

## EFFICIENCY ANALYSIS IN TURKISH BANKING SECTOR<sup>1</sup>

Rüştü YAYAR<sup>2</sup>

Süleyman Serdar KARACA<sup>3</sup>

### ABSTRACT

In this study, efficiency of the banks carrying on their business in Turkey in 2009-2011 periods has been measured. Data Envelopment Analysis which is one of the non-parametric methods has been used to measure the efficiency. Moreover, factors that are considered as possible to affect efficiency scores of banks have been determined with TOBIT regression analysis. Totally 37 banks data of which could be reached exactly have been included in the research. According to Data Envelopment Analysis results, the group of bank that has the highest average efficiency is state-owned banks, followed by privately-owned and foreign banks. According to TOBIT regression analysis results, total assets and profitability variables have a positive effect upon total efficiency scores, but capital adequacy ratio and number of branches have a negative effect.

**Keywords:** Banking, Efficiency, Data Envelopment Analysis, TOBIT Regression

**JEL Classification:** C14, C35, G21

### INTRODUCTION

At the present time, when the sources are economically limited, subjects such as efficiency, productivity and performance have always maintained their importance and have still been maintaining. Global competition conditions and current global crisis drive businesses to utilize their sources in the most efficient way. Business managers need measurements and evaluations in order to determine deviations from their targeted plans, to see their position in the market among their competitors, to maintain their efficiency in the sector and to come through with the least loss from the financial crisis. To manage this, firms are required to evaluate their performance relatively within the sector in which they carry on their business and to determine the firms they should take as references in order to take place within the efficient frontier (Kaya and Gülhan, 2010: 63).

At the present time when financial turbulence and shocks have been faced at certain intervals, structure and functioning of banks which have a special and essential position for the economy is highly important. Banking sector in Turkey has had important structural changes recently. For a stable economy, the sector should be strong and enduring against financial shocks (Tarkoçin and Gençer, 2010: 19).

The competition that has been faced in Turkish banking sector compels banks to use their sources efficiently. Efficiency and productivity analyses are important management tools to determine to what extent inputs have been used in the process of acquiring required outputs of banks. Efficient and productive functioning of the banks in Turkey has a major importance in terms of national economy. Being different from other economic sectors, the banking undertakes the duty of financial intermediation which

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<sup>2</sup> Doç.Dr., Gaziosmanpaşa Üniversitesi, İİBF İktisat Bölümü, [rustu.yayar@gop.edu.tr](mailto:rustu.yayar@gop.edu.tr)

<sup>3</sup> Doç.Dr, Gaziosmanpaşa Üniversitesi, İİBF İşletme Bölümü, [suleymanserdar.karaca@gop.edu.tr](mailto:suleymanserdar.karaca@gop.edu.tr)

determines resource allocation. This places banking to a central position for the economic development of the country. For this reason, analysis of efficiency and productivity measurements is necessary to carry out performance analysis of the banking sector (Karpaz,Çatalbaş and Atan, 2005: 49).

The purpose of this study is to determine whether national and foreign banks carrying on their business in Turkey have utilized their sources efficiently or not and to make comparisons. There has been planned to make prudential inferences determining which firms have been efficient and which have been not with the results obtained from these comparisons. The important of this study is that assets of banking sector are getting better at the present time. With this aim, firstly we applied Data Envelope Analysis to determine efficiency scores of banks. Then, factors that are considered as possible to affect efficiency scores of banks have been determined with TOBIT regression analysis.

## **1. LITERATURE**

In efficiency analysis literature, there have been several studies that have been carried out upon Turkish banking sector. On this subject, studies of Aydoğın and Apođlu (1989), Zaim (1995), Yolalan (1996), İnan (2000),Cingi and Tarım (2000), Mercan and Yolalan (2000), Çolak and Altan (2002),Atan (2003), Eleren and Özgür (2006), Önal and Sevimeser (2006), Aydın et al. (2009), Behdiođlu and Özcan (2009),Özer et al. (2010) and Budak (2011) can be given as examples. The common point of those studies is their performing efficiency and productivity analyses by using production or financial ratio and several various financial values measured with intermediation approach as input and output for the purpose of evaluating performances of the banking sector.

Budak (2011), this study analyzes a non-parametric method: Data Envelopment Analysis, which is used to measure relative efficiency of decision making units in multiple input - multiple output processes. Using this method, 22 commercial banks, which operate in banking sector in Turkey in the years 2008, 2009 and 2010, have been chosen and the efficiency rates of these banks have been measured, determining which banks have been efficient and which not. Moreover, target values of non-efficient banks in 2010 have been calculated.

Behdiođlu ve Özcan (2009) that are widely used and application steps of these models are explained. DEA application is made by using data of trade banks which has been active in between 1999-2005 in Turkey. In the solution phase of the models, DEA Solver which is a special standard program for DEA Method is used. As a result of the study, average efficiently percentage (1999-2005) of trade banks is found 43.3 percent in Turkey and it is determined foreign capital banks which is most efficient groups. In 2005, 9 of trade banks are found efficient for CCR Model, and 19 of trade banks are determined efficient for BCC Model.

Özer et al (2010), in this study, it is tried to examine whether 24 businesses which traded in Istanbul Stock Exchange in food and drink sector are efficient. For this aim, businesses efficiency is measured by Data Envelopment Analysis (DEA). Also, similar businesses are clustered by cluster analysis and business efficiencies are ranged by TOPSIS analysis and methods are compared. According to the result of DEA, 14 businesses in 2007 and 11 businesses in 2008 are found to be efficient. As a result of the study, it is observed that the methods we used produced contradictory results. Although some businesses found to be efficient in DEA method, these businesses could not show a good performance in

TOPSIS analysis. Also, some efficient businesses are in different clusters in Cluster Analysis.

Aydın et al (2009) The purpose of their study is to assess the efficiency of the banks operating in Turkish Banking Sector for the period December 2002 to March 2006, consisted of 14 quarterly periods. The study applies Data Envelopment Analysis (DEA) method to examine the efficiency of the banks in Turkey. The study employs commonly accepted financial ratios as data to analyze the efficiency of the banks and calculate the efficiency rates for each bank. Empirical results show that the most efficient banks in Turkey are state-owned, foreign-owned, development-investment and private-owned banks respectively. The efficiency rates in Turkish Banking Sector had been increased for the covered period substantially.

There have also been several studies upon efficiency in banking in the foreign literature. Some of those studies are; Tatje and Lovell (1997), Sathye (1999), Camanho and Dyson (1999), Drake and Hall (1999), Maudos et al. (2002), Chen et al. (2005), Salim et al. (2010), Assaf et al. (2011).

Sufian (2007) in his paper, he investigates the performance of Malaysian Islamic banking sector during the period of 2001-2005. Several efficiency estimates of individual banks are evaluated using non-parametric Data Envelopment Analysis (DEA). Two different approaches have been employed to differentiate how efficiency scores vary with changes in inputs and outputs. To examine the impact of risk factor on Islamic bank efficiency, he has incorporated problem loans as a nondiscretionary input variable in our analysis. The findings suggest that during the period of study, scale inefficiency dominates pure technical inefficiency in the Malaysian Islamic banking sector. He found that foreign banks have exhibited higher technical efficiency compared to their domestic peers. The inclusion of risk factors has mixed impact on Malaysian Islamic banks' efficiency. The results seem to suggest that while potential economies of scale may be overestimated when risk factors are excluded, pure technical efficiency estimates on the other hand, tend to be much more sensitive to the exclusion of risk factors. The empirical results from the Spearman and Pearson tests reinforce these findings.

Ong et al (2011)'s analysis is based on a panel data set of 9 domestic banks and 12 foreign banks in Malaysia over the period of 2002-2009. The findings of the study show that domestic banks have a higher efficiency level than foreign banks. This implies that domestic banks are relatively more managerially efficient in controlling their cost. The second stage of the empirical results is based on Tobit model which suggest that the pure technical efficiency of banks in Malaysia is mainly affected by capital strength, loan quality, expenses and asset size.

Chen and Lin (2007)'s paper studies whether the performance of 9 Australian domestically owned commercial banks improves after taking financial supervision into account in 1998 using Data Envelopment Analysis (DEA) and Malmquist productivity indexes (MPI). They find overall technical efficiency fell up to 2000, but recovered gradually thereafter. In comparison with American banks, Australian banks had better average efficiency for the 2001-2004 post-financial reforms period. The results represent the overall technical inefficiency mainly was due to the scale inefficiency. In addition, the mean total factor productivity rose slightly by 0.1 percent per year and this increase could be traced to a positive technological change. On the other hand, they also find return on assets (ROA) is an important financial factor affecting positively the performance of Australian banks.

Singh et al (2012)'s paper appraises by taking into consideration various efficiency factors to determine the efficiency of 18 different private and public sector banks against the independent output variables assets, profits and deposits. This study employed Data Envelopment Analysis model, a non-parametric technique to examine the efficiency score. Input oriented efficiency with constant return model has been operated. The results acquainted that SBI, IDBI, Canara and ICICI have sustained high efficiency score from the past 10 years, 2002-2011.

## 2. DATA AND METHOD

In this study, three-month-period financial statement data of 37 domestic and foreign banks which have been carrying on their business in Turkey including the period between March 2009 and September 2011 have been used. Data were obtained from the Banks Association of Turkey officials sources. To measure efficiency of banks; *Total Assets, Total Equity, Number of Staff and Number of Branches* were used as the input variable and *Total Loans, Total Deposit and Net Profit/Loss* were used as the output variables. Data Envelopment Analysis (DEA) Method, which is one of the non-parametric methods, was used to measure efficiency performances of the banks.

The theoretical development of DEA was initiated by Farrell (1957), but the model was proposed by Charnes, Cooper and Rhodes (1978), namely it is called the CCR model. DEA is a non-parametric technique which is used to construct empirical production frontiers and it provides a comprehensive evaluation of the homogenous organizations, processes or decision-making units (DMUs). DMUs or in this case, banks, typically perform the same function by consuming multiple inputs to produce multiple outputs. One of the most important features of DEA is its ability to manage the multiple characteristics of a bank which use several inputs and outputs. The DEA or CCR model allows each bank to adopt its own set of weights, thus maximizes its own best possible efficiency in comparison to the other banks. Under these circumstances, the efficiency for a bank is determined as a maximum of a ratio of outputs to weighted inputs (Jackson and Fethi, 2000).

A commonly used measure of efficiency is

$$Efficiency = \frac{Output}{Input}$$

It is challenging to measure the overall efficiency of a process when such process is a multi-output/multi-input process. To address this challenge, an innovative approach for efficiency measurement, DEA, is derived. DEA is a mathematical method based upon the principles of linear programming theory and application. It enables anyone to assess how efficiently a firm, organization, agency or such another unit uses the resources available inputs to generate a set of outputs relative to other units in the data. Within the context of DEA, such units are called decision-making units (DMUs).

The efficiency score of any DMU is calculated as the maximum of a ratio of the weighted outputs to the weighted inputs subjecting to the constraints which the same ratio for every DMU in the data set will be less than or equal to unity using the same set of weights and such weights will be nonnegative. Calculated efficiencies are relative to the best performing DMU or DMUs if there is more than one best performing DMU (Özbek et al 2009:823).

Mathematical expression of input-oriented CCR model is given as below (Behdioğlu and Özcan, 2009:305):

$$E_k = \text{Min} \alpha - \varepsilon \quad \begin{matrix} m \\ i=1 \end{matrix} \quad \begin{matrix} p \\ r=1 \end{matrix} \quad \begin{matrix} s_i^- - \varepsilon \\ s_r^+ \end{matrix} \quad (1)$$

Under the following constraints:

$$\begin{matrix} n \\ j=1 \end{matrix} \quad x_{ij} \lambda_j + s_i^- - \alpha x_{ik} = 0, \quad i = 1, \dots, m \quad (2)$$

$$\begin{matrix} n \\ j=1 \end{matrix} \quad y_{ij} \lambda_j - s_r^+ - y_{rk} = 0, \quad r = 1, \dots, p \quad (3)$$

$$\lambda_j \geq 0 \quad j = 1, \dots, n; \quad s_i^- \geq 0 \quad i = 1, \dots, m; \quad s_r^+ \geq 0 \quad r = 1, \dots, p \quad (4)$$

Here definitions are;

$E_k$ : Efficiency of the decision-making unit

$X_{ij}$ :  $i$ -numbered input that was used by  $j$ -numbered decision making unit.

$X_{ik}$ :  $i$ -numbered input that was used by  $k$ - decision making unit

$Y_{ij}$ :  $i$ -numbered output produced by  $j$ - decision making unit

$Y_{rk}$ :  $r$ -numbered output produced by  $k$ -decision making unit

$\varepsilon$ : A small enough positive number

$n$ : Number of decision making units

$p$ : Number of outputs

$m$ : Number of inputs

$\alpha$ : Coefficient of contraction that determined to what extent  $k$  decision making unit inputs relative efficiency of which was measured can be reduced

$s_i^-$ : Inactive value that belongs to  $i$  numbered input of  $k$  decision making unit

$s_r^+$ : Inactive value that belongs to  $r$  numbered output of  $k$  decision making unit

$\lambda_j$ : Value of density that  $j$  numbered decision making unit takes

In objective function of this model, it has been determined to what extent inputs that belong to  $k$  decision making unit efficiency which was measured for a specific level of input can be reduced. If the aforementioned decision making units are efficient, then it will be:

$$\alpha = 1, s_i^- = 0, s_r^+ = 0, \lambda_k = 1 \text{ ve } E_k = 1$$

If measured decision making unit is not efficient,  $\alpha$  contraction coefficient that determines the efficiency scale will be less than 1 and  $\lambda$  of theoretical decision making units will be more than 0.

In the final stage of the study, factors that affect efficiency level of the study were analyzed using Standard TOBIT Model. Standard TOBIT Model can be formulated as below (Onget al. 2011: 36):

$$y_i^* = \beta' x_i + \varepsilon_i \quad (5)$$

$$y_i = y_i^*, \text{ If } y_i^* \geq 0 \text{ and,}$$

$$y_i = 0, \text{ otherwise,}$$

Where  $x_i$  and  $\beta$  are vectors of regression, coefficient and independent variable respectively, while  $y_i^*$  is a latent variable and  $y_i$  is the DEA efficiency score. The bank-specific variables included in the regressions are *Total Assets (TA) (Million TL)*, *Number of Branches (NB)*, *Net Profit/Total Assets (NP/TA)*, *Shareholders' Equity/Total Assets (SHE/TA)*, *Privately-owned Bank (POB)* and *Foreign-owned Bank (FOB)*. By using the efficiency scores as dependent variable; the researcher estimates the following regression model:

$$E_{jt} = \beta_0 + \beta_1 TA_{jt} + \beta_2 NB_{jt} + \beta_3 NP/TA_{jt} + \beta_4 SHE/TA_{jt} + \beta_5 POB_{jt} + \beta_6 FOB_{jt} \quad (6)$$

Coefficient indicators of the NB, NP/TA from the explanatory variables in Equation 6 have been expected to be positive. There has been considered that the positive change at aforementioned variables would positively change the efficiency. Coefficient indicators regarding POB and FOB variables of the regression analysis could be negative or positive. Positive changes of total assets and number of branches could affect the efficiency.

$E_{jt}$  is the pure total efficiency of the  $j^{\text{th}}$  bank in period  $t$ .  $TA_{jt}$  is total assets of bank  $j$  in period  $t$ ;  $NB_{jt}$  is number of branches of bank  $j$  in period  $t$ ;  $NP/TA_{jt}$  is net profit divided by total assets of bank  $j$  in period  $t$ ;  $SHE/TA_{jt}$  is shareholders' equity divided by total assets of bank  $j$  in period  $t$ ;  $POB_{jt}$  is private-owned bank  $j$  in period  $t$ ;  $FOB_{jt}$  is foreign-owned bank  $j$  in period  $t$ .

### 3. FINDINGS

In this section, input-oriented fixed income efficiency scores of 37 banks including 6 public, 15 private and 16 foreign capitalized banks were obtained for three month each financial statement periods between March 2009 and September 2011. Whether banks with different capital structure have been efficient or not was compared. Constant returns to scale approach offers opportunity to the comparison of small and big banks.

In the second phase, modifications, namely targeted values, which will be able to be appropriate, be made at their inputs and outputs for the inefficient ones of 37 banks that has been discussed for the same statement periods were measured. There have been suggestions for each inefficient bank measuring the potential improvement rates. In the third phase, TOBIT regression analysis was performed for the determination of factors that affect efficiency scores of the 37 banks in terms of their capital structure for three each period between March 2009 and September 2011.

Variables of bank size, bank profitability, ownership status of the bank and capital adequacy ratio were used as the possible factors that have been considered as affecting efficiency scores. Total assets and number of active branches of the banks were accepted as the bank size. The bank profitability was obtained by proportioning net profit/loss amount

to total assets. Proportion of equities to total assets was included to the capital adequacy ratio. Two dummy variables were included to the model for ownership status of state-owned, privately-owned and foreign banks. State-owned banks were accepted as the basic level.

In Table 3.1, there have been given banks' input-oriented fixed income efficiency scores according to their capital structure for three each financial statement periods between March 2009 and September 2011. Other state-owned banks except from İller Bankası have nearly maintained their activities in an efficient or close to efficient for whole periods. Only Ziraat Bankası was not found as efficient in the last two terms and Türkiye Kalkınma Bankası in the first three periods. For state-owned banks, average efficiency percentage was 97.96% between March 2009 and September 2011. State-owned banks were found efficient in December 2009, March and June 2010 periods. In September 2011 average efficiency score decreased to a minimum level (94.77%).

**Table 1** March 2009 - September 2011 Banks' Input-Oriented Fixed Income Efficiency Score Values According to Capital Structure for Three Each Financial Statement Periods

BANKS	2009 March	2009 June	2009 September	2009 December	2010 March	2010 June	2010 September	2010 December	2011 March	2011 June	2011 September
<b>STATE-OWNED BANKS</b>											
ZİRAAT BANKASI	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,93	0,92
TÜRKİYE HALK BANKASI	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
TÜRKİYE VAKIFLAR BANKASI	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,99	1,00
İLLER BANKASI	0,93	1,00	0,99	1,00	1,00	1,00	0,95	0,94	0,91	0,81	0,77
TÜRK EXİMBANK	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
TÜRKİYE KALKINMA BANKASI	0,78	0,84	0,89	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
<b>PRIVATELY-OWNED BANKS</b>											
TÜRKİYE İŞ BANKASI	0,91	0,90	0,90	0,89	0,91	0,91	0,89	0,91	0,92	0,89	0,90
TÜRKİYE GARANTİ BANKASI	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,97	1,00	0,97	0,93
AKBANK	0,93	0,94	0,90	0,92	1,00	1,00	0,96	0,94	0,95	0,90	0,88
YAPI VE KREDİ BANKASI	0,99	0,99	0,94	0,93	1,00	1,00	1,00	0,98	0,95	0,99	1,00
TÜRK EKONOMİ BANKASI	0,88	0,91	0,92	0,90	1,00	0,95	0,94	0,98	0,94	0,93	0,91
ŞEKERBANK	0,91	0,94	1,00	1,00	0,94	0,92	0,93	0,94	0,89	0,87	0,89
TÜRKİYE SİNAİ KALKINMA B.	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
ANADOLU BANK	0,93	1,00	0,98	1,00	0,92	0,99	0,94	1,00	0,95	0,97	0,90
ALTERNATİF BANK	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
TEKSTİL BANKASI	0,75	0,92	0,95	0,98	0,97	0,95	1,00	1,00	1,00	1,00	1,00
AKTİF YATIRIM BANKASI	0,72	0,92	0,74	0,66	0,74	0,83	0,72	0,85	1,00	1,00	1,00
İMKB TAKAS VE SAKLAMA B.	1,00	1,00	0,86	0,85	0,58	0,62	0,59	0,64	0,55	0,59	0,58
TURKİSH BANK	0,62	0,63	0,65	0,66	0,61	0,78	0,80	0,78	0,70	0,68	0,81
GSD YATIRIM BANKASI	0,90	1,00	0,92	0,89	0,91	1,00	0,91	1,00	0,97	1,00	1,00
DİLER YATIRIM BANKASI	0,94	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
<b>FOREIGN BANKS</b>											
FİNANS BANK	1,00	1,00	0,98	0,97	0,98	0,95	0,99	0,99	1,00	1,00	1,00
DENİZBANK	1,00	0,99	0,99	1,00	0,95	0,99	0,97	0,96	0,99	1,00	1,00
HSBC BANK	0,93	0,96	0,92	0,91	0,96	0,90	0,91	0,83	0,79	0,83	0,96
ING BANK	0,96	0,99	0,97	0,96	0,96	0,93	0,96	0,93	1,00	1,00	0,99
EURO BANK TEKFEN	0,69	0,72	0,70	0,66	0,68	0,64	0,65	0,62	0,71	0,62	0,66
BANK MELLAT	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
ARAP TÜRK BANKASI	0,60	0,68	0,67	0,61	0,61	0,79	0,74	0,69	1,00	0,78	0,86
TURKLAND BANK	0,82	0,87	0,96	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
BANK POZİTİF KREDİ KALK. B.	0,92	0,93	1,00	1,00	1,00	1,00	1,00	1,00	0,94	0,98	0,97
THE ROYAL B. SCOTLAND N.V.	1,00	1,00	1,00	1,00	1,00	0,93	0,96	0,77	1,00	1,00	1,00

JP MORGAN CHASE BANK N.A.	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,83	1,00
BİRLEŞİK FON BANKASI	1,00	1,00	1,00	1,00	0,89	1,00	1,00	0,07	1,00	1,00	0,73
WESTLB AG	1,00	1,00	1,00	1,00	1,00	0,84	0,75	0,79	0,26	0,27	0,49
MERRİLL LYNCH Y.B.	0,14	0,00	0,50	0,75	1,00	1,00	1,00	1,00	0,17	0,21	0,31
CREDİT AGRICOLE YATIRIM B.	0,91	1,00	1,00	1,00	0,57	1,00	1,00	1,00	1,00	1,00	1,00
HABİB BANK	0,70	0,62	1,00	0,53	0,34	0,53	0,46	0,47	0,58	0,70	0,65

Türkiye Sinai Kalkınma Bankası and Alternatif Bank were found efficient in all periods. Isbank and Turkish Bank were not found as efficient in any of the periods. Diler Yatırım Bankası was efficient in all periods except from March 2009. Takasbank, Turkish Bank and Aktif Yatırım Bankası seemed to be the most unstable banks in terms of efficiency. Türk Ekonomi Bankası and Şekerbank were efficient only once. Akbank, Anadolu Bankası and Takas Banks were found to be efficient for three times. For privately-owned banks, average efficiency percentage was found as 91.90% among December 2009 and September 2011 and the highest efficiency score achieved on June 2009 (94.35%) and the lowest efficiency score was on March 2009 (89.93%).

In terms of foreign banks, Bank Mellat has become efficient in all periods. HSBC Bank and Euro Bank have not been found as efficient in any periods. Habip Bank was found efficient only on September 2009 and Arap Turk Bankası was only found efficient on March 2001. Merrill Lynch, Kalkınma Bankası and Habib Bank have stood out as the most undulate banks in terms of their efficiency during the analyzed period.

Among the whole analyzed banks, Euro Bank, Tekfenbank, Arap Turk Bankası and Habib bank have been the ones that have the lowest efficiency scores during the analysis period. Merrill Lynch Kalkınma Bank and WestLB AG were noticed as not utilizing from their sources efficiently recently. For foreign banks, average efficiency percentage was 86.71% between March 2009- September 2011 three each financial statement periods, and the highest efficiency rate (93.03%) was in December 2011 period and the lowest efficiency rate (81.93%) occurred in December 2010 period. Within the research period, average efficiency percentage of foreign banks carrying on their business in Turkey between March 2009 and September 2011 three each financial statement periods was 90.64%. The highest efficiency rate (93.03%) was in June 2010 period.

The bank group with the highest average efficiency level includes state-owned banks. Then, privately-owned banks and foreign banks have succeeded, respectively. Effect of the public authority upon the capital structure of the banks has been considered as an efficiency improving factor. While foreign banks were found as the most efficient ones in another study carried out on this subject, privately-owned and state-owned banks succeeded this, relatively (Karpal Çatalbaş and Atan, 2005,9).

Original input and output values of the inefficient banks that were analyzed according to CCR model related to September 2011 period were given in Table 3.2 and target values and potential correction values that belong to input and output variables for banks to use their sources efficiently were given in Table 3.3 and Table 3.4, respectively. As result of the analysis, which inputs and outputs will be reduced to what extent has been determined for the banks' becoming more efficient. When Ziraat Bankası which is one of the inefficient banks has been analyzed, it is seen that its CCR model result efficiency value was measured as 0.916. It has been noticed that whole inputs of the bank is used in an inactive way. Inputs that cause inefficiency of the bank are number of employees, equities and total net assets.

When analysis results have been looked at, according to CCR model for Ziraat Bankası; net assets must be reduced from 164277 million TL to 50966 million TL (69.0%), equities from 13140 million TL to 8005 million TL (39.1%), number of employees from 23153 to 9510 (58.9%) and number of branches from 1446 to 567. For the banks' efficient use of their sources, reducing their outputs will be suitable. Reducing 66.1% of the credits, 83.2% of the total deposit and 81.6% of net profit will be appropriate.

Similarly, measurements as absolute and proportional related to potential recovery of the banks that do not utilize their sources efficiently are seen in Table 3.3 and 3.4, respectively.

**Table 2** Original Input and Output Values of Inefficient Banks in September 2011 Period (Million TL)

BANKS	Total Assets	Total Equities	Number of Personnel	Number of Branches	Total Credits-Assets	Total Deposit	Net Profit-Loss
ZİRAAT BANKASI	164277	13140	23153	1446	70177	120242	1489
İLLER BANKASI	11252	8176	2776	19	7469	0	195
TÜRKİYE İŞ BANKASI	160005	17882	24788	1194	85433	95544	1803
TÜRKİYE GARANTI BANKASI	148644	17247	16784	907	81133	80469	2280
AKBANK	132975	17355	15513	916	68474	72917	1844
YAPI VE KREDİ BANKASI	106369	11255	14704	894	66111	62712	1383
TÜRK EKONOMİ BANKASI	40008	4189	9598	602	25649	21594	124
ŞEKERBANK T.	14988	1394	3468	266	8587	9395	56
ANADOLUBANK	6250	798	1904	88	3849	3767	43
İMKB TAKAS VE SAKLAMA B.	2169	297	213	1	8	0	24
TURKISH BANK	908	154	281	21	303	611	0
HSBC BANK	21203	2811	6254	333	13456	14095	201
ING BANK	20787	2278	5363	327	14667	11656	43
EUROBANK TEKFEN	5114	608	945	59	2189	2221	20
ARAP TÜRK BANKASI	2528	339	250	6	754	1764	34
BANKPOZİTİF KREDİ VE KALK. B.	1972	465	266	2	1375	0	8
BİRLEŞİK FON BANKASI	824	601	243	1	2	26	20
WESTLB AG	718	186	42	1	37	45	11
MERRILL LYNCH YATIRIM BANK	246	65	35	1	0	0	3
HABİB BANK	73	42	16	1	28	12	2

Note: Number of personnel and branches were given as items; other variables were given as million TL

**Table 3** Targeted Input and Output Values of Inefficient Banks in September 2011 Period

BANKS	Total Assets	Total Equities	Number of Personnel	Number of Branches	Total Credits-Assets	Total Deposit	Net Profit-Loss
ZİRAAT BANKASI	50996	8005	9510	567	23798	20193	274
İLLER BANKASI	274337	36533	80877	4273	174222	180834	2591
TÜRKİYE İŞ BANKASI	113311	12225	28227	1744	76411	62320	294
TÜRKİYE GARANTI BANKASI	132748	14524	33516	2066	91122	73641	322
AKBANK	132919	14341	33565	2073	91074	73994	316
YAPI VE KREDİ BANKASI	65187	6695	16199	995	40514	37279	885
TÜRK EKONOMİ BANKASI	72090	8137	17901	1032	44821	40670	1439
ŞEKERBANK	82552	9108	21153	1283	58075	45576	195
ANADOLUBANK	3895	527	489	17	1358	1070	38
İMKB TAKAS VE SAKLAMA B.	23249	2653	3147	173	13005	12605	374
TURKISH BANK	5122	536	1200	73	3268	2591	22

HSBC BANK	5167	2155	590	15	1919	1641	157
ING BANK	2856	1257	349	9	1195	1016	93
EUROBANK TEKFEN	4172	475	964	57	2750	2299	17
ARAP TÜRK BANKASI	8860	990	2260	138	6167	4904	20
BANKPOZİTİF KREDİ VE K.B.	366	67	51	2	41	43	4
BİRLEŞİK FON BANKASI	603	161	38	1	0	298	20
WESTLB AG	314	80	22	0	15	143	10
MERRİLL LYNCH YATIRIM B.	119	17	20	1	44	53	1
HABİB BANK	57	21	9	0	0	0	1

Note: Number of personnel and branches were given as items; other variables were given as million TL

**Table 4** Potential Correction Rates (%) of Inefficient Banks in September 2011 Period

BANKS	Total Assets	Total Equities	Number of Personnel	Number of Branches	Total Credits-Assets	Total Deposit	Net Profit-Loss
ZİRAAT BANKASI	-69,0	-39,1	-58,9	-60,8	-66,1	-83,2	-81,6
İLLER BANKASI	2338,0	346,9	2813,4	22391,0	2232,5	-	1230,0
TÜRKİYE İŞ BANKASI	-29,2	-31,6	13,9	46,1	-10,6	-34,8	-83,7
TÜRKİYE GARANTİ BANKASI	-10,7	-15,8	99,7	127,8	12,3	-8,5	-85,9
AKBANK T.	0,0	-17,4	116,4	126,3	33,0	1,5	-82,9
YAPI VE KREDİ BANKASI	-38,7	-40,5	10,2	11,2	-38,7	-40,6	-36,0
TÜRK EKONOMİ BANKASI	80,2	94,2	86,5	71,5	74,7	88,3	1059,4
ŞEKERBANK T.	450,8	553,2	509,9	382,2	576,3	385,1	248,5
ANADOLUBANK	-37,7	-33,9	-74,3	-81,2	-64,7	-71,6	-10,2
İMKB TAKAS VE SAKLAMA B.	972,0	792,9	1377,3	17229,0	162182,7	-	1432,7
TURKISH BANK	464,1	248,3	327,2	248,3	976,7	324,4	15733,6
HSBC BANK	-75,6	-23,3	-90,6	-95,4	-85,7	-88,4	-21,8
ING BANK	-86,3	-44,8	-93,5	-97,2	-91,9	-91,3	118,2
EUROBANK TEKFEN	-18,4	-22,0	2,0	-3,8	25,6	3,5	-16,4
ARAP TÜRK BANKASI	250,5	191,8	804,0	2192,0	718,3	177,9	-40,6
BANKPOZİTİF KREDİ VE K.B.	-81,4	-85,6	-80,8	-10,0	-97,0	-	-50,3
BİRLEŞİK FON BANKASI	-26,7	-73,3	-84,4	-27,0	-100,0	1045,7	0,0
WESTLB AG	-56,3	-57,2	-47,8	-58,0	-60,9	216,8	-6,0
MERRİLL LYNCH YATIRIM B.	-51,7	-74,5	-43,0	20,0	-	-	-63,0
HABİB BANK	-21,6	-49,3	-42,7	-67,0	-100,0	-100,0	-19,1

Note: Number of personnel and branches were given as items; other variables were given as million TL

In this stage of the research, TOBIT regression analysis was performed. TOBIT model estimation was acquired for each period separately and results of estimation were given in Table 3.5 When Table 3.5 has been analyzed, total assets was only found as significant in June 2011 period; however, its having a negative effect upon total efficiency has been noticed.

**Table 5** TOBIT Model Results

Years	Variable	Coefficient	Std. Error	z-Statistic	Prob.
March 2009	Total Assets (Million TL)	-2.18E-06	2.70E-06	-0.805328	0.4206
	Number of Branches	0.000278	0.000251	1.106265	0.2686
	Net Profit/Total Assets	17.35282***	4.231268	4.101092	0.0000
	Shareholders' Equity/Total Assets	-0.341713**	0.157159	-2.174317	0.0297
	Privately-owned Bank	-0.039306*	0.066249	-0.593306	0.5530
	Foreign-owned Bank	-0.142514**	0.073475	-1.939637	0.0524
	Constant	0.865741***	0.081248	10.65559	0.0000

	<i>SCALE: C(8)</i>	0.131752***	0.015316	8.602395	0.0000
June 2009	<i>Total Assets (Million TL)</i>	-3.71E-06	2.85E-06	-1.302225	0.1928
	<i>Number of Branches</i>	0.000337	0.000272	1.242527	0.2140
	<i>Net Profit/Total Assets</i>	10.53792***	2.350560	4.483154	0.0000
	<i>Shareholders' Equity/Total Assets</i>	-0.458470***	0.187070	-2.450790	0.0143
	<i>Privately-owned Bank</i>	-0.058193	0.070877	-0.821051	0.4116
	<i>Foreign-owned Bank</i>	-0.219809***	0.079816	-2.753962	0.0059
	<i>Constant</i>	0.940583***	0.087656	10.73040	0.0000
	<i>SCALE: C(8)</i>	0.139016***	0.016160	8.602386	0.0000
September 2009	<i>Total Assets (Million TL)</i>	-1.61E-06	2.00E-06	-0.805169	0.4207
	<i>Number of Branches</i>	0.000207	0.000196	1.058461	0.2898
	<i>Net Profit/Total Assets</i>	2.559875**	1.166270	2.194925	0.0282
	<i>Shareholders' Equity/Total Assets</i>	-0.085507	0.136494	-0.626449	0.5310
	<i>Privately-owned bank</i>	-0.056088	0.053035	-1.057560	0.2903
	<i>Foreign-owned Bank</i>	-0.087599	0.061041	-1.435080	0.1513
	<i>Constant</i>	0.921091***	0.065332	14.09856	0.0000
	<i>SCALE: C(8)</i>	0.105361***	0.012248	8.602375	0.0000
December 2009	<i>Total Assets (Million TL)</i>	-1.94E-06	2.14E-06	-0.906570	0.3646
	<i>Number of Branches</i>	0.000211	0.000215	0.983039	0.3256
	<i>Net Profit/Total Assets</i>	2.418899**	1.138823	2.124034	0.0337
	<i>Shareholders' Equity/Total Assets</i>	-0.141048	0.145890	-0.966810	0.3336
	<i>Privately-owned Bank</i>	-0.085882	0.058949	-1.456890	0.1451
	<i>Foreign-owned Bank</i>	-0.137841**	0.066176	-2.082948	0.0373
	<i>Constant</i>	0.966758***	0.070841	13.64681	0.0000
	<i>SCALE: C(8)</i>	0.116702***	0.013566	8.602363	0.0000
March 2010	<i>Total Assets (Million TL)</i>	-2.23E-06	2.58E-06	-0.864670	0.3872
	<i>Number of Branches</i>	0.000246	0.000264	0.929621	0.3526
	<i>Net Profit/Total Assets</i>	10.75836**	4.733664	2.272735	0.0230
	<i>Shareholders' Equity/Total Assets</i>	-0.181291	0.125982	-1.439022	0.1501
	<i>Privately-owned Bank</i>	-0.113756	0.072709	-1.564527	0.1177
	<i>Foreign-owned Bank</i>	-0.167890**	0.080202	-2.093329	0.0363
	<i>Constant</i>	0.988367***	0.084616	11.68059	0.0000
	<i>SCALE: C(8)</i>	0.143654***	0.016699	8.602357	0.0000
June 2010	<i>Total Assets (Million TL)</i>	-1.87E-06	1.98E-06	-0.945700	0.3443
	<i>Number of Branches</i>	0.000193	0.000205	0.940139	0.3471
	<i>Net Profit/Total Assets</i>	7.762976**	3.252206	2.386988	0.0170
	<i>Shareholders' Equity/Total Assets</i>	-0.101736	0.108481	-0.937831	0.3483
	<i>Privately-owned Bank</i>	-0.069248	0.052139	-1.328137	0.1841
	<i>Foreign-owned Bank</i>	-0.121827**	0.058660	-2.076838	0.0378
	<i>Constant</i>	0.938005***	0.061810	15.17571	0.0000
	<i>SCALE: C(8)</i>	0.103006***	0.011974	8.602347	0.0000
September 2010	<i>Total Assets (Million TL)</i>	-2.05E-06	2.15E-06	-0.950702	0.3418
	<i>Number of Branches</i>	0.000229	0.000227	1.010761	0.3121
	<i>Net Profit/Total Assets</i>	5.180701**	2.285529	2.266741	0.0234
	<i>Shareholders' Equity/Total Assets</i>	-0.121384	0.124274	-0.976741	0.3287
	<i>Privately-owned Bank</i>	-0.076578	0.058755	-1.303353	0.1925
	<i>Foreign-owned Bank</i>	-0.112825*	0.065138	-1.732077	0.0833
	<i>Constant</i>	0.932725***	0.068979	13.52185	0.0000
	<i>SCALE: C(8)</i>	0.116572***	0.013551	8.602344	0.0000
December 2010	<i>Total Assets (Million TL)</i>	-2.70E-06	2.41E-06	-1.121745	0.2620
	<i>Number of Branches</i>	0.000216	0.000274	0.790394	0.4293
	<i>Net Profit/Total Assets</i>	8.144070***	1.786735	4.558075	0.0000

	<i>Shareholders' Equity/Total Assets</i>	-0.505487***	0.132479	-3.815590	0.0001
	<i>Privately-owned Bank</i>	-0.099582	0.068273	-1.458593	0.1447
	<i>Foreign-owned Bank</i>	-0.210613***	0.072196	-2.917227	0.0035
	<i>Constant</i>	0.998845***	0.081190	12.30255	0.0000
	<i>SCALE: C(8)</i>	0.135421***	0.015742	8.602334	0.0000
March 2011	<i>Total Assets (Million TL)</i>	-2.67E-06	2.92E-06	-0.915389	0.3600
	<i>Number of Branches</i>	0.000350	0.000329	1.063341	0.2876
	<i>Net Profit/Total Assets</i>	16.70574**	7.564928	2.208315	0.0272
	<i>Shareholders' Equity/Total Assets</i>	-0.066860	0.169158	-0.395254	0.6927
	<i>Privately-owned Bank</i>	-0.069453	0.089894	-0.772610	0.4398
	<i>Foreign-owned Bank</i>	-0.165451*	0.096592	-1.712882	0.0867
	<i>Constant</i>	0.902169***	0.103373	8.727304	0.0000
	<i>SCALE: C(8)</i>	0.177536***	0.020638	8.602332	0.0000
June 2011	<i>Total Assets (Million TL)</i>	-4.26E-06*	2.51E-06	-1.698124	0.0895
	<i>Number of Branches</i>	0.000523*	0.000304	1.720907	0.0853
	<i>Net Profit/Total Assets</i>	15.98395***	5.927930	2.696379	0.0070
	<i>Shareholders' Equity/Total Assets</i>	-0.215414	0.179827	-1.197894	0.2310
	<i>Privately-owned Bank</i>	-0.047895	0.083947	-0.570532	0.5683
	<i>Foreign-owned Bank</i>	-0.163304*	0.089745	-1.819657	0.0688
	<i>Constant</i>	0.868982***	0.097033	8.955496	0.0000
	<i>SCALE: C(8)</i>	0.165606***	0.019251	8.602327	0.0000
September 2011	<i>Total Assets (Million TL)</i>	-2.53E-06	2.05E-06	-1.235007	0.2168
	<i>Number of Branches</i>	0.000311	0.000259	1.203060	0.2290
	<i>Net Profit/Total Assets</i>	5.197478**	2.311412	2.248616	0.0245
	<i>Shareholders' Equity/Total Assets</i>	-0.264517*	0.164253	-1.610422	0.1073
	<i>Privately-owned Bank</i>	-0.038716	0.073541	-0.526459	0.5986
	<i>Foreign-owned Bank</i>	-0.140910*	0.079361	-1.775563	0.0758
	<i>Constant</i>	0.952343***	0.083486	11.40716	0.0000
	<i>SCALE: C(8)</i>	0.147062***	0.017094	8.602914	0.0000

\*, \*\* and \*\*\* shows 10%, 5%, 1% significance level, respectively.

Effect of profitability variable upon efficiency was determined as positive. According to this, at banks where profitability is high, total efficiency will be higher than the ones with lower profitability. As result of the performed analysis, there has been acquired a negative correlation between total efficiency and capital adequacy.

It does not seem possible to say that number of branches effect efficiency in a positive or negative way. This variable has not been found statistically significant. When coefficients of privately-owned and foreign banks variables related to ownership status of the banks have been analyzed, it has been noticed that both privately-owned and foreign banks have lower efficiencies than state-owned banks that are selected as the baseline. There can be carried out different evaluations on this subject. It has been in question in Turkey that state-owned banks have targets such as reducing the cost and increasing the profit. For this reason, total efficiency's being higher than other banks can be accepted as a normal result.

## CONCLUSION

Banks are one of the most important factors that direct the economy of a country. After 2001 economic crisis, financial sector in Turkey has entered into the process of reconstruction. New legal regulations have been brought for the banks. Recently, banking

sector has ranked first among the leading factors of economic crisis. For this reason, banks' efficient use of their sources has been quite important in terms of steady economic growth and development.

In this study, there has been analyzed whether domestic and foreign banks carrying on their business in Turkey have used their sources efficiently in the period between March 2009 and September 2011. In the efficiency analysis, data envelopment analysis has been made and CCR model has been obtained with input-oriented constant returns to scale assumption. After obtaining efficiency scores, there has been made TOBIT regression analysis with some variables considered to be possible for affecting efficiency.

According to the results of the efficiency analysis, there could be said that banks have generally used their sources more efficiently towards the end of the period within the analyzed period. However, two foreign capitalized banks (Birleşik Fon Bankası and WESTLB AG) and one private capitalized bank (İMKB Takas and Saklama Bankası) have been determined not to use their sources efficiently within the analyzed period.

Whereas some banks (Turkish Republic Ziraat Bankası, Türkiye İis Bankası, Türkiye Garanti Bankası, Akbank, etc.) should decrease their total assets and total equity capital in order for banks that cannot efficiently use their sources efficiently to increase their efficiency, some other banks (İller Bankası, Türk Ekonomi Bankası, Sekerbank T., TURKISH Bank, etc.) should increase their total assets and total equity capital.

There has been deduced that in the period after 2001 crisis, legal regulations that have been made for the banks positively affected banking sector. It is clear that banks in Turkey have had a strong structure and complying with the current legal regulations will provide banks to be stronger and accordingly this will contribute to economic growth and development. In terms of all periods, Türkiye Halk Bankası, Türk Eximbank, Türkiye Sınai Bank, Alternatif Bank and Bank Mellat are %100 efficient banks. Merrill Lynch and Habib Bank have lower efficiency. Also in terms of all periods state-owned banks' average efficiency score is %98 and privately-owned banks are %92 and foreign banks are % 87. For all banks, average efficiency score are found %90 in terms of all periods.

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