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EFFICIENCY IN TURKISH BANKING INDUSTRY: A COMPARISON OF STATE-OWNED AND PRIVATELY-OWNED BANKS

Cahide Şeniz KÜÇÜK

108673059

Assist. Prof. Dr. Cenktan ÖZYILDIRIM

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EFFICIENCY IN TURKISH BANKING INDUSTRY: A COMPARISON OF STATE-OWNED AND PRIVATELY-OWNED BANKS

TÜRK BANKACILIK SEKTÖRÜNDE VERİMLİLİK ANALİZİ: KAMU BANKALARI İLE ÖZEL BANKALARIN KARŞILAŞTIRMALI ANALİZİ

Cahide Şeniz KÜÇÜK

108673059

Assist. Prof. Dr. Cenktan ÖZYILDIRIM : .....

Assist. Prof. Dr. Begumhan Gokmen ÖZDİNÇER : .....

Assist. Prof. Dr. Mehmet Fuat BEYAZIT : .....

Tezin Onaylandığı Tarih : .....

Toplam Sayfa Sayısı:

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2) Veri Zarflama Analizi	2) Data Envelopment Analysis
3) Verimlilik	3) Efficiency
4) Finansal Kriz	4) Financial Crisis
5) Ticari Bankalar	5)Commercial Banks

Özet

Bu çalışmada Türkiye'deki ticari bankaların 2006-2011 yılları arasındaki verimliliği veri zarflama analizi yöntemi ile incelenmiştir. Veri zarflama analizi yöntemi, 2006-2011 yıllları arasında sürekli faaliyet gösteren 13 bankanın verileriyle yapılmıştır. Bankacılık sektöründe faaliyet gösteren tüm bankalar bu çalışmaya dahil edilmemiştir. 3 kamu bankası ve 10 özel banka örneklem olarak seçilmiştir.

Uygulanan veri zarflama analizi yönteminde, 3 girdi ve 4 çıktı belirlenmiştir. Girdiler; şube sayısı, personel sayısı ve toplam krediler olup çıktılar ise net kar/zarar, takipteki krediler, toplam mevduat ve net faiz geliridir. 13 bankanın 2006-2011 yılları arasındaki veri zarflama analizi verimlilik skorları matlab programı aracılığıyla hesaplanmıştır. Belirlenen süre boyunca ortalama verimlilik skoru 0,769 ile 0,839 arasında değişmiştir. Kamu bankaları ile özel bankalar karşılaştırıldığında, kamu bankalarını içeren grubun daha yüksek verimlilik skorlarına sahip olduğu gözlenmiştir.

Abstract

This study aims to examine the efficiency of Turkish commercial banks for the period 2006 to 2011 with the help of data envelopment analysis (DEA) which is a nonparametric method. DEA application is made by using data of 13 banks which have been active in between 2006-2011. All of the operating banks in the banking sector are not included in this study. 3 state-owned banks and 10 privately-owned banks are selected as a sample.

In this DEA analysis 3 input and 4 output variables are determined. The inputs are number of branches, number of personnel and total loans. The outputs used are net profit/loss, non-accruing loans, total deposits and net interest income. DEA efficiency scores of 13 banks are calculated by the help of matlab program for the years of 2006-2011. The results indicate that during this period average efficiency scores of banks range from 0,769 to 0,839.

Over this period, a comparison of efficiency scores by group of ownership shows that the group of state-owned commercial banks displayed greater efficiency scores compared to the group of privately-owned commercial banks.

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1. INTRODUCTION

It's important to understand which factors led up to the last financial crisis all over the world. This previous crisis began in USA in August 2007 and in a short time period became global by expanding firstly in developed countries and then in developing countries. U.S. crisis that started in 2007 produced a recession and it was the worst since the Great Depression in 1930s. From the beginning of crisis, Stock Exchange Indexes decreased and capital inflows to developing countries slowed down. At the same time, economic recession and macroeconomic problems started in USA affected other countries, too. In this study, the efficiency of commercial banks will be investigated from the year of 2006 which includes the period before the financial crisis occurred.

Since banking sector is the major sector that contributes substantially to the development of national economy with its financial function, efficiency of commercial banks is one of the most interesting and important issues for both the government and private sector. It is seen previously that the financial crisis in the banking sector may have destructive results in other sectors and also in whole economy. This could be defined as systemic risk in finance. It refers to the risks that the failure of a financial institution could affect negatively other financial institutions and the whole economy. As the banks play a crucial role in determining the financial markets in any country, profitability, sustainability and social investment of banks are the most concerns of the government and other sectors.

If we look at the Turkish banking sector, it's seen that banks in Turkey could be classified in three different ownership forms: state-owned commercial, privately-owned commercial, foreign and participation banks. As on the date of 2006, there were a total of 50 banks in Turkey but only 13 banks are included in this study. These banks are;

- 3 state-owned commercial banks,
- 10 privately-owned commercial banks which operate actively from 2006 to 2011.

4 participation banks which operate actively from 2006 to 2011 are not included in this study.

Consequently, this study examines the efficiency of banks in Turkey between the years of 2006 and 2011 to understand how efficiency of those banks changed over the years.

2. LITERATURE REVIEW

The efficiency of banks has been often studied by many economists in Turkey and other countries. The most preferred research method is Data Envelopment Analysis. The first DEA application was used by Sherman and Gold (1985) for evaluating bank branch operating efficiency.

Aydın, Yalama and Sayim (2009) investigated the efficiency of 44 banks for the period between December 2002 and March 2006, including 14 quarterly periods by using DEA. This study is one of the studies that focus on the period after 2001 financial crisis. Equity/Total Assets, Total Credits/Total Assets, Liquid Assets/Short-term liabilities, Non-operating interest expenses/Total interest expenses and Non-operating interest expenses/Total operating expenses were used as inputs and Return on Assets (ROA) and Return on Equity (ROE) were chosen as outputs. Banks were classified as state-owned, foreign-owned, private-owned and development-investment banks. As a result, the most efficient bank category was found as state-owned and then followed by foreign-owned, development-investment and private-owned.

Damar (2006) utilized Envelopment Analysis (DEA) to estimate the effects of shared ATM Networks on the efficiency of Turkish banks for the period between 2000 and 2003. The analysis includes six inputs and four outputs. The inputs are the number of ATMs owned and operated by the bank, the number of additional ATMs that the bank's customers can use through a shared ATM network, the number of branches, the number of employees, total operating costs and total interest expense on deposits. The outputs are defined as: total deposits, total performing loans, value of all ATM transactions, and commissions and fees received for services. One of the findings of this study is that participation in shared ATM networks has a negative effect on the efficiency of small and medium size banks. Another finding is that technology adoption and sharing do not always result in cost savings for small banks.

Seyrek and Ata (2010) investigated efficiency of 20 deposit banks in Turkey between 2003 and 2008. Efficiency scores of 20 banks are measured with the help of Data Envelopment Analysis. Important factors of bank efficiency are determined by using Data Mining Techniques. As a result, important financial ratios to predict bank efficiency are found as "Total Credits/Total Deposits" ratio and "Other Operating Costs/Total Operating Income" ratio.

Ayrancı (2011) examined the effects of liberalization processes initiated in the early 1980s in Turkey on the efficiency of private commercial banks. In other words, this study is trying to answer the question of whether the efficiency of the private Turkish commercial banking sector increased after the liberalization process during the 1980s.This study considers the efficiency of banks in creating a net profit given the costs that they have incurred to remain operational. This study used Data Envelopment Analysis and covered the period between 1990 and 2000.As a result, it was found that the efficiency of the private Turkish commercial banking sector did not increase annually during the period in question after the liberalization process of the 1980s but during global crisis efficiency levels fluctuated significantly. Another finding is that foreign private commercial banks were more efficient compared to their domestic rivals.

Chansarn (2008) examined the relative efficiency of 13 Thai commercial banks during the years 2003-2006 by using Data Envelopment Analysis. This study investigates the relative efficiency of commercial banks in different classes, such as large, medium and small. Operation and intermediation approaches are used to evaluate the relative efficiency of Thai banks. By operation approach, interest expenses, labor-related expenses and capital-related expenses are defined as inputs. Interest and dividend incomes and non-interest incomes are defined as outputs. By intermediation approach, total deposits and total expenses are defined as inputs. Total loans and net investments are defined as outputs. The results of this study show that it is noticeable that banks are more efficient in operation approach than in intermediation approach.

Gaganis and Pasiouras (2009) examined the impact of ownership on efficiency in Greece banking sector. This study compares 18 foreign banks with 21 domestic banks during 1999-2004. As a result, it was decided that domestic banks were more technically efficient in most of the years. On the other hand, foreign banks were more scale efficient. There is no evidence to support the argument that ownership has a statistically significant impact on efficiency.

Bedhioğlu and Özcan (2009) studied the effectiveness of Turkish banking sector by grouping them according to their capital structure (private-public-foreign) and scale size (small-medium-large). The data of 29 trade banks which have been continuously operating in the sector between the years 1999 and 2005 is used by DEA application. Inputs are determined as number of personnel, number of branch, interest expenses and non-interest expenses where the outputs are defined as total loans, total credits and net profit. Efficiency rates of those banks have been calculated according to input-oriented CCR Model by classifying them according to their capital structure and scale-size. As a result, the most efficient banks are found as foreign banks and then followed by public and private banks. According to their scale-size, the most efficient banks are big size banks, and followed by small and medium size banks come. Vakıflar Bankası, Ziraat Bankası, Akbank, Koçbank, Türk Ekonomi Bankası, ABN AMRO Bank, Bank Mellat, Citibank and JPMorgan Chase Bank are determined as efficient and the other banks are inefficient by using input-oriented CCR Model.

An article of Camanho and Dyson (1999) studied the performance of the branches of Portuguese banks by the application of DEA. Data of 168 bank branches were analyzed in 1996. The customers of these branches are generally individuals and small business enterprises who are likely to show similar patterns of activities in banking. The selected inputs are employee number in the branch, floor space of the branch, operational costs and number of external ATMs. The selected outputs are number of general service transactions by the employees, number of transactions in external ATMs, number of accounts at the branch, value of savings and value of loans. The results of DEA show that, the average technical efficiency for the entire sample is 78% and that only 34 branches (20%) are operating efficiently. That is, there is scope for efficiency improvements in 134 branches. The least efficiently used inputs are found as floor space and operational costs and the best-used input is found as labour (number of employees).

Gümüş and Çelikkol (2011) studied the performance of non-financial entities listed on the Istanbul Stock Exchange by using DEA and ratio analysis. The study investigates the relationship between the results of the financial analysis and DEA by focusing on the manufacturing companies listed on Istanbul Stock Exchange for the period from 2005 to 2008. DEA efficiency scores are calculated by using CCR model to measure the total efficiency score. Inputs are total assets, total equity and cost of goods sold, and output is net sales. The results show that the deviation of DEA efficiency scores and deviations of Quick Ratio, Net-income-to-Sales, ROA, and ROE are correlated.

Quey-Jen Yeh (2011) investigated the banking enviroment in Taiwan before the deregulation in the banking industry. Data of the six largest commercial banks in Taiwan were used in the application of DEA. Inputs are determined as interest expenses, non-interest expenses and total deposits. Outputs are determined as interest income, non-interest income and total loans. The results show that DEA scores generally decreased between the year 1982 and 1986, then began to increase. This change coincided with the drop in the business cycle that occurred in Taiwan in the mid 1980s, perhaps indicating the influence of economic conditions on banking business. These results seem to confirm the validity of DEA in evaluating bank performances with an emphasis on the essential intermediary functions of a bank.

Vassiloglou and Giokas (1990) evaluated the relative efficiency of the 20 branches of Commercial Bank of Greece by using Data Envelopment Analysis. All branches locate in Athens and their operations and transactions are similar. The inputs are labour, a variety of supplies, branch installation and number of computer terminals. Branch output was measured in terms of the number of transactions processed at each branch. Among 20 branches, nine of them are efficient (E=1) and the 11 of them are relatively inefficient.

Fotios Pasiouras (2008) studied cross-country samples from 95 country during the estimation of 715 banks' efficiency. This study employs data envelopment analysis and Tobit regression to examine the impact of regulations and supervision approaches related to capital adequacy, private monitoring, banks' activities, deposit insurance schemes, disciplinary power of the authorities, and entry into banking on banks' technical efficiency. The inputs are selected as customer deposits and short term funding (i.e. total deposits), total costs (interest expenses and non-interest expenses), and equity for the DEA. The 3 outputs are loans, other earning assets, and non-interest income. According to the DEA, the most efficient region appears to

be Asia Pacific and while the least efficient region is Latin America and Caribbean. As for the size of scale, the least inefficient banks operate in Asia Pacific as opposed to banks operating in Australia.

Ngo Dang-Thanh (2011) evaluates the effectiveness of the banking sectors in 64 countries in 2010 and intends to define how the global banking systems is under the effect of the current crisis, using the data envelopment analysis approach. In this research, there are 3 stages. In the first stage, a dynamic DEA model (DSW model) is conducted to calculate the maximum effectiveness scores that each country can achieve with the observed (achievement) factors. In the next step, a Tobit regression is used to determine the factors affecting the countrys banking efficiencies. The last stage is to define the optimal common set of weights which should be used for compare and ranking countries based on their banking systems' effectiveness, by appling the CSW model. It can be concluded that the last economic crisis has more negative effects on the developed countries than the developing countries but they run better than the developing countries. Reasons related with the development of the banking sector in quantity (number of bank branches) and more importantly in quality aspects (including the NPL ratio, public credit bureau coverage, bank concentration, bank's capital, and cost-income ratio). It is also included the effect of economic development, expresses through level of income (group) and inflation rates.

3. TURKISH BANKING SECTOR

Banks, the financial institutions that serve to fund suppliers and fund demanders, are significantly affected by the financial instabilities or unexpected economic changes. There are close relations among the banking activities, the economic structure, and economic policies in a country.

Banking sector takes the most important place in both the operation of economic system and the realization of the institutional or individual activities. The foundation of banking system is based on trust, stability and strong capital formation.

The establishment and development of Turkish banking sector is not far away. The development of the Turkish banking sector was limited due to the some obstacles. Political and macroeconomic instability became a major problem in the real and financial sectors. Banks face with various financial risks and may go into bankruptcy or experience crises.

Banks operating in Turkish banking sector became more open to these kinds of risks especially in the financial liberalization period after 1980. [10] By the help of financial liberalization, Turkey left its inward-oriented policies and began to apply free-market based rules. When the economy started to have interaction with the rest of the world, new investment possibilities occurred for the real and financial sectors. The banking sector has been one of the most affected sectors from the liberalization after 1989. During the 1990s, the Turkish banking sector had been dominated by inefficient public banks and the sector had serious deficiencies such as high foreign currency, interest rate and liquidity risks. [31] High interest rates on government bonds and the overvaluation of the Turkish Lira attracted short-term capital inflows into Turkey. This hot-money mechanism caused currency and banking crisis in 1994. [53]

After the crisis, most of the banks continued to purchase government securities in space of doing their traditional banking activities. By December 1999, the government introduced a restructuring program for the years between 2000 and 2002. In the same year, an independent Banking Regulation and Supervision Agency was set up. Interest rates and inflation decreased by the help of the restructuring program. The banking crisis occurred in 2000 with a recession. The government decided to float the Turkish Lira in February 2001. Structural banking problems deepened the crisis and according a systematic banking crisis occurred. [53]

Turkish banking sector began to develop with the restructuring reforms after the 2001 crisis. Before this crisis, there was a very nontransparent and politicized banking sector but new economic program and economic conditions have had positive effects on banks. Interaction between banking sector and real sector played an important role in the success of the restructuring reforms.

Between 1999 and 2003, 20 banks were taken over by Savings Deposit Insurance Fund (SDIF) because of their losses and bad financial conditions and 11 bank mergers occurred after the financial crisis. Banking Regulation and Supervision Agency, which is an independent agency, was established in 2000 to regulate and supervise the sector.

Economic activities responded positively in a short time and expectations improved rapidly, and stability maintained in the financial markets. [55] In 2002, rate of economic growth began

to increase and continued until 2007. The global changes in economy also affected the banking sector in Turkey in a limited extend. The reasons were a high capital adequacy ratio, a high asset quality, low currency and liquidity risks due to successful risk management and effective public supervision, and good management of the interest, counterparty and maturity risks. Some reflections of global crisis in Turkish economy are as follows:

- Decrease in domestic and external demand,
- Increase in unemployment,
- Increase in budget deficit,
- Rapid decrease in interest rates.

In various countries financial institutions went bankrupt, were made public or allocated financial resources. Lehman Brothers of the USA filed for bankruptcy. Bank of America announced that the bank was going to buy off Merrill Lynch, 450 banks were confiscated in the US only in 2009, and the White House took overhaul two giant mortgage companies Fannie Mae and Freddie Mac to protect them going into bankruptcy. High-income banks and investment funds of developed countries withdrew their funds from developing countries and turned these risky assets into more liquid financial instruments.

Bankruptcy, nationalisation and resource transfers of some financial Institutions in different countries are shown in the following table. (Table 3.1)

Date	**Description**	**Resource Allocation**
7 February 2008 UK	Northem Rock was made public.	£ 88 billion
14 March 2008- USA	Bear Stearns was bought off by a commercial bank after FED subsidies.	$ 29 billion
7 September 2008-USA	Freddie Mac and Fannie Mae were made public.	$ 200 billion
15 September 2008-USA	Lehman Brothers went bankrupt.	
17 September 2008-USA	AIG was made public.	$ 87 billion
17 September 2008-UK	Lloyd TSB bought off HBOS.	£ 12 billion
29 September 2008-Benelux	Fortisbank was saved.	$ 16 billion
29 September 2009-USA	Citibank bought off Washoiva.	$ 12 billion
29 September 2008-Germany	Hypo was saved.	$ 71 billion

29 September 2008-Iceland	Glitnir was saved.	$ 850 billion
29 September 2008-UK	Bradford&Bingley was saved.	$ 32.5 billion
30 September 2008-Belgium	Dexia was saved.	$ 9.2 billion
30 September 2008-Ireland	Ireland banks were saved.	$ 572 billion
7 October 2008-Iceland	Lansbanki was made public.	
9 October 2008-Iceland	Kaupthing was made public.	$ 864 billion
12 October 2008-UK	HBOS, Royal Bank of Scotland, Lylods TSB and Barclays were saved.	$ 60.5 billion
16 October2008-Switzerland	UBS was saved.	$ 59.2 billion
19 Oct. 2008-Netherland	ING received capital aid.	€ 10 billion
20 October 2008-France	French government gave loans to six large banks.	€ 10.5 billion
27 October 2008-Belgium	KGB was publicized.	€ 3.5 billion
4 November 2008-Austria	Kommunalkredit was made public. Constantine Private bank was made public.and five Austurian Banks were bought for 1 Euro.	
11 November 2008-Kazakhstan	Four large banks received capital injection.	€ 2.7 billion
24 November 2008-USA	Citigroup was given capital aid.	$ 40 billion
22 November 2008-Irland	Anglo Irish Bank was made public. 3 large banks were transferred to the fund.	$ 7.68 billion

Table 3.1: Effects of the last financial crisis on financial institutions

As of today, a challenging banking environment exits in Turkey. Turkish banking sector is very small in terms of size, market structure, assets and liability size compared with European countries or other developed countries. [10]

In December of 2010, 49 banks existed in the Turkish banking sector. 32 of them were commercial banks, 13 of them were development and investment banks. Those banks were the members of Banks Association of Turkey. Remaining 4 banks in the country were participation banks and are the members of the Participation Banks Association of Turkey.

In December of 2011, the whole Turkish banking sector was operating with 195.292 employees and 10.518 branches. In one year, the number of employees increased by 4112 and

the number of branches increased by 452. At the end of 2011, the number of operating banks in Turkish banking sector was 48, which 31 of them were commercial banks, and 13 of them were development and investment banks. The other 4 banks in the sector were participation banks and were the members of the Participation Banks Association of Turkey. [23]

The commercial banks do not have participation accounts and the participation banks are not allowed to accept deposits. The development and investment banks are not allowed to issue deposit and participation certificates. Because of these differences, only commercial banks are included in this study.

As at the end of December 2006, the number of branches in the banking system including Turkey and abroad was 7204. Until the end of December 2011, the number of branches increased by 54 percent and reached to 10072.

4. DATA ENVELOPMENT ANALYSIS

Up until now, a large number of studies tried to measure the efficiency of banks. One of the most widely used and popular methods is Data Envelopment Analysis, which was originally developed by Charnes, Cooper and Rhodes in 1978. It is a non-parametric mathematical model that measures the efficiency of a bank relative to a best-practice bank on the efficiency frontier. DEA has been applied in many sectors such as: health care (hospitals, doctors), education (schools, universities), banks, manufacturing, management evaluation, fast food restaurants, and retail stores. This model was first applied to the banking sector by Sherman and Gold in their study of "Bank Branch Operating Efficiency: Evaluation with Data Envelopment Analysis" in the year of 1985.

The main difference between a typical statistical approach and DEA is that a typical statistical approach evaluates producers relative to an average producer and DEA compares each producer with the best producers. [46]

This approach measures the efficiency of a decision-making unit (DMU) relative to other similar DMUs with the simple restriction that all DMUs lay on or below the efficiency frontier. Generally a DMU is regarded as the entity responsible for converting inputs to outputs and whose performance is evaluated. DMU's may include banks, department stores, supermarkets, schools or hospitals. The use of DEA is to characterize the so-called efficient

frontier based on the available set of DMUs and project all DMUs onto this frontier. If a DMU lies on the frontier, it is referred to as an efficient unit; if not, it is labelled as inefficient.

The efficiency of a Decision Making Unit (DMU) is basically the ratio of the inputs to the outputs and cannot be more than 1. Efficiency score less than one is assigned as inefficient unit and the score reflects the radial distance from the estimated production frontier to the DMU. For the inefficient DMUs, DEA derives efficient input and output targets and a reference set, corresponding to the subset of efficient DMUs to which they were directly compared.

DEA takes into account multiple inputs and outputs to produce a single aggregate measure of relative efficiency for each DMU. Selected inputs and outputs must be quantifiable. DEA evaluates all the DMU'S and all their inputs and outputs simultaneously, and find out the sets of efficient and inefficient DMUs. Because of that, variable selection is a critical process in efficiency studies because it affects the results. When unnecessary variables are selected, interpretation of results becomes problematic. As the number of inputs and outputs increase, more DMUs have a tendency to get the efficiency score of 1 as they become too specialized to be evaluated with respect to other units. On the other hand, if there are too few inputs and outputs, more DMUs tend to be comparable.

It is important to select the approtiate inputs and outputs in Data Envelopment Analysis to measure the relative efficiency of the DMUs. There are 2 widely used approaches to identify a bank’s inputs and outputs. One of them is the production approach and it was firstly studied by Sherman and Gold in 1985. The other approach is intermediation approach.

The role of a commercial bank is summarized as follows. To explain in detail, a commercial bank accepts deposits from households and other money lenders and transfers those deposits into lending activities. Production approach and intermediation approach discuss the activities of the banks. In the production approach, banking activities are defined as the production of services to depositors and borrowers. The workforce is calculated as the total number of employees and workforce costs, whereas the capital is generally viewed as fixed assets. Deposits and loans, which constitute outputs, are generally considered the total deposits and loan amounts on the balance sheet, but the total number of deposits and loan accounts can also be used. [58]

By the intermediation approach, banking activities are described as transforming money from lenders to borrowers. In other words, it is the function of banks to convert the deposits that they collect and other funds into loans, and this conversion process requires capital and labor. Inputs are generally composed of funds and the cost of collecting funds. Outputs, on the other hand, include loans, interest revenue and investments. [58]

The third method is the "profitability" approach, in which it is assumed that the primary goal of a bank is to make a profit or to increase its profitability. Based on the need to reduce costs and boost revenues, the bank uses interest and non-interest expenses as inputs, whereas the outputs are net interest revenue and non-interest revenue. [58]
This study uses the Charnes, Cooper and Rhodes (CRR) input-minimization Data Envelopment Analysis Model.

5. CCR-MODEL

This model was introduced by Charnes, Cooper and Rhodes in 1978. Decision Making Unit (DMU) refers to any entity that is to be evaluated in terms of its abilities to convert inputs into outputs and this model evaluates the performance of Decision Making Units. In other words, this model uses multiple inputs and outputs to evaluate relative efficiency, and calculate the production frontier of valuating units to calculate the relative efficiency of each evaluating unit. The Dual of the CCR model is given as follows.

$$Max \quad h_k \models \frac{\sum_{r=1}^{s} u_r . y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}}$$

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

$$u_r, v_i \geq \varepsilon > 0 \qquad (1)$$

r = 1 to s,

i = 1 to m,

j = 1 to n,

yrj = amount of output k produced by DMUi,

xij = amount of output j produced by DMUi,

ur = weight given to output k,

vi = weight given to output j,

The fractional program shown as (1) can be changed to a linear program as shown in (2).

$$\begin{aligned} Max \quad & h_k = \sum_{r=1}^{s} u_r y_{rk} \\ s.t \quad & \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 , \quad j = 1,...,n \\ & \sum_{i=1}^{m} v_i x_{ik} = 1 \\ & u_r, v_i \ge \varepsilon > 0 \end{aligned} \qquad (2)$$

The above problem has been run in identifying the relative efficiency scores of all the DMUs. Each DMU selects input and output weights that maximize its efficiency score. Generally, a DMU is defined as efficient if the score is 1. A score of less than 1 means inefficient. For every inefficient DMU, DEA identifies a set of corresponding efficient units that can be utilized as benchmarks which can be obtained from the dual problem shown as (3).

$$\begin{aligned} Min \quad & h_k = \theta_k - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right) \\ s.t \quad & \theta_k x_{ik} \models s_i^- + \sum_{j=1}^{n} \lambda_j x_{ij} , \quad i = 1,...,m \\ & y_{rk} = -s_r^+ + \sum_{j=1}^{n} \lambda_j y_{rj} , \quad r = 1,...,s \\ & \lambda_i, s_r^+, s_i^- \ge 0 , \quad j = 1,...,n \end{aligned} \qquad (3)$$

Based on the above-mentioned function, a sample DMU is inefficient if a composite DMU (linear combination of units) can be identified which utilizes less input than the test DMU while maintaining at least the same output levels. The best performance DMU can be utilized as benchmarks for improving the inefficient sample.

$$x_{ik}^* = \theta_k x_{ik} - s_i^- , \quad i = 1,...,m \qquad (4)$$

$$y_{rk}^* = y_{rk} + s_r^+ , \quad r = 1,...,s \qquad (5)$$

6. EMPIRICIAL RESULTS

In this section, the main question which is "How did the efficiency of the Turkish banking industry for the period 2006-2011changed?" will be tried to be answered by showing and discussing the empirical results of the study. At first, the methodology of the study will be explained in detail. Then, empirical results for both a 6 year and a 2 sequantial year time horizon will be presented.

6.1.Data and Methodology of the study

Data Gathering: Annual data from 2006 through 2011 has been collected from the banks' balance sheets, income statements, their websites and related web pages.

Methodology: Data Envelopment Analysis technique is used to investigate the efficiency of the banks. As the DEA is a linear programming model that measures the efficiency of decision making units (DMU's) in multiple-inputs and multiple-outputs setting, the following multiple input-output variable are selected.

The inputs used for each bank are:

- number of branches,
- number of personnel,
- total loans.

The outputs used are:

- net profit/loss,
- non-accruing loans,
- total deposits,
- net interest income.

This study covered the years 2006-2011 to understand whether the economic crisis in 2008 affected the efficiency of the banks in Turkey. 3 state-owned commercial banks and 10 privately-owned commercial are included in this study. A sample of commercial banks are selected for this study.

Investment, development and participation banks are discluded because of their characteristics. Investment and development banks are not allowed to issue deposit and

participation certificates. Development and investment banks are the institutions operating primarily for the purposes of granting loan and/or fulfill the duties assigned thereto by their special Laws. Participation banks are the institutions operating primarily for the purpose of collecting fund through participation accounts and granting loan. On the other hand, commercial banks accept deposits, give loans and provide some investment products.

All those selected banks have been operating during the study period. The list of banks included in this study is shown on the Table 6.1.

State-Owned Banks
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.
Türkiye Halk Bankası A.Ş.
Türkiye Vakıflar Bankası T.A.O.
Privately-Owned Banks
Adabank A.Ş.
Akbank T.A.Ş.
Alternatif Bank A.Ş.
Anadolubank A.Ş.
Şekerbank T.A.Ş.
Turkish Bank A.Ş.
Türk Ekonomi Bankası A.Ş.
Türkiye Garanti Bankası A.Ş.
Türkiye İş Bankası A.Ş.
Yapı ve Kredi Bankası A.Ş.

Table 6.1: List of Banks Included in this Study

6.2.Results and Analysis

6.2.1. Six-Years Observation Period

Based on the previously mentioned data, DEA efficiency scores are calculated for each bank for the period 2006-2011. MATLAB (matrix laboratory) program which was developed by Mathworks is used for calculation.

DEA efficiency scores between 2006 and 2011 are shown in Table 6.2.1.1.

Name of Bank	**Year**	**Efficiency Score**	**Efficiency**
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2006	1	Efficient
Türkiye Halk Bankası A.Ş.	2006	0,74691227	Inefficient

Türkiye Vakıflar Bankası T.A.O.	2006	0,79663882	Inefficient
Adabank A.Ş.	2006	1	Efficient
Akbank T.A.Ş.	2006	0,92374113	Inefficient
Alternatif Bank A.Ş.	2006	0,84236004	Inefficient
Anadolubank A.Ş.	2006	0,60306288	Inefficient
Şekerbank T.A.Ş.	2006	0,3969222	Inefficient
Turkish Bank A.Ş.	2006	1	Efficient
Türk Ekonomi Bankası A.Ş.	2006	0,62174792	Inefficient
Türkiye Garanti Bankası A.Ş.	2006	0,84298008	Inefficient
Türkiye İş Bankası A.Ş.	2006	0,67362466	Inefficient
Yapı ve Kredi Bankası A.Ş.	2006	0,64465839	Inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2007	1	Efficient
Türkiye Halk Bankası A.Ş.	2007	0,78761863	Inefficient
Türkiye Vakıflar Bankası T.A.O.	2007	0,75723349	Inefficient
Adabank A.Ş.	2007	1	Inefficient
Akbank T.A.Ş.	2007	0,94946579	Inefficient
Alternatif Bank A.Ş.	2007	0,78837684	Inefficient
Anadolubank A.Ş.	2007	0,76204481	Inefficient
Şekerbank T.A.Ş.	2007	0,59609362	Inefficient
Turkish Bank A.Ş.	2007	1	Efficient
Türk Ekonomi Bankası A.Ş.	2007	0,53106337	Inefficient
Türkiye Garanti Bankası A.Ş.	2007	1	Efficient
Türkiye İş Bankası A.Ş.	2007	0,69751103	Inefficient
Yapı ve Kredi Bankası A.Ş.	2007	0,60999888	Inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2008	1	Efficient
Türkiye Halk Bankası A.Ş.	2008	0,7680098	Inefficient
Türkiye Vakıflar Bankası T.A.O.	2008	0,79972473	Inefficient
Adabank A.Ş.	2008	1	Efficient
Akbank T.A.Ş.	2008	0,86811678	Inefficient
Alternatif Bank A.Ş.	2008	1	Efficient
Anadolubank A.Ş.	2008	0,80289296	Inefficient
Şekerbank T.A.Ş.	2008	0,73357744	Inefficient
Turkish Bank A.Ş.	2008	0,61820971	Inefficient
Türk Ekonomi Bankası A.Ş.	2008	0,52015137	Inefficient
Türkiye Garanti Bankası A.Ş.	2008	0,8518593	Inefficient
Türkiye İş Bankası A.Ş.	2008	0,72799145	Inefficient
Yapı ve Kredi Bankası A.Ş.	2008	0,60545561	Inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2009	1	Efficient
Türkiye Halk Bankası A.Ş.	2009	0,8374444	Inefficient
Türkiye Vakıflar Bankası T.A.O.	2009	1	Efficient
Adabank A.Ş.	2009	0,98732038	Inefficient
Akbank T.A.Ş.	2009	1	Efficient
Alternatif Bank A.Ş.	2009	0,82140565	Inefficient

Anadolubank A.Ş.	2009	0,7979196	Inefficient
Şekerbank T.A.Ş.	2009	0,73139995	Inefficient
Turkish Bank A.Ş.	2009	0,58365324	Inefficient
Türk Ekonomi Bankası A.Ş.	2009	0,51086256	Inefficient
Türkiye Garanti Bankası A.Ş.	2009	1	Efficient
Türkiye İş Bankası A.Ş.	2009	0,84513919	Inefficient
Yapı ve Kredi Bankası A.Ş.	2009	0,78712009	Inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2010	1	Efficient
Türkiye Halk Bankası A.Ş.	2010	0,88633784	Inefficient
Türkiye Vakıflar Bankası T.A.O.	2010	0,88474147	Inefficient
Adabank A.Ş.	2010	0,68490331	Inefficient
Akbank T.A.Ş.	2010	1	Efficient
Alternatif Bank A.Ş.	2010	0,55260426	Inefficient
Anadolubank A.Ş.	2010	0,73025259	Inefficient
Şekerbank T.A.Ş.	2010	0,57011876	Inefficient
Turkish Bank A.Ş.	2010	0,54086294	Inefficient
Türk Ekonomi Bankası A.Ş.	2010	0,48071861	Inefficient
Türkiye Garanti Bankası A.Ş.	2010	1	Efficient
Türkiye İş Bankası A.Ş.	2010	0,87275136	Inefficient
Yapı ve Kredi Bankası A.Ş.	2010	0,78871128	Inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2011	0,95132004	Inefficient
Türkiye Halk Bankası A.Ş.	2011	0,94979878	Inefficient
Türkiye Vakıflar Bankası T.A.O.	2011	0,97359413	Inefficient
Adabank A.Ş.	2011	0,85180578	Inefficient
Akbank T.A.Ş.	2011	0,96933659	Inefficient
Alternatif Bank A.Ş.	2011	0,68657973	Inefficient
Anadolubank A.Ş.	2011	0,74701568	Inefficient
Şekerbank T.A.Ş.	2011	0,57239643	Inefficient
Turkish Bank A.Ş.	2011	0,56868742	Inefficient
Türk Ekonomi Bankası A.Ş.	2011	0,56539655	Inefficient
Türkiye Garanti Bankası A.Ş.	2011	1	Efficient
Türkiye İş Bankası A.Ş.	2011	0,89237711	Inefficient
Yapı ve Kredi Bankası A.Ş.	2011	0,82821729	Inefficient

Table 6.2.1.1: Efficiency Scores of Banks

According to the efficiency values in Table 6.2.1.2, it is seen that average efficiency score is between 0,769 and 0.839. The less efficient year is 2010. The score fluctuates over the years and shows no significiant improvement in this period. Only three banks (23,08%) were found efficient in four years (2006, 2007, 2008, 2010). When the global financial crisis occured in 2008 and has some negative effects to Turkey in 2009, it seems that the efficiency scores and number of efficient banks are not effected accordingly. The table further indicates that the

average efficiency score is in its highest level in 2009. The sector is in its lowest level in 2010. When the entire 6 years period is considered, the efficiency level of the sample of the banks did not influenced by the crisis.

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Average efficiency score	0,776	0,806	0,792	0,839	0,769	0,812
Standart deviation	0,18	0,17	0,15	0,16	0,19	0,17
Number of efficient banks	3	3	3	4	3	1
Percentage of efficient banks (%)	23,08	23,08	23,08	30,77	23,08	7,69

Table 6.2.1.2: DEA Results

A comparison between domestic and foreign banks is shown in Table 6.2.1.3 and 6.2.1.4. According to this table, state-owned banks are more efficient, which means average efficiency scores and percentage of efficient banks are higher than privately-owned banks. Türkiye Cumhuriyeti Ziraat Bankası A.Ş. has an efficiency score of 1 for the whole period, except 2011 and is the most efficient bank among 13 Turkish banks.

Year	**2006**		**2007**		**2008**	
	State	**Private**	**State**	**Private**	**State**	**Private**
Average efficiency score	0,85	0,755	0,85	0,793	0,86	0,773
Standart deviation	0,13	0,198	0,13	0,184	0,13	0,163
Number of efficient banks	1	2	1	3	1	2
Percentage of efficient banks (%)	0,33	0,2	0,33	0,3	0,33	0,2

Table 6.2.1.3: DEA Results (2006-2008)

Year	**2009**		**2010**		**2011**	
	State	**Private**	**State**	**Private**	**State**	**Private**
Average efficiency score	0,946	0,806	0,924	0,722	0,958	0,768
Standart deviation	0,094	0,167	0,066	0,19	0,013	0,166
Number of efficient banks	2	2	2	2	2	1
Percentage of efficient banks (%)	0,67	0,2	0,67	0,2	0,67	0,1

Table 6.2.1.4: DEA Results (2009-2011)

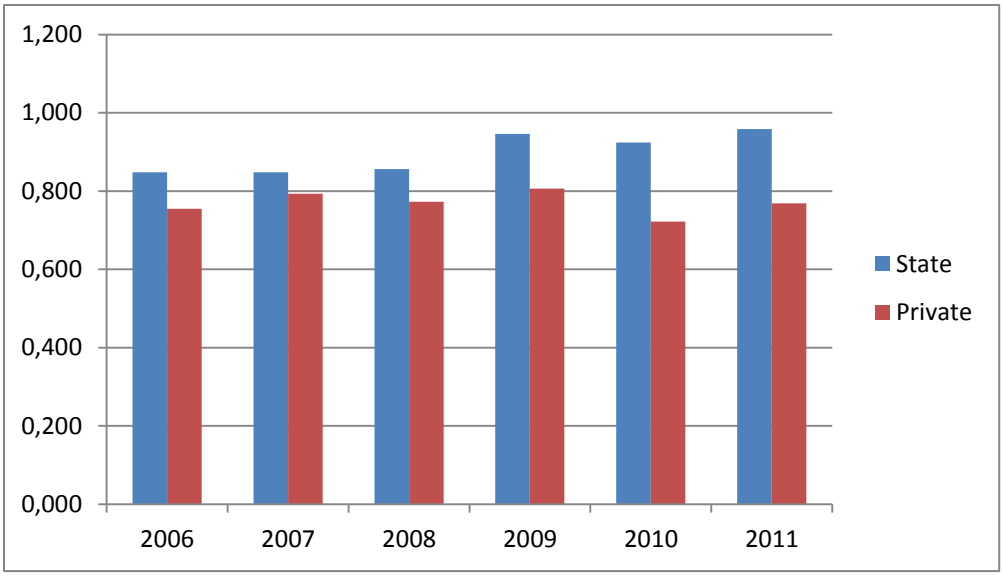

Figure 6.2.1.1: Efficiency Score Analysis of Privately/ State-owned Banks

As compared the efficiency scores of privately and state-owned banks in Figure 6.2.1.1, it is obvious that these banks did not influenced by the economic crisis. State-owned banks have the highest average efficiency score in 2011. On the other hand, privately banks have the highest score in 2009 when the global economic crisis began to show its negative effects in Turkey. The main question of this study has attempted to answer how the efficiency of privately and state-owned commercial banks in Turkey changed before and after domestic and foreign economic crisis. According to the results obtained, the relative efficiency of this sample of banks generally did not decline during the crisis.

It is necessary to indicate that on the above analysis the dataset contains the inputs and outputs of the whole 6-years period. Also, the efficiency scores are calculated accordingly.

6.2.2. Sequential Two-Years Observation Period

The following analysis investigates the efficiency scores of banks calculated for the sequential 2 years period.

6.2.2.1. Sequential Two-Years Observation Period for the years 2006-2007

As resulted in Table 6.2.2.1.1, 26 efficiency scores are calculated for the years 2006-2007.

Name of Bank	Efficiency Score	Description
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	0,835	inefficient
Türkiye Vakıflar Bankası T.A.O.	1	efficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	0,992	inefficient
Alternatif Bank A.Ş.	0,904	inefficient
Anadolubank A.Ş.	0,603	inefficient
Şekerbank T.A.Ş.	0,618	inefficient
Turkish Bank A.Ş.	1	efficient
Türk Ekonomi Bankası A.Ş.	0,622	inefficient
Türkiye Garanti Bankası A.Ş.	0,962	inefficient
Türkiye İş Bankası A.Ş.	0,872	inefficient
Yapı ve Kredi Bankası A.Ş.	0,837	inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	0,89	inefficient
Türkiye Vakıflar Bankası T.A.O.	1	efficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	1	efficient
Alternatif Bank A.Ş.	0,897	inefficient
Anadolubank A.Ş.	0,78	inefficient
Şekerbank T.A.Ş.	0,656	inefficient
Turkish Bank A.Ş.	1	efficient
Türk Ekonomi Bankası A.Ş.	0,581	inefficient
Türkiye Garanti Bankası A.Ş.	1	efficient
Türkiye İş Bankası A.Ş.	0,852	inefficient
Yapı ve Kredi Bankası A.Ş.	0,775	inefficient

Table 6.2.2.1.1: Efficiency scores for the years 2006-2007

According to the table, 10 of 26 scores could be defined as efficient. 16 of them have an efficiency score below 1 and could be defined as inefficient. Türkiye Cumhuriyeti Ziraat Bankası A.Ş. , Türkiye Vakıflar Bankası T.A.O. , Adabank A.Ş. and Turkish Bank A.Ş. are efficient in 2006 and 2007. Türk Ekonomi Bankası A.Ş. is the most inefficient bank with a score of 0,581.

Efficiency scores of state-owned and privately-owned bank are shown on Figure 6.2.2.1.1 and 6.2.2.1.2.

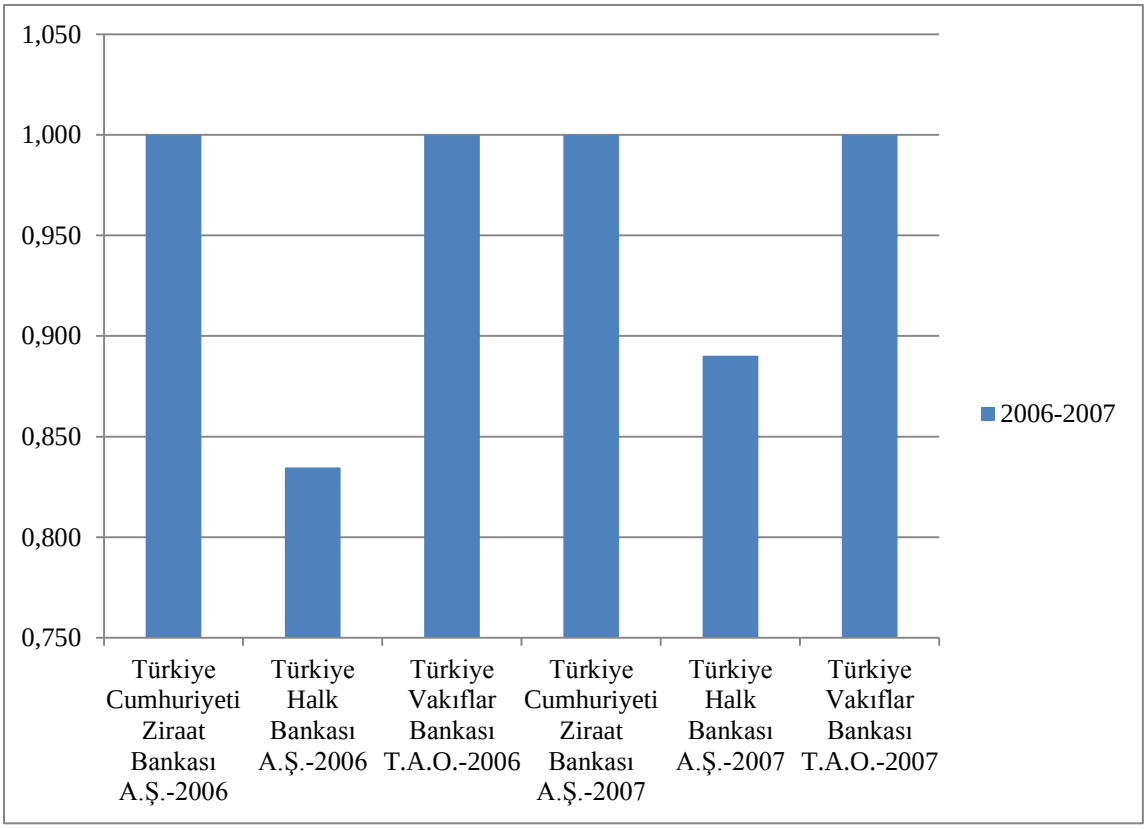

Figure 6.2.2.1.1: Efficiency scores of state-owned banks in 2006-2007

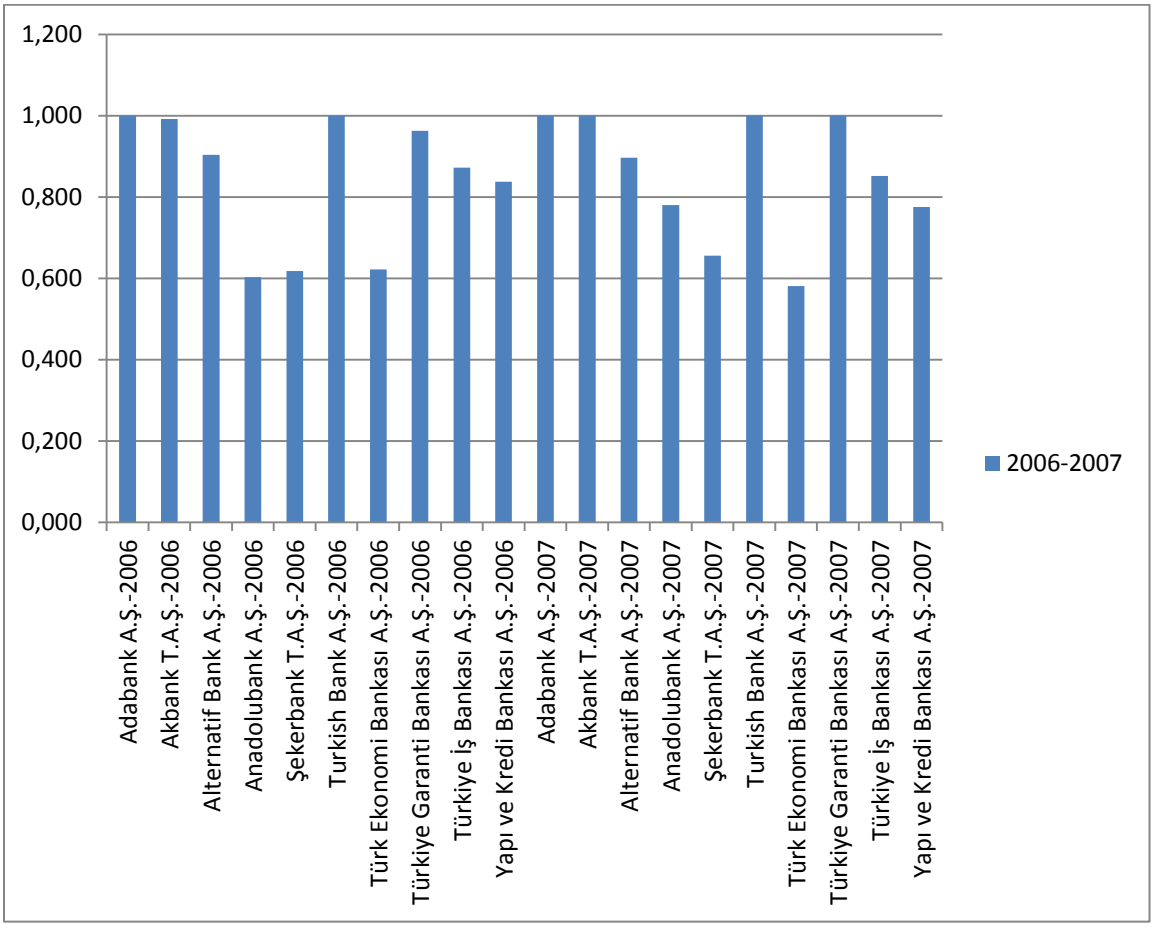

Figure 6.2.2.1.2: Efficiency scores of privately-owned banks in 2006-2007

6.2.2.2. Sequential Two-Years Observation Period for the years 2007-2008

Efficiency scores of banks are calculated for the years 2007-2008 in Table 6.2.2.2.1.

Name of Bank	Efficiency score	Description
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	Efficient
Türkiye Halk Bankası A.Ş.	0,836	Inefficient
Türkiye Vakıflar Bankası T.A.O.	0,975	Inefficient
Adabank A.Ş.	1	Efficient
Akbank T.A.Ş.	1	Efficient
Alternatif Bank A.Ş.	0,859	Inefficient
Anadolubank A.Ş.	0,78	Inefficient
Şekerbank T.A.Ş.	0,615	Inefficient
Turkish Bank A.Ş.	1	Efficient
Türk Ekonomi Bankası A.Ş.	0,58	Inefficient
Türkiye Garanti Bankası A.Ş.	1	Efficient
Türkiye İş Bankası A.Ş.	0,788	Inefficient
Yapı ve Kredi Bankası A.Ş.	0,733	Inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	Efficient
Türkiye Halk Bankası A.Ş.	0,943	Inefficient
Türkiye Vakıflar Bankası T.A.O.	1	Efficient
Adabank A.Ş.	1	Efficient
Akbank T.A.Ş.	1	Efficient
Alternatif Bank A.Ş.	1	Efficient
Anadolubank A.Ş.	0,819	Inefficient
Şekerbank T.A.Ş.	0,782	Inefficient
Turkish Bank A.Ş.	0,674	Inefficient
Türk Ekonomi Bankası A.Ş.	0,627	Inefficient
Türkiye Garanti Bankası A.Ş.	1	Efficient
Türkiye İş Bankası A.Ş.	0,889	Inefficient
Yapı ve Kredi Bankası A.Ş.	0,763	Inefficient

Table 6.2.2.2.1: Efficiency scores for the years 2007-2008

According to the table, 11 of them could be defined as efficient. Rest of the banks, which counts 15, are inefficient. Türkiye Cumhuriyeti Ziraat Bankası A.Ş. , Adabank A.Ş., Akbank T.A.Ş. and Türkiye Garanti Bankası A.Ş. are efficient in both of the years 2007 and 2008. Türk Ekonomi Bankası A.Ş. is the most inefficient bank with a score of 0,580.

Efficiency scores of state-owned and privately-owned bank are shown on Figure 6.2.2.2.1 and Figure 6.2.2.2.2.

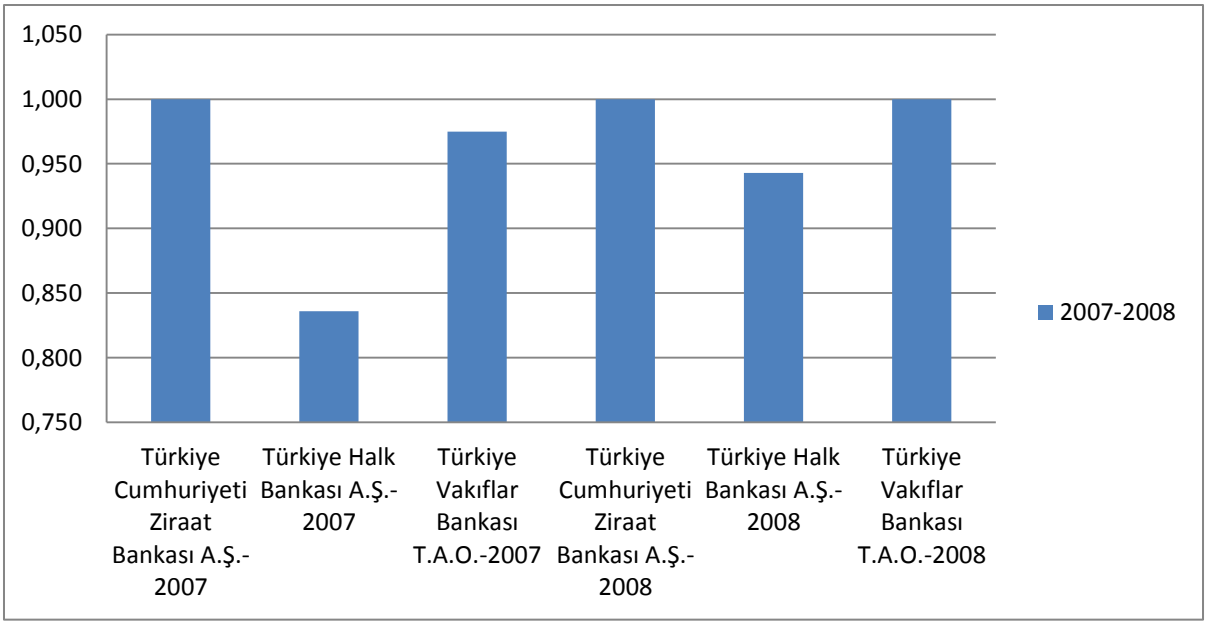

Figure 6.2.2.2.1: Efficiency scores of state-owned banks in 2007-2008

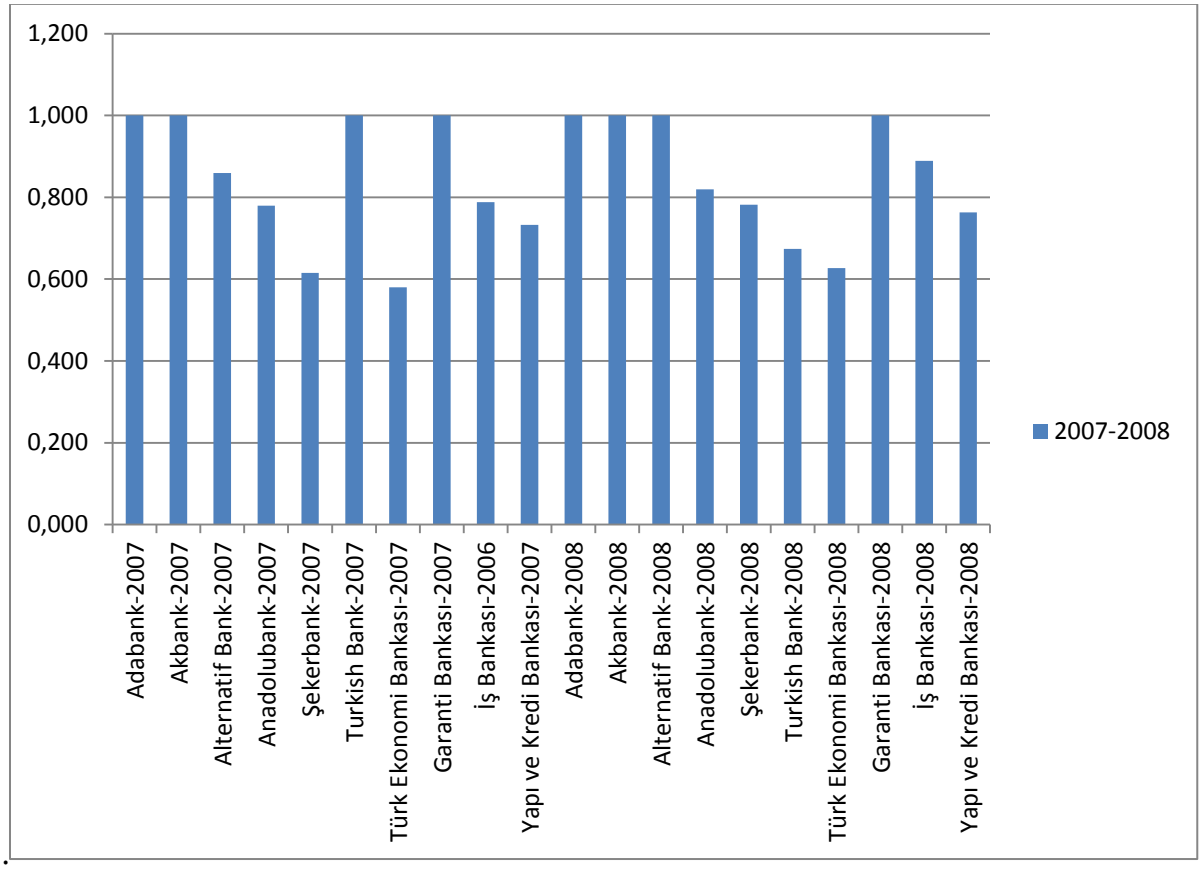

Figure 6.2.2.2.2: Efficiency scores of privately-owned banks in 2007-2008

6.2.2.3. Sequential Two-Years Observation Period for the years 2008-2009

Efficiency scores belonging to the years 2008-2009 are shown on the Table 6.2.2.3.1. According to this table, 8 of the overall efficiency value are equal to 1 which represent these are efficient. 18 values are below the efficiency score of 1 and indicates that they are inefficient. Türkiye Cumhuriyeti Ziraat Bankası A.Ş. , Türkiye Vakıflar Bankası T.A.O. and Adabank A.Ş. have the efficiency value of 1 in both of the years. The scores ranges from 0,522 to 1.

Name of Bank	**Efficiency score**	**Description**
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	0,897	inefficient
Türkiye Vakıflar Bankası T.A.O.	1	inefficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	0,92	inefficient
Alternatif Bank A.Ş.	0,77	inefficient
Anadolubank A.Ş.	0,831	inefficient
Şekerbank T.A.Ş.	0,87	inefficient
Turkish Bank A.Ş.	0,823	inefficient
Türk Ekonomi Bankası A.Ş.	0,548	inefficient
Türkiye Garanti Bankası A.Ş.	0,992	inefficient
Türkiye İş Bankası A.Ş.	0,83	inefficient
Yapı ve Kredi Bankası A.Ş.	0,72	inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	1	efficient
Türkiye Vakıflar Bankası T.A.O.	1	efficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	1	efficient
Alternatif Bank A.Ş.	0,823	inefficient
Anadolubank A.Ş.	0,841	inefficient
Şekerbank T.A.Ş.	0,861	inefficient
Turkish Bank A.Ş.	0,824	inefficient
Türk Ekonomi Bankası A.Ş.	0,522	inefficient
Türkiye Garanti Bankası A.Ş.	1	efficient
Türkiye İş Bankası A.Ş.	0,907	inefficient
Yapı ve Kredi Bankası A.Ş.	0,788	inefficient

Table 6.2.2.3.1: Efficiency scores for the years 2008-2009

On the Figure 6.2.2.3.1, efficiency scores of state-owned banks are given. Among 6 values, 5 of efficiency score values are efficient. On the Figure 6.2.2.3.2, efficiency scores of privately-owned banks are shown. Average score of state-owned banks (0,983) are higher than average score of privately-owned banks (0,844)

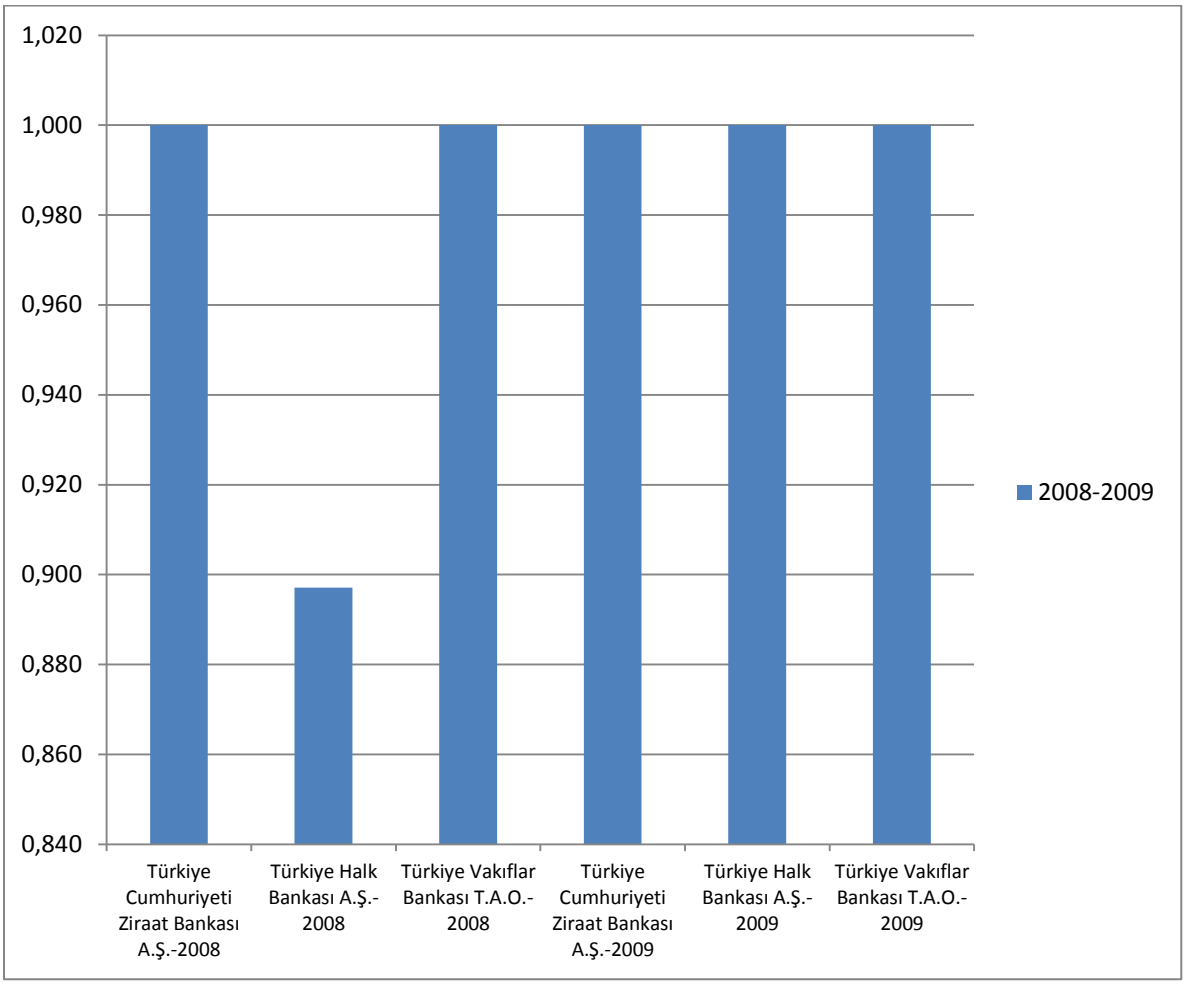

Figure 6.2.2.3.1: Efficiency scores of state-owned banks in 2008-2009

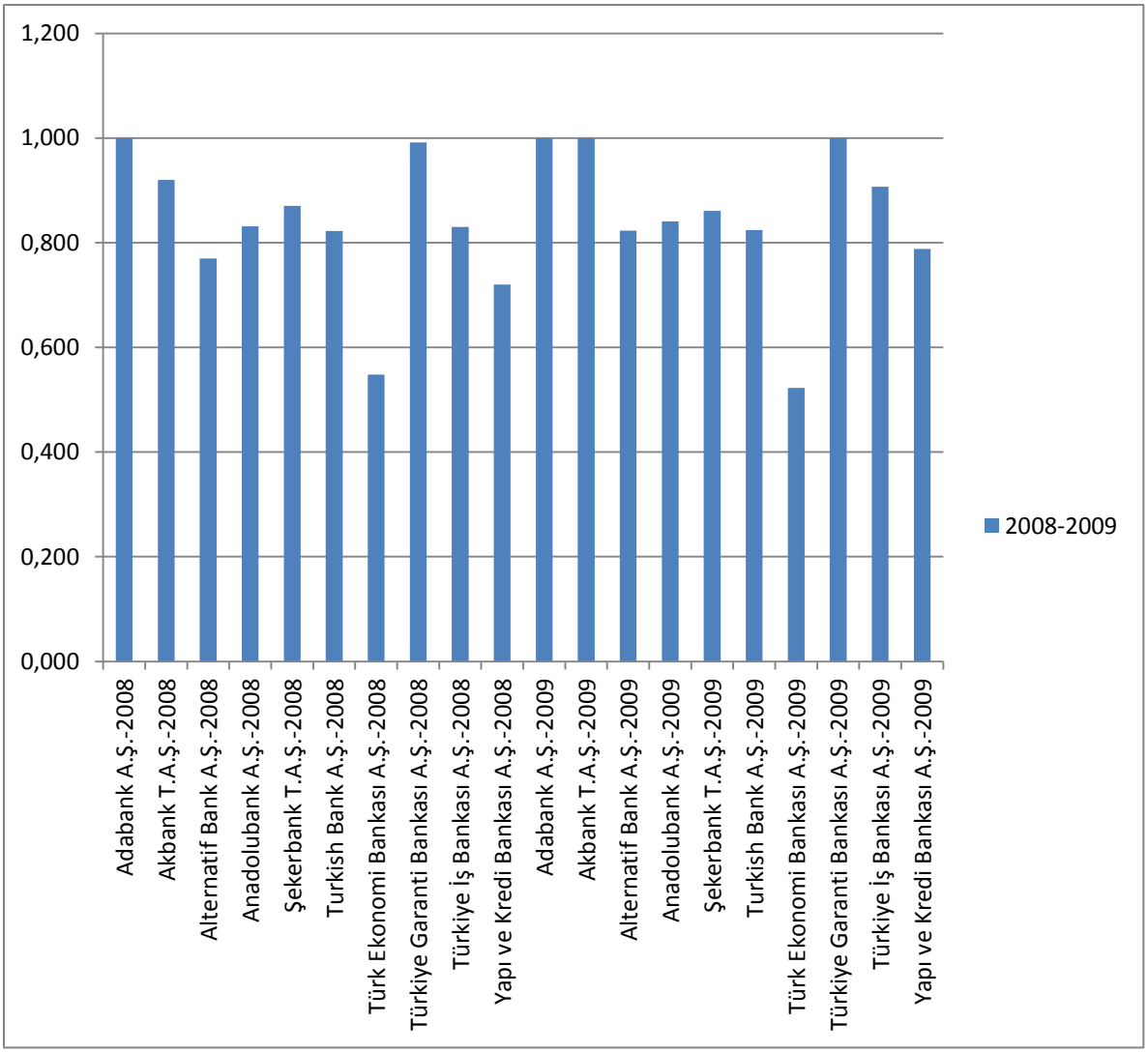

Figure 6.2.2.3.2: Efficiency scores of privately-owned banks in 2008-2009

6.2.2.4. Sequential Two-Years Observation Period for the years 2009-2010

Efficiency scores of the years 2009-2010 are shown on the Table 6.2.2.4.1. According to this table, 9 efficiency values of banks are equal to 1 and can be defined as efficient. 17 values are below the efficiency score of 1 and can be defined as inefficient. Türkiye Cumhuriyeti Ziraat Bankası A.Ş. , Adabank A.Ş., Akbank T.A.Ş. and Türkiye Garanti Bankası A.Ş. have the efficiency value of 1 in 2009 and 2010. The scores ranges from 0,481 to 1. Türk Ekonomi Bankası A.Ş. has the less score of 0,481 in 2010.

Name of Bank	Efficiency score	Description
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	0,837	inefficient
Türkiye Vakıflar Bankası T.A.O.	1	efficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	1	efficient
Alternatif Bank A.Ş.	0,831	inefficient
Anadolubank A.Ş.	0,874	inefficient
Şekerbank T.A.Ş.	0,864	inefficient
Turkish Bank A.Ş.	0,833	inefficient
Türk Ekonomi Bankası A.Ş.	0,528	inefficient
Türkiye Garanti Bankası A.Ş.	1	efficient
Türkiye İş Bankası A.Ş.	0,898	inefficient
Yapı ve Kredi Bankası A.Ş.	0,79	inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	0,898	inefficient
Türkiye Vakıflar Bankası T.A.O.	0,91	inefficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	1	efficient
Alternatif Bank A.Ş.	0,555	inefficient
Anadolubank A.Ş.	0,765	inefficient
Şekerbank T.A.Ş.	0,596	inefficient
Turkish Bank A.Ş.	0,625	inefficient
Türk Ekonomi Bankası A.Ş.	0,481	inefficient
Türkiye Garanti Bankası A.Ş.	1	efficient
Türkiye İş Bankası A.Ş.	0,882	inefficient
Yapı ve Kredi Bankası A.Ş.	0,8	inefficient

Table 6.2.2.4.1: Efficiency scores for the years 2009-2010

On the Figure 6.2.2.4.1 and 6.2.2.4.2, efficiency scores of state-owned banks and privately-owned banks are illustrated. Among 6 state-owned banks values, 3 of efficiency score values are equal to 1 and are efficient. The average score of state-owned banks is 0,941. On the other hand, 6 of privately-owned banks' efficiency score is 1. Average score total 20 efficiency values of privately-owned banks is 0,816 and is less than average score of state-owned banks.

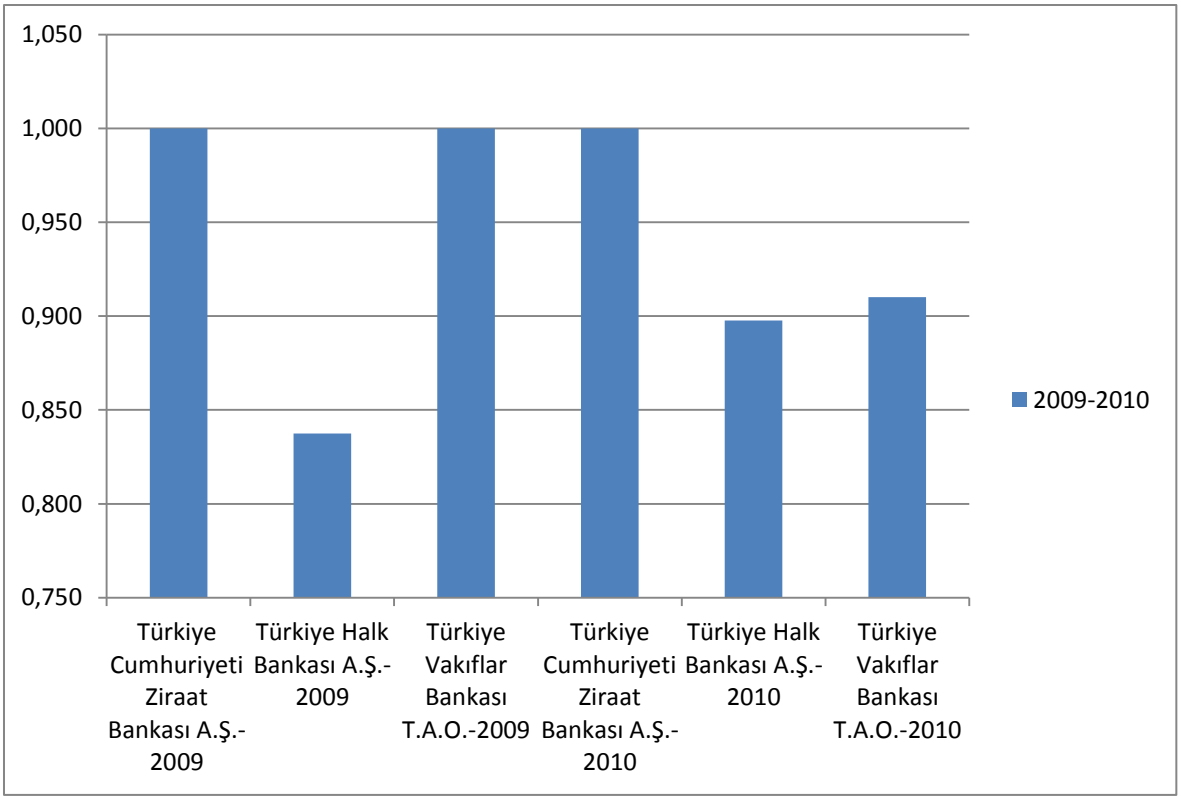

Figure 6.2.2.4.1: Efficiency scores of state-owned banks in 2009-2010

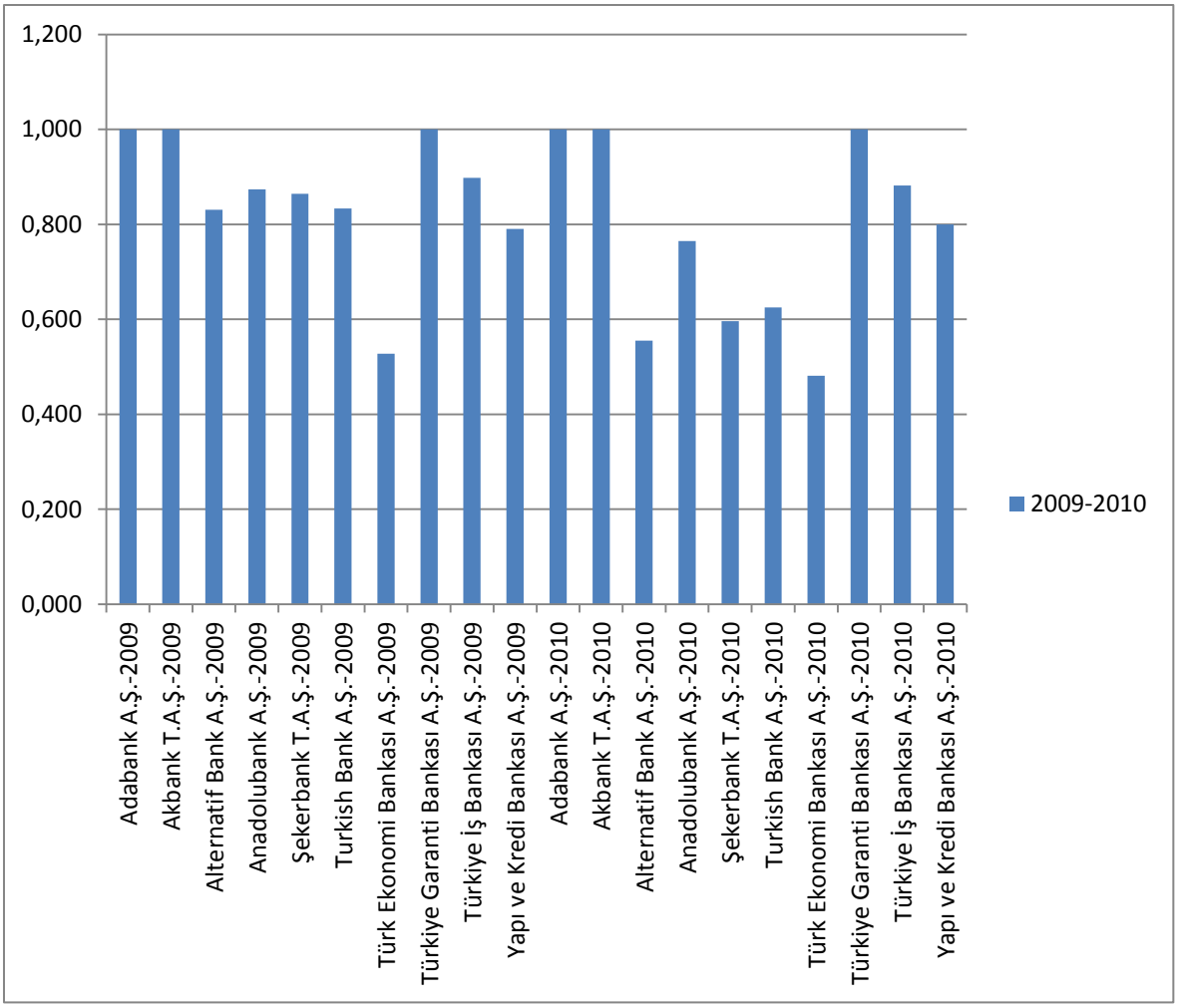

Figure 6.2.2.4.2: Efficiency scores of privately-owned banks in 2009-2010

6.2.2.5. Sequential Two-Years Observation Period for the years 2010-2011

Based on the Table 6.2.2.5.1, it's seen that there are 6 efficient and 20 inefficient scores according to the values of 2010 and 2011. Adabank A.Ş. and Türkiye Garanti Bankası A.Ş. are efficient in both years.

Name of Bank	Efficiency score	Description
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1	efficient
Türkiye Halk Bankası A.Ş.	0,911	inefficient
Türkiye Vakıflar Bankası T.A.O.	0,897	inefficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	1	efficient
Alternatif Bank A.Ş.	0,627	inefficient
Anadolubank A.Ş.	0,834	inefficient
Şekerbank T.A.Ş.	0,78	inefficient

Turkish Bank A.Ş.	0,699	inefficient
Türk Ekonomi Bankası A.Ş.	0,637	inefficient
Türkiye Garanti Bankası A.Ş.	1	efficient
Türkiye İş Bankası A.Ş.	0,881	inefficient
Yapı ve Kredi Bankası A.Ş.	0,802	inefficient
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	0,97	inefficient
Türkiye Halk Bankası A.Ş.	0,952	inefficient
Türkiye Vakıflar Bankası T.A.O.	0,974	inefficient
Adabank A.Ş.	1	efficient
Akbank T.A.Ş.	0,969	inefficient
Alternatif Bank A.Ş.	0,706	inefficient
Anadolubank A.Ş.	0,808	inefficient
Şekerbank T.A.Ş.	0,699	inefficient
Turkish Bank A.Ş.	0,935	inefficient
Türk Ekonomi Bankası A.Ş.	0,613	inefficient
Türkiye Garanti Bankası A.Ş.	1	efficient
Türkiye İş Bankası A.Ş.	0,892	inefficient
Yapı ve Kredi Bankası A.Ş.	0,828	inefficient

Table 6.2.2.5.1: Efficiency scores for the years 2010-2011

On the Figure 6.2.2.5.1 and 6.2.2.5.2 show the efficiency scores of state-owned banks and privately-owned banks. Among 6 state-owned banks values, only 1 of efficiency score values are equal to 1 and can be defined as efficient. The average score of state-owned banks is 0,951, while the average score of privately-owned banks is 0,836.

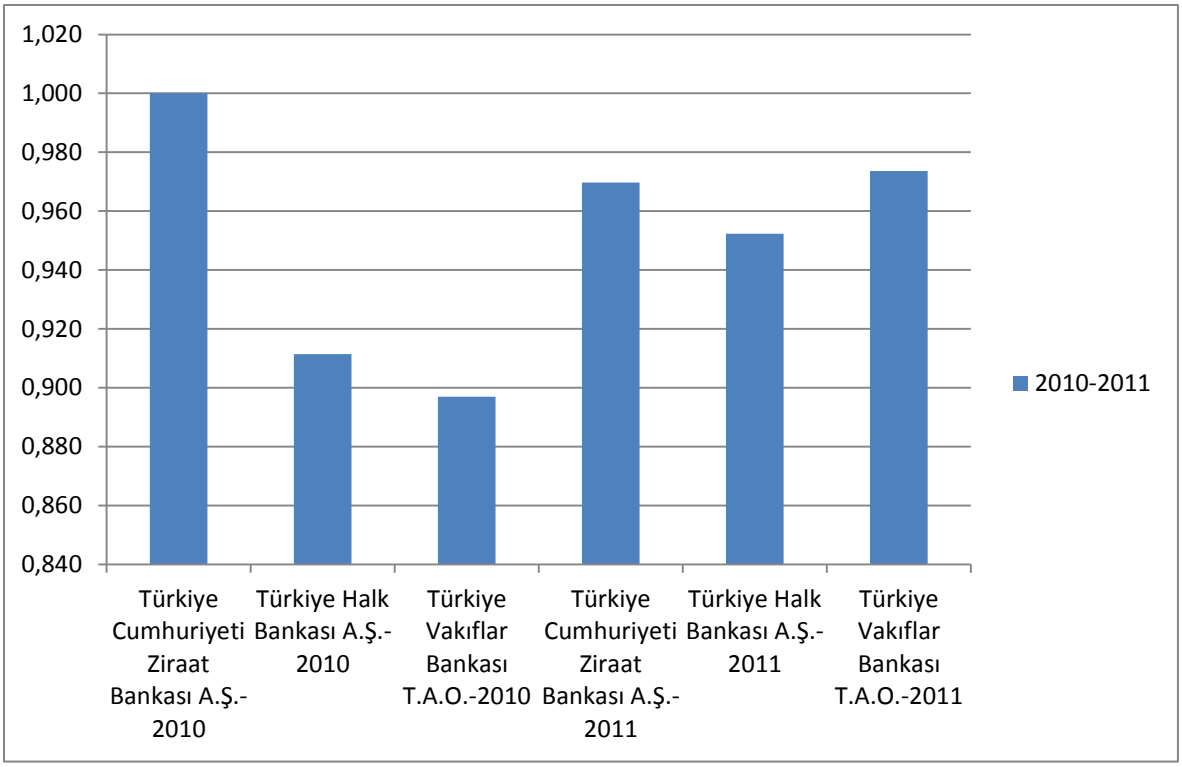

Figure 6.2.2.5.1: Efficiency scores of state-owned banks in 2010-2011

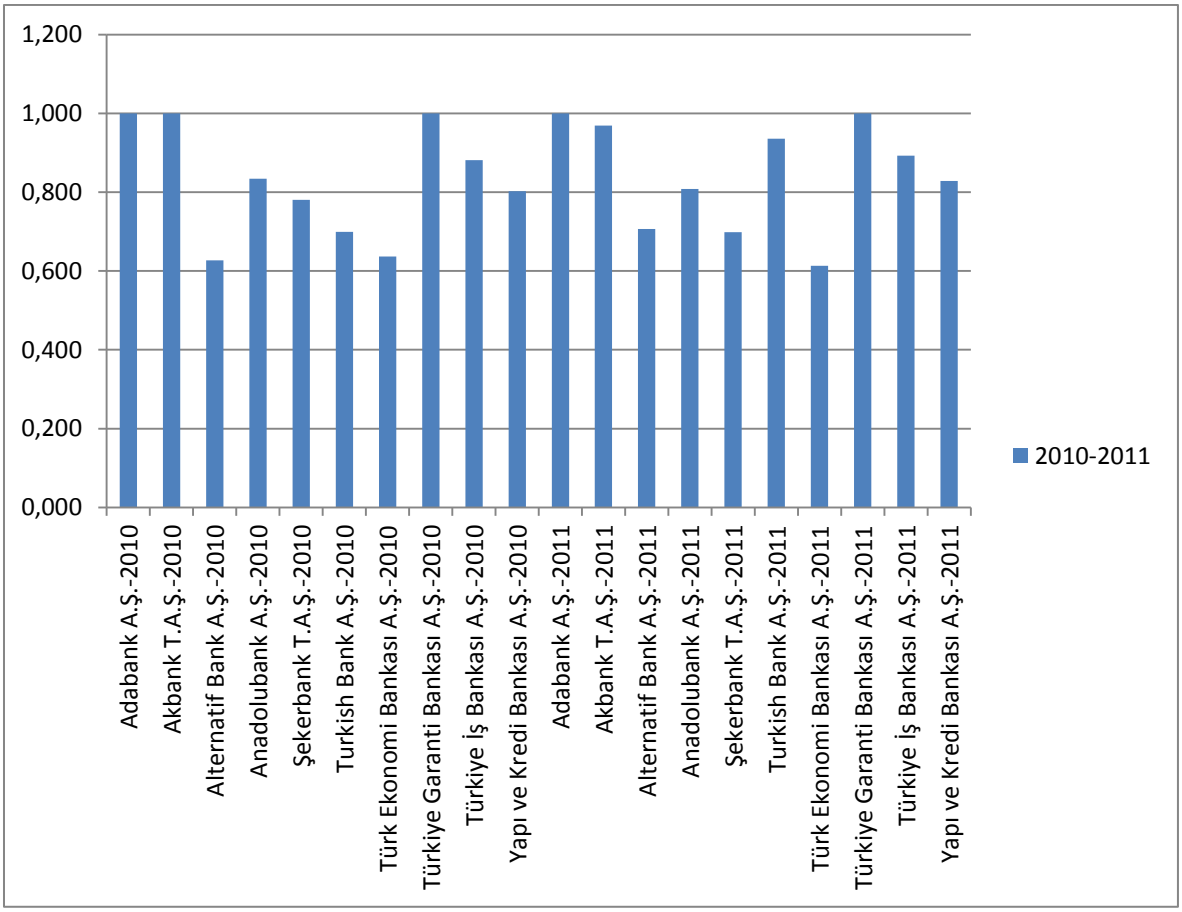

Figure 6.2.2.5.2: Efficiency scores of privately-owned banks in 2010-2011

6.3. Kruskal-Wallis one-way analysis of variance

A non-parametric method, named as Kruskal-Wallis one-way analysis of variance, is found approtiate to test the previous DEA analysis in this study. Kruskal-Wallis one-way analysis of variance is used to compare more than 2 samples which are independent from each other. It tests whether the samples originate from the same distribution. With the Kruskal-Wallis test, a chi-square statistic is used to evaluate differences in mean ranks to evaluate the null hypothesis that the medians are equal across the groups.

The data set includes efficiency scores of 13 banks between the years 2006 and 2011, and the group of the years. Because this study investigates how the banks' efficiency scores have changed over the years, the years are grouped by accordingly. The variable has 3 levels:

- Group 1 (before the crisis) : 2006 and 2007
- Group 2 (during the crisis) : 2008 and 2009
- Group 3 (after the crisis) : 2010 and 2011

The variables are selected as efficiency score and group of the years and is showed in the Table 6.3.1.

Name of Bank	**Year**	**Efficiency score (Variable 1)**	**Group (Variable 2)**
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2006	1	1
Türkiye Halk Bankası A.Ş.	2006	0,74691	1
Türkiye Vakıflar Bankası T.A.O.	2006	0,79664	1
Adabank A.Ş.	2006	1	1
Akbank T.A.Ş.	2006	0,92374	1
Alternatif Bank A.Ş.	2006	0,84236	1
Anadolubank A.Ş.	2006	0,60306	1
Şekerbank T.A.Ş.	2006	0,39692	1
Turkish Bank A.Ş.	2006	1	1
Türk Ekonomi Bankası A.Ş.	2006	0,62175	1
Türkiye Garanti Bankası A.Ş.	2006	0,84298	1
Türkiye İş Bankası A.Ş.	2006	0,67362	1
Yapı ve Kredi Bankası A.Ş.	2006	0,64466	1
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2007	1	1
Türkiye Halk Bankası A.Ş.	2007	0,78762	1
Türkiye Vakıflar Bankası T.A.O.	2007	0,75723	1
Adabank A.Ş.	2007	1	1
Akbank T.A.Ş.	2007	0,94947	1
Alternatif Bank A.Ş.	2007	0,78838	1

Anadolubank A.Ş.	2007	0,76204	1
Şekerbank T.A.Ş.	2007	0,59609	1
Turkish Bank A.Ş.	2007	1	1
Türk Ekonomi Bankası A.Ş.	2007	0,53106	1
Türkiye Garanti Bankası A.Ş.	2007	1	1
Türkiye İş Bankası A.Ş.	2007	0,69751	1
Yapı ve Kredi Bankası A.Ş.	2007	0,61	1
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2008	1	2
Türkiye Halk Bankası A.Ş.	2008	0,76801	2
Türkiye Vakıflar Bankası T.A.O.	2008	0,79972	2
Adabank A.Ş.	2008	1	2
Akbank T.A.Ş.	2008	0,86812	2
Alternatif Bank A.Ş.	2008	1	2
Anadolubank A.Ş.	2008	0,80289	2
Şekerbank T.A.Ş.	2008	0,73358	2
Turkish Bank A.Ş.	2008	0,61821	2
Türk Ekonomi Bankası A.Ş.	2008	0,52015	2
Türkiye Garanti Bankası A.Ş.	2008	0,85186	2
Türkiye İş Bankası A.Ş.	2008	0,72799	2
Yapı ve Kredi Bankası A.Ş.	2008	0,60546	2
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2009	1	2
Türkiye Halk Bankası A.Ş.	2009	0,83744	2
Türkiye Vakıflar Bankası T.A.O.	2009	1	2
Adabank A.Ş.	2009	0,98732	2
Akbank T.A.Ş.	2009	1	2
Alternatif Bank A.Ş.	2009	0,82141	2
Anadolubank A.Ş.	2009	0,79792	2
Şekerbank T.A.Ş.	2009	0,7314	2
Turkish Bank A.Ş.	2009	0,58365	2
Türk Ekonomi Bankası A.Ş.	2009	0,51086	2
Türkiye Garanti Bankası A.Ş.	2009	1	2
Türkiye İş Bankası A.Ş.	2009	0,84514	2
Yapı ve Kredi Bankası A.Ş.	2009	0,78712	2
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2010	1	3
Türkiye Halk Bankası A.Ş.	2010	0,88634	3
Türkiye Vakıflar Bankası T.A.O.	2010	0,88474	3
Adabank A.Ş.	2010	0,6849	3
Akbank T.A.Ş.	2010	1	3
Alternatif Bank A.Ş.	2010	0,5526	3
Anadolubank A.Ş.	2010	0,73025	3
Şekerbank T.A.Ş.	2010	0,57012	3
Turkish Bank A.Ş.	2010	0,54086	3
Türk Ekonomi Bankası A.Ş.	2010	0,48072	3
Türkiye Garanti Bankası A.Ş.	2010	1	3
Türkiye İş Bankası A.Ş.	2010	0,87275	3

Yapı ve Kredi Bankası A.Ş.	2010	0,78871	3
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	2011	0,95132	3
Türkiye Halk Bankası A.Ş.	2011	0,9498	3
Türkiye Vakıflar Bankası T.A.O.	2011	0,97359	3
Adabank A.Ş.	2011	0,85181	3
Akbank T.A.Ş.	2011	0,96934	3
Alternatif Bank A.Ş.	2011	0,68658	3
Anadolubank A.Ş.	2011	0,74702	3
Şekerbank T.A.Ş.	2011	0,5724	3
Turkish Bank A.Ş.	2011	0,56869	3
Türk Ekonomi Bankası A.Ş.	2011	0,5654	3
Türkiye Garanti Bankası A.Ş.	2011	1	3
Türkiye İş Bankası A.Ş.	2011	0,89238	3
Yapı ve Kredi Bankası A.Ş.	2011	0,82822	3

Table 6.3.1: Variables for the Kruskal-Wallis Test

The following table (Table 6.3.2) summarizes the rank sums for three groups. 26 observations exist in every group. All of the 78 efficiency scores are ranked ignoring which group they belong to. The procedure for ranking is as following: The lowest score gets the lowest rank. According to the rank sums of the groups, group 2 has the highest rank sum among 3 different year groups which represents the years when the global crisis occured and spread to all over the world. On the other hand, it means that efficiency scores of banks are higher during crisis compared with the years before the crisis and after the crisis.

Group	**Observation**	**Rank Sum**
1	26	1008,5
2	26	1083,5
3	26	989

Table 6.3.2: Rank Sums of 3 Groups

Table 6.3.3 shows the result of the Kruskal-Wallis test as a value of Chi-Square; how many degrees of freedom (d.f.) are associated with it; and the significance level (an exact p-value).

Test Statistics
chi-squared = 0.373 with 2 d.f.
probability = 0.8299
chi-squared with ties = 0.378 with 2 d.f.
probability = 0.8280

Table 6.3.3: Test Statistics

In statistical hypothesis testing, the p-value is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. One often "rejects the null hypothesis" when the p-value is less than the predetermined significance level α (Greek alpha), which is often 0.05. The level of significance (alpha) is the area in the critical region. That is, the area in the tails to the right or left of the critical values. The p-value is the area to the right or left of the test statistic. If the test statistic is in the critical region, then the p-value will be less than the level of significance.

This Kruskal-Wallis test generates the chi-squared value 0.373. The p-value of this value is 0.829. This p-valeu revealed that the null hypothesis that the medians are equal across the groups can not be rejected. Therefore it can be stated that the three groups do not have different distributions. The 13 banks in our analysis do not have different efficiency distributions during this three time intervals, considered as groups in our analysis. Efficiency of the banks do not change before, during and after time of crisis.

7. Summary and Concluding Remarks

In this study, it is tried to be investigated the efficiency of a group of the commercial banks in Turkey. Banks are divided into two groups according to their ownership status: privately-owned and state-owned and is compared with each other. It's tried to be understand which type of bank is more efficient. The ability to operate efficiently is very important for the competitive banking industry of Turkey to achieve profitability and growth.

The global financial crisis of 2008-2009 is considered by many economists to be the worst financial crisis since the Great Depression of the 1930s. The crisis resulted in the threat of total collapse of large financial institutions, the bailout of banks by governments, downturns in stock markets around the world. In a short time period, the crisis spread from USA to other countries including Turkey. Macroeconomic indicators showed that the last crisis had negative effects on the Turkish economy.

This study examined the efficiency of the Turkish banking industry for the period 2006-2011. This period includes the years before the economic crisis and the years after the crisis. A sample of commercial banks are included in this study. Investment, development and participation banks are discluded because of their characteristic and their role in the banking

sector. On the other hand, this study also analyzed whether the banks' efficiencies changed over the period. The efficiency scores are measured by the help of Data Envelopment Analysis which is a non- parametric method. DEA is considered to be a sophisticated tool for efficiency that allows to investigate complex production processes among a set of decision making units (DMUs). The analysis was performed on 6 years and 2-sequantial years time periods.

A sample of 13 banks are included in this study. A comparison of efficiency between privately-owned and state-owned banks is analyzed to understand whether the efficiency scores of those banks has changed or not.

This DEA analysis takes into account 3 input and 4 output variables. The inputs used in this study are number of branches, number of personnel and total loans. The outputs used are net profit/loss, non-accruing loans, total deposits and net interest income. DEA efficiency scores of 13 banks are calculated by the help of MATLAB program for the years of 2006-2011. Average efficiency scores of banks range from 0,769 to 0,839. In 2009, the negative effects of global financial crisis occured in Turkey but the efficiency scores of banks and the number of efficient banks are not affected accordingly.

Another important issue in this study is the comparison of state-owned and privately-owned banks in terms of efficiency. State-owned banks were found more efficient than privately-owned banks. State-owned banks close some of their branches to protect themselves from the negative effects of the financial crisis. In 2010 the number of state-owned banks' branches decreased compared with the year 2009. On the other hand, most of the privately-owned banks continued to open more branches in 2010 and 2011. None of privately-owned banks closed their branches during the financial crisis. The results show that state-owned banks managed the last crisis more successfully by decreasing their number of branches (input 1). The average efficiency score of state-owned banks are higher than the average efficiency score of privately-owned banks in the 6 years period. According to the results, Türkiye Ziraat Bankası A.Ş. can be considered as the most efficient bank among 13 banks.

Another efficiency analysis is investigated for the sequential year. Although Adabank A.Ş. is not seen as operating effectively in the sector, it's found as efficient in this analysis. The loan amount of Adabank is always null during the period. On the other hand, the outputs, such as

accepted deposits and profit of the bank, is greater than null. Because of this, Adabank is found as efficient.

The selected 13 banks in this sample have different characteristics, which means they have various size of input and output variables. Some of them have similar size of input and output variables, but on the other hand some of them are very small-sized compared to other ones. These small-sized banks are named as Adabank, Turkishbank, Alternatifbank and Anadolubank. Small-sized banks (in terms of profit, loans, credits, etc.) take place in the group of privately-owned banks. 3 state-owned banks' input and output variables indicate more efficient results. All of the 3 state-owned banks' data are above average. As a result, privately-owned banks are less efficient than state-owned banks.

There are some methodological limitations to this study. One of them is sample size. As in the year of 2006, there were a total of 50 banks in Turkey and the number of banks decreased to 48 as in the year of 2011 but only 13 banks are included in this study. Another limitation is that participation banks are not included in this study. Privately-owned and state-owned banks are compared with each other but participation banks cannot be compared with them. While acknowledging these limitations, I hope that they do not significantly reduce the importance of this study. For future resarches sample size can be increased so that the results will be more likely to reflect how the banks are affected over the years. Future researchers can also consider different type of banks such as participation banks in their studies.

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