, Ş. (2013), Azerbaycan bankacılık sisteminin finansal analizi: 2006-2011. *Journal of Qafqaz University*, 1(1), 75-83.
- Oktar, S., Yüksel, S. (2015), Bankacılık krizlerinin erken uyarı sinyalleri: Türkiye üzerine bir uygulama, *İstanbul Ticaret Üniversitesi Sosyal Bilimleri Dergisi*, 14(28), 37-53.
- Önal, Y.B., Sevimeser, N.C. (2006), Yabancı banka girişlerinin Türk bankacılık sistemine etkileri: Yerli ve yabancı bankaların etkinlik analizi. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 15(2), 295-312.
- Özgür, E. (2007), Katılım Bankalarının Finansal Etkinliği Ve Mevduat Bankaları İle Rekabet Edebilirliği. Yayınlanmamış Doktora Tezi, Afyonkarahisar Kocatepe Üniversitesi Sosyal Bilimler Enstitüsü.
- Pasiouras, F. (2008), Estimating the technical and scale efficiency of Greek commercial banks: The impact of credit risk, off-balance sheet activities, and international operations. *Research in International Business and Finance*, 22(3), 301-318.
- Périco, A.E., Rebelatto, D.A.D.N., Santana, N.B. (2008), Eficiência Bancária: Os maiores bancos são os mais eficientes? Uma análise por envoltória de dados. *Gestão e Produção*, São Carlos, 15(2), 421-431.
- Ray, S.C. (2004), *Data Envelopment Analysis. Theory and Techniques for Economics and Operations*. United Kingdom: Cambridge University Press.
- Ruiz, C., Tabak, B.M., Cajueiro, D.O. (2008), Mensuração da Eficiência Bancária no Brasil—A Inclusão de Indicadores Macroeconômicos. *Revista Brasileira de Finanças*, 6(3), 411-436.
- Sathye, M. (2003), Efficiency of banks in a developing economy: The case of India. *European Journal of Operational Research*, 148(3), 662-671.
- Seiford, L.M., Thrall, R.M. (1990), Recent developments in DEA: The mathematical programming approach to frontier analysis. *Journal of Econometrics*, 46(1), 7-38.
- Seyrek, İ.H., Ata, H.A. (2010), Veri zarflama analizi ve veri madenciliği ile mevduat bankalarında etkinlik ölçümü. *BDDK Bankacılık ve Finansal Piyasalar*, 4(2), 67-84.
- Silva, T.L., Jorge Neto, P.D.M. (2002), Economia de escala e eficiência nos bancos brasileiros após o Plano Real. *Estudos Econômicos*, 32(4), 577-619.
- Souza, G., Staub, R., Tabak, B. (2006), Assessing the significance of factors effects in output oriented dea measures of efficiency: An application to Brazilian banks. *Brazilian Journal of Business Economics*, 6(1), 7-20.
- Staub, R.B., e Souza, G.D.S., Tabak, B.M. (2010), Evolution of bank efficiency in Brazil: A DEA approach. *European Journal of Operational Research*, 202(1), 204-213.
- Sufian, F. (2007), The efficiency of Islamic banking industry: A non-parametric analysis with non-discretionary input variable. *Islamic Economic Studies*, 14(1-2), 53-78.
- Sufian, F. (2009), Determinants of bank efficiency during unstable macroeconomic environment: Empirical evidence from Malaysia. *Research in International Business and Finance*, 23(1), 54-77.
- Şen, S.A. (2006), Bankacılık sektörü ve devlet müdahaleleri: Politik devresel dalgalanmalar çerçevesinde Türk bankacılık sektörü etkinlik analizi. *Sosyoekonomi*, 4(4), 11-30.
- Tecles, P.L., Tabak, B.M. (2010), Determinants of bank efficiency: The case of Brazil. *European Journal of Operational Research*, 207(3), 1587-1598.
- Tabak, B.M., Krause, K., Portella, G.R. (2005), Eficiência bancária: O valor intrínseco na função de produção. *Revista de Administração*; São Paulo, 40(4), 1-15.
- Vassiloglou, M., Giokas, D. (1990), A study of the relative efficiency of bank branches: An application of data envelopment analysis. *Journal of the Operational Research Society*, 41(7), 591-597.
- Yudistira, D. (2003), Efficiency in Islamic banking: An Empirical Analysis of 18 Banks. *Economics Working Paper Archive at WUSTL*.