PERFORMANCE EVALUATION OF BANKS AND BANKING GROUPS: TURKEY CASE

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ABSTRACT

PERFORMANCE EVALUATION OF BANKS AND BANKING GROUPS: TURKEY CASE

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Bank performance is one of the vital issues for the healthy functioning of the Turkish economy. This study aims to measure performance levels of the banks in Turkey and to find the factors affecting those levels for the period of 2006-2010. Although the measures evaluating bank performance are ample in amounts we choose two different approaches: Data Envelopment Analysis (DEA) measuring bank efficiency and CAMELS analysis. DEA is carried out in different levels: first for top 14 banks in the economy; then separating the banks as the state banks, the domestic private banks and the foreign private banks. Also long term and short term, and public and non-public assets and liabilities distinctions are made in the analyses. The bank performance measures obtained from DEA and CAMELS analysis are compared and the factors affecting the performances of the Turkish banks are analyzed. The results show that high efficiency levels of the state banks decrease when the public assets and liabilities are excluded. The state banks and domestic private banks have high CAMELS' ratios, while the foreign

banks have low ones. Both the bank-specific and macroeconomic factors, like ownership type, publicly trading and ATM net, play important roles in the determination of the efficiency levels of the banks in Turkey.

Keywords: bank efficiency, DEA, CAMELS, bank performance measurement, banking groups

ÖZ

BANKALARIN VE BANKA GRUPLARININ PERFORMANS DEĞERLENDİRMESİ: TÜRKİYE'DE VAKA ÇALIŞMASI

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Banka performansı Türk ekonomisinin sağlıklı işleyişi açısından çok önemlidir. Bu çalışma, 2006-2010 dönemi için bankaların performans seviyelerini ölçümlemeyi ve bu seviyeleri etkileyen faktörleri bulmayı amaçlamaktadır. Banka performansını ölçen birçok metot olmasına rağmen, etkinliği ölçen Veri Zarflama Yöntemi (VZA) ve CAMELS analizi seçilmiştir. VZA analizi öncelikle ekonomideki en önemli 14 banka için, daha sonra bankaları kamu, yerli özel ve yabancı özel banka olarak ayırarak uygulanmıştır. Aynı zamanda analizlerde uzun vade ve kısa vade, kamu ve kamu dışı ayrımları da yapılmıştır. VZA ve CAMELS yöntemlerinden elde edilen banka performans değerleri karşılaştırılmış ve Türk bankalarının performansını etkileyen faktörler analiz edilmiştir. Elde edilen sonuçlara göre, kamu bankalarının yüksek etkinlik seviyeleri kamu varlıkları ve borçları çıkarıldığında düşmüştür. Kamu bankaları ve yerli özel bankalar yüksek CAMELS rasyolarına sahipken, yabancı bankalar düşük değerlere sahiptir. Bankanın ait olduğu grup,

kamuya açık olup olmaması, ATM ağı gibi bankaya özel faktörlerin yanı sıra makro ekonomik faktörler de Türkiye'de bankaların etkinlik seviyelerinin belirlenmesinde önemli rol oynamaktadır.

Anahtar Kelimeler: banka etkinliği, VZA, CAMELS derecelendirme sistemi, banka performans ölçümü, banka grupları

to my love, Aytaç Öztorul and
my beloved mother, Nilgün Katlangaç

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CHAPTER 1

1. INTRODUCTION

Turkey has experienced different economic stages. Before 1980s, a planned economy was on the scene, after these years it left its place to an economy affected by the liberalization actions. Improvements of these years did not reach success because of structural weaknesses. Inflation, public sector expenditures and public sector borrowings were high in 1990s. In these years, banks did not make their own business, financial intermediation. Instead, they financed government at high interest rates. Moreover, in 1994, Turkey experienced a currency crisis. In 1999, an IMF supported exchange rate anchor program was implemented. However, heavy depreciation of currency resulted in 2001 crisis in Turkey. This crisis was especially polarized on the Turkish banking sector, because banks in the sector had serious open positions. Weaknesses of the banking sector were considered to be the main cause of 2001 crisis. So after this severe crisis, for restructuring the Turkish economy, efforts had been focused on the banking sector. The Banking Regulation and Supervision Agency (BRSA) had implemented strict regulations on the sector (Akın, Aysan, & Yıldıran, 2008). Turkish Banking Sector has become so sound that it has not affected by the 2008 global crisis as much as its counterparts in other countries. While the 2001 crisis had been polarized on the banking sector, effects of the 2008 global crisis are said to be seen on the real sector. 2001 crisis has opened a new era for the Turkish economy. Although it was mainly a banking crisis, it affected every square of Turkey.

The banking sector is very important for the Turkish economy. Banks do not make intermediation only to individuals; they also intermediate to the firms in other sectors. So the performance and soundness of the banking sector is very important for almost all sectors, consequently for the Turkish economy.

To keep performance of the banking sector high, knowing dynamics of it is very important. This paper aims to analyze the performance of the banking sector in different perspectives and determine factors affecting the performance.

As the Figure 1 shows, we measure bank performance by using DEA and CAMELS rating in order to calculate bank efficiency and financial performance, respectively. Afterwards, we analyze factors affecting bank performance. Finally, relations among bank efficiency, CAMELS rating and factors affecting bank performance are analyzed. While doing these analyses, we also give results specific to the banking groups namely state owned banks, privately owned banks and public owned bank.

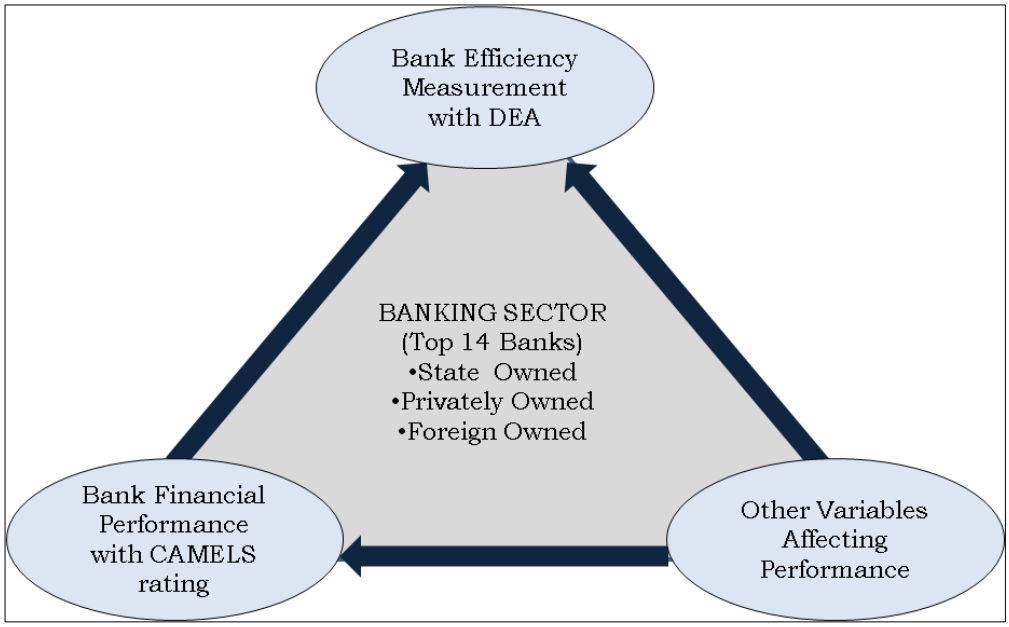

Figure 1 Summary of the study

In order to measure bank efficiency with Data Envelopment Analysis (DEA), we calculate pure technical efficiency, scale efficiency and technical efficiency. Pure technical efficiency and scale efficiency show efficiency in terms of converting inputs into outputs and in terms of producing at the right scale, respectively. Technical efficiency is the multiplication of these two levels. We use intermediation approach in calculating the levels. Our inputs are labor, capital and loanable funds, while our outputs are loans and other earning assets. These calculations are made under three different concepts; general, non-public and long term efficiency. We use gross amounts in calculation of the general efficiency levels. To calculate the non-public efficiency, we extract the public related input and output levels from gross levels. So we only use non-public portion of the variables. Finally, in the long term efficiency calculation, we only use the long term portion of these levels. That is to say, we extract short term part of the inputs and outputs from gross amounts.

CAMELS rating is calculated in order to show financial performance of the banks in different respects. C, A, M, E, L and S stand for Capital Adequacy, Asset Quality, Management, Earnings Quality, Liquidity and Sensitivity to Market Risk.

The variables affecting bank performance are grouped into five; governance, rivalry, distribution channels, macroeconomic and other factors. The governance variables include ownership type, level of delegation and being publicly traded or not. Loan, deposit and net income market shares are used in the rivalry part. We use variables related to two channels in distribution channel analysis; branch and ATM. These variables are number of branches, ratio of İstanbul branches to all branches and being in an ATM network or not. In terms of macroeconomic factors, we use five different variables namely; gross domestic product (GDP), inflation, interbank lending rate, exchange rate (USD) and the ratio of current account deficit to GDP. Finally, the other factors analyzed are asset size and education level. The education level used in the analysis is the ratio of employees having a graduate degree to the total number of employees.

After calculating performance levels and analyzing the factors, we test the relations between them. Firstly, we analyze the relationship between calculated efficiencies and the CAMELS rating. Secondly, the relation between the factors affecting bank performance and the efficiency levels are analyzed. Finally, we make regression analyses between the CAMELS rating results and these factors.

The thesis is organized as follows: The second chapter reviews the literature on efficiency, the CAMELS rating and factors affecting bank performance. The third chapter includes calculations of the different efficiency concepts. In fourth chapter, the CAMELS ratings of the banks are calculated. Following these two calculations, in the fifth chapter the factors affecting bank performance are analyzed. In the sixth chapter, we find the relation of the efficiency concepts, the CAMELS ratings and the factors affecting bank performance. Finally, in the last chapter conclusions are discussed.

CHAPTER 2

2. LITERATURE REVIEW

In this chapter, the literature related to banking performance evaluation is reviewed. The first part is about bank efficiency and it includes methodologies for calculating efficiency and input-output determination approaches and the studies on bank efficiency. In the second part, the CAMELS rating and applications of the method is discussed. The final part is about the factors affecting bank performance and the studies using these factors in analyzing performance.

2.1. Bank Efficiency

In order to measure bank efficiency, two main decisions should be made; which method and which approach to be used. In this part, the first and second sections are about the methodology and the input / output determination approaches. Figure 2 also shows methods and input / output determination approaches. After these sections, the studies on bank efficiency and the variables affecting it is reviewed.

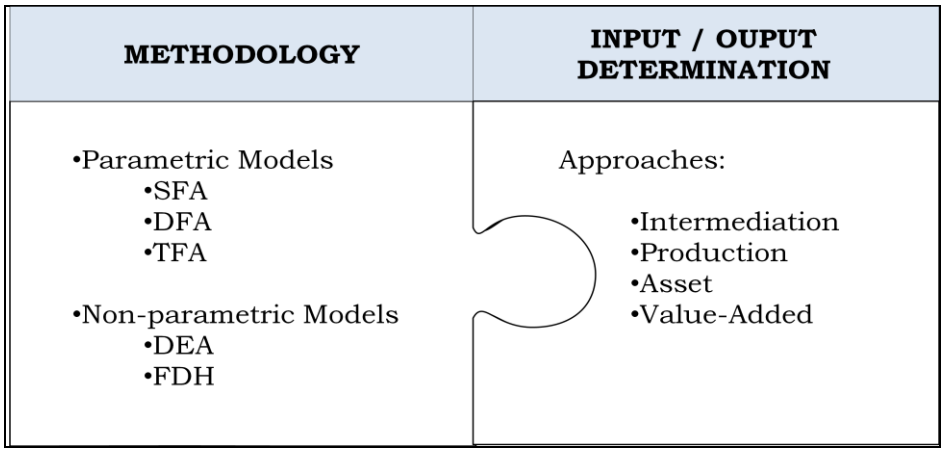

Figure 2 Techniques and approaches for measuring bank efficiency

2.1.1. Methodology

In general, efficiency is the comparison of what is actually produced with what can be produced by using available resources. The efficiency is measured for several sectors. Banking sector is one of the sectors for which efficiency measurement literature is ample. In order to measure bank efficiency, both simple accounting ratios and sophisticated models can be used.

Simple accounting ratios are easy to calculate and give information about various aspects of banking activities. But these ratios have some limitations in terms of analyzing bank performance.

> *…through each ratio only one aspect of activities of banks which are already complex organizations can be studied. An unlimited number of ratios often cause perplexing and inconsistent results thereby making the method unsuitable for evaluating the general performance. Because of not being able to determine the top of the range in any homogenous group and not being able to make a calculation with more than one input and output, the ratio analysis is incapable of measuring efficiency.* (Arslan & Ergeç, 2010).

Although using accounting ratios is useful for measuring bank efficiency, it is criticized for showing only the level of efficiency, not sources of inefficiency or points required to be improved (Daley & Matthews, 2009)

In order to avoid the weaknesses of accounting ratios in performance measurement of banks, more sophisticated models are used. As Figure 2 shows there are two different sophisticated methods mostly used in the literature; parametric and non-parametric approach. It is difficult to decide which method to use because they have their own advantages and drawbacks (Pakistan Research Repository). The non-parametric approaches are simple to compute and they can be implemented without knowing the algebraic form of the input / output relationship (Coelli, Rao, ODonnell, & Battese, 2005). But they do not give any information about the production process, instead inputs and outputs are just used in order to estimate efficiency. However, production processes are not that simple all the time. Some of them operate under a network structure that is to say the output of a process may be the input of another process. In order to overcome this problem, Fukuyama and Weber introduced a new model called "two stage network system" (Fukuyama & Matousek, 2010). Moreover, mostly used non-parametric model DEA does not allow unbalanced panel data. However, banking sector is too dynamic so the banks entering and exiting from the market are so important that while measuring efficiency of the banks and the sector, they should be included in the data. Because excluding good performer newly entered banks or bad performer exited banks may result in biased efficiency scores. Furthermore, in DEA models efficiency of a bank is measured against best practice banks that may also cause misleading results (Reynaud, 2010).

Structural Approach

Structural approach which is also called econometric approach is used in order to estimate a relationship between input and output under a given a functional form by using econometric techniques in order to

estimate unknown parameters in a determined model. This approach is parametric and stochastic (Coelli, Rao, ODonnell, & Battese, 2005).

Criteria used to choose a functional form are flexibility, linearity in parameters, regularity and principle of parsimony.

> *A functional form is said to be first-order flexible if it has enough parameters to provide a first-order differential approximation to an arbitrary function at a single point. A second-order flexible form has enough parameters to provide a second-order approximation.* (Coelli, Rao, ODonnell, & Battese, 2005)

Among the functional forms, linear and Cobb-Douglas are first-order and others are second-order flexible forms. Although flexibility is preferable, it brings difficulty of estimating more parameters resulting in econometric difficulties such as multicollinearity. Linearity in parameters makes our functions suitable for estimating them with linear regression techniques. Although Cobb-Douglas form and translog functional form seem violating this property, they can be made amenable to estimate using linear techniques by taking logarithms of both sides of these functions. Regularity means checking functional forms in terms of satisfying economic regularity properties such as homogeneity, convexity. The principle of parsimony says we should choose the simplest functional form that "gets the job done adequately". Adequacy of functional form can be checked by using different techniques such as hypothesis testing, calculating measures of goodness to fit and assessing predictive performance (Coelli, Rao, ODonnell, & Battese, 2005).

In structural models, inefficiency of the bank is explained by error term in the equation. However, explaining error term with just inefficiency of the bank is a misleading conclusion because there can be other deviations in our model caused by other sources of statistical noise. For this reason, in structural approach, *"…output is specified as a function of a nonnegative random error which represents technical inefficiency, and a symmetric random error which accounts for noise."* Random error

can be resulted from omission of relevant variable, measurement error or approximation errors associated with choice of functional form (Coelli, Rao, ODonnell, & Battese, 2005).

In the literature, there are three methods used for structural approach: Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and Thick Frontier Approach (TFA) and. The difference between them is their approaches to inefficiency and random parts of the error term.

Stochastic Frontier Approach (SFA)

Its assumptions about error term components are based on distributional characteristics of them. In this approach, it is assumed that inefficiency part of the error term has asymmetric distribution (usually half normal or exponential) whereas random error part has a symmetric distribution (usually standard normal) (Pakistan Research Repository).

Distribution Free Approach (DFA)

This approach does not have any strong assumption about distributional characteristics of the error term components as name of it suggests. It separates random and inefficiency parts of error term by analyzing their trend over time. According to this approach, while average of random part is close to zero, efficiency part of the error term is stable over time (Pakistan Research Repository).

Thick Frontier Approach (TFA)

As in the case of DFA, TFA approach does not have any strong assumption about distributional characteristics of error term components. Instead of this, it

> *…assumes that deviations from predicted performance values within the highest and lowest performance quartiles of observations represent random error, while deviations in predicted performance between highest and lowest quartiles represent inefficiencies* (Pakistan Research Repository).

Nonstructural Approach

Nonstructural approach is nonparametric and deterministic. In this non-parametric approach, assumption about functional form is not required. An efficient non-parametric frontier or a piece-wise linear surface is constructed in order to have a benchmark for comparisons of individual decision making units (DMUs). In this approach, there is a simple restriction that all decision making units (DMUs) lay on or below the efficient frontier regardless of whether efficiency is based on constant returns to scale or variable returns to scale (Pakistan Research Repository).

In the literature there are two methods used in non-structural approach: Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH).

Data Envelopment Analysis (DEA)

DEA is a linear programming technique which generates a piece-wise form and calculates efficiency of each decision making unit (DMU) separately. It assumes that *"…linear substitution is possible between observed combinations on an isoquant for the input requirements to produce a given output"* (Pakistan Research Repository). Although DEA is advantageous in terms of not being sensitive to model selection or aggregation / disaggregation of variables, it has a drawback of being too sensitive to errors in data because it requires only a single observation (Pakistan Research Repository). This sensitivity of DEA can especially cause problems for measuring efficiency of countries facing challenge of accessing sufficient, accurate and reliable data (Daley & Matthews, 2009). Also there are three important complications in DEA. These are need for sample homogeneity, proper variable selection, and treating with time series data. In order to deal with sample homogeneity, clustering methodology can be used and to cope with proper variable selection, objective weights of selected variables can be determined by using Shannon's "entropy" measure (Çınar, 2010).

DEA can be used under two different assumptions regarding scale: Constant Returns to Scale (CRS) DEA model and Variable Returns to Scale (VRS) DEA model. CRS DEA model is suitable for an environment in which all firms produce at optimal scale. However, under some conditions such as imperfect competition, government regulations and constraints on finance, VRS DEA model is better. A CRS DEA model can be converted into a VRS DEA model by adding convexity constraint to the model. Convexity constraint ensures that firms are benchmarked against similar scale firms. CRS Technical Efficiency (TE) can be decomposed into two parts: scale inefficiency and pure technical inefficiency (Coelli, Rao, ODonnell, & Battese, 2005).

> *Pure technical efficiency is also known as the managerial efficiency. A decision making unit has managerial inefficiency when the inputs used to produce a given level of output is more than the required amount.* (Aysan & Ceyhan, 2008).

Pure technical efficiency is equal to VRS Technical Efficiency (TE), so if CRS TE is not equal to VRS TE, then we can say that there is scale inefficiency. Scale inefficiency can be calculated as TECRS/TEVRS. However, calculation of the value of scale inefficiency by this method does not give whether scale inefficiency is caused by increasing returns to scale (IRS) or decreasing returns to scale (DRS). In order to find this, non-increasing returns to scale (NIRS) model can be used by adjusting convexity condition in VRS. This time, value of NIRS Technical Efficiency (TE) and VRS TE should be compared. If they are equal, then it can be concluded that scale inefficiency occurs at decreasing returns to scale (DRS) part and vice versa (Coelli, Rao, ODonnell, & Battese, 2005).

Free Disposal Hull (FDH)

FDH is a special case of DEA. Different from classical DEA model, in FDH approach

> *…points on lines connecting DEA vertices are not included in the frontier. Instead, the FDH production possibilities set is composed only of the DEA vertices and free disposal hull points interior to these vertices* (Pakistan Research Repository).

2.1.2. Input / Output Determination

In the literature, there are five approaches used in order to determine inputs and outputs for bank efficiency: intermediation approach, production approach, asset approach, user cost approach and value added approach. Among these approaches intermediation approach and production approach are the most frequently used ones (Pakistan Research Repository).

> *Berger and Humphrey* (1992) *showed that studies on bank efficiency use the following three approaches for estimating bank efficiency: the asset, user cost, and value-added methods. Berger and Humphrey* (1997) *suggested the intermediation approach is best suited for evaluating bank efficiency, whereas the production approach is appropriate for evaluating the efficiency of bank branches.* (Fukuyama & Matousek, 2010).

Intermediation Approach

This approach is based on bank's main function which is transferring funds from units having financial surplus to units having financial deficit by utilizing labor and capital to produce loans and other earning assets from deposits (Pakistan Research Repository); (Daley & Matthews, 2009). Treating deposits as an input or output is a dispute in the literature. For this reason,

> *…a network two-stage DEA approach where deposits are treated as an intermediate output of a first stage of production and then they become an input in the production of loans and securities seems to be an appropriate alternative to the intermediation approach.* (Fukuyama & Matousek, 2010).

Production Approach

Unlike intermediation approach, production approach is not based on intermediation function of the banks. Instead of it, this approach evaluates banks as normal firms producing deposit accounts and loan services by using labor and capital. Therefore in this approach, inputs include labor and capital costs but do not include interest costs (Pakistan Research Repository).

Asset Approach

This approach is a different version of intermediation approach. Under this approach, *"…outputs are defined by assets and mainly by production of loans due to which banks have advantages over the other financial institutions"* (Pakistan Research Repository).

Value Added Approach

In this approach not only inputs and outputs are defined, but also their share of value added should be determined. As value added of the item increases, it becomes more and more important. This approach is used to measure technological changes in banking.

2.1.3. Studies on Bank Efficiency

There are several studies about bank efficiency on Turkey and other countries.

Effect of liberalization on bank efficiency is one of the mostly discussed topics and important portion of first papers about bank efficiency in Turkey was written on this topic. Özkan (1996), Denizer (1997),

Ertuğrul and Zaim (1999), Mercan and Yolalan (2003), Denizer, Dinç and Tarımcılar (2007) analyzed this topic and they have made different conclusions about direction of the effect.

Another mostly analyzed topic is the effect of ownership on bank efficiency. In these studies, efficiency levels of banks are calculated and compared by considering group they belong. There are again different conclusions about the most and least efficient banking group. Zaim (1995), Özkan and Günay (1997), Emir (1999), Denizer, Dinç and Tarımcılar (2000), Mercan and Yolalan (2003) and Işık and Hassan (2003) are the ones studied on this topic.

There are also studies on methodologies used for measuring bank efficiency. Fukuyama and Matousek (2010)examined bank efficiency in Turkey for 1991-2007 periods by using both two-stage network DEA model introduced by Fukuyama and Weber (2010) and classical DEA model. They compared results of these two methods.

Also there are analyses about more special topics. Arslan and Ergeç (2010) analyzed performance of *Participation Banking*, also called *Islamic Banking* in Turkey and compared scores of them with Turkish conventional banks' performances. Aysan and Ceyhan (2008) tried to identify the effect of 2001 crisis on banking efficiency in Turkey. They analyzed performance of the banking sector between 1900 and 2007 using input oriented DEA and Malmquist Total Factor Productivity Change Index. Reynaud (2010) tried to find whether or not efficiency level is a good sign for predicting bank failure by using both parametric and non-parametric techniques for the years between 1996 and 2001.

In terms of data usage, input and output data is generally used as given. However, in some studies data is disaggregated and used. Işık and Hassan (2003) disaggregate loan data into short term and long term. They used them as two distinct outputs.

We analyze non-public efficiency of all banks for the period 2006-2010. Different from studies about ownership type, we compare the efficiency levels of different banking groups by not only comparing their general efficiency levels but also comparing them with other efficiency levels

calculated under different concepts. In order to eliminate unfair competition of state owned banks in financing public, we extract public related input and output levels from total amounts. By doing this, also different from other studies in which data is disaggregated; we use only the related part of the disaggregated data in calculation and compare the results with the aggregated data. That is to say, instead of using public and private loans as two outputs, we only use private loans as output and then find non-public efficiency of different banks and banking groups. Moreover, we compare these levels by the ones calculated by total loans. By doing this, we also find public efficiency levels of each bank. Furthermore, since 2010 banking data is recently published for Turkey, we are one of the first users of this data in bank efficiency.

2.2. CAMELS Rating

In order to evaluate banks' overall financial condition, CAMELS supervisory rating system is built and introduced first in USA for onside monitoring. Now, it is used both on-site and off-site monitoring purposes (Kaya, 2001).

The system analysis performance in terms of capital adequacy (C), asset quality (A), management (M), earnings quality (E), liquidity (L) and sensitivity to market risk (S) and gives rating between 1 and 5 with 1 being strongest and 5 being weakest (Wikipedia).

The literature on CAMELS rating for Turkey is mainly focused on predicting bank failures with rating system. Kaya (2001) analyzes the relationship of CAMELS rating and possibility of failure of a bank by using 1997 and 2000 data of Turkish commercial banks and finds that only 17% of the banks pointed out as successful by CAMELS system have failed. Moreover, CAMELS trend from 1997 to 2000 and CAMELS rating-asset size relation are also discussed in the study. Çinko and Avcı (2008) try to find power of CAMELS rating in terms of predicting the transfer of commercial banks in 2001 to the SDIF. They use three different models namely; discriminant analysis, logistic regression and neural network models and find that CAMELS rating is not powerful

enough to predict bank failure. Pekkaya (2002), Canbaş (2005), Karacabey (2007) and Baoyacıoğlu (2009) are some other researchers trying to find whether or not CAMELS can predict bank failure. However, they cannot reach a consensus in terms of prediction power of CAMELS rating (Çinko & Avcı, 2008).

Bank efficiency and CAMELS rating concepts are also used together in some studies. Aydın (2009) calculates bank efficiency with commonly accepted financial ratios of CAMELS for the period from 2002 to 2006. Like this study, Mercan and Yolalan (2003) also calculate bank efficiency with CAMELS ratios. However, as far as we know, relationship between the bank efficiency and the CAMELS rating has not been analyzed with panel data analysis for Turkey.

2.3. Factors Affecting Bank Performance

In the literature, governance is the most widely used factor affecting bank performance. In terms of governance, ownership and whether or not a CEO being chair of the board are the two main concerns.

The relation between bank efficiency and the factors affecting performance are analyzed by Işık and Hassan (2003). In terms of governance, they used being publicly traded or not in addition to mostly used variables we have discussed above. They also point out importance of market structure and use some variables for this topic namely; asset size, share of bank deposit, product diversification, ratio of loans to total assets and purchased funds to total assets. One another topic they discuss is the risk structure. For this analysis, they use the variables ROE, ROA, ratio of equity to total assets and nonperforming loans to total assets. Finally, they try to find the relation between bank efficiency and ratio of employees having a university degree or above, age and annual growth rate of assets. In our analysis, we cover most of these variables. Moreover, different from Işık and Hassan (2003), we bring new concepts such as distribution channels, delegation of power and agglomeration of bank branches in İstanbul.

CHAPTER 3

3. BANK EFFICIENCY

In second chapter, we make literature review about methodology and studies on measuring bank performance. In this chapter, we begin bank performance analysis by measuring the bank efficiency. In first two parts, we mention about variable selection approaches and methodology we use. In third part, we calculate efficiency levels with gross input and output values for different years, banks and banking groups. In fourth section, we analyze productivity change among these years. Fifth and sixth parts are again about measuring efficiency levels but under non-public and long term concepts respectively.

3.1. Variable Selection

In the literature, in order to measure efficiency levels of banks, intermediation approach is used generally. The intermediation approach is based on a bank's main function which is transferring funds from the units having financial surplus to the units having financial deficit. Different from other approaches, deposits are used as an input instead of an output. In our analysis, bank efficiency is measured by using this approach.

In order to select correct variables for our analysis, different studies are analyzed. In these studies, labor, capital and funds are found to be the most widely used inputs while loans and other earning assets are the most widely used outputs. Figure 3 shows inputs and outputs used in our analysis. In both input and output side, we are in accordance with the literature. Total numbers of employee, net fixed assets and deposits plus other borrowed funds are used as labor, capital and funds respectively. Level of loans and level of securities are used as loans and other earning assets.

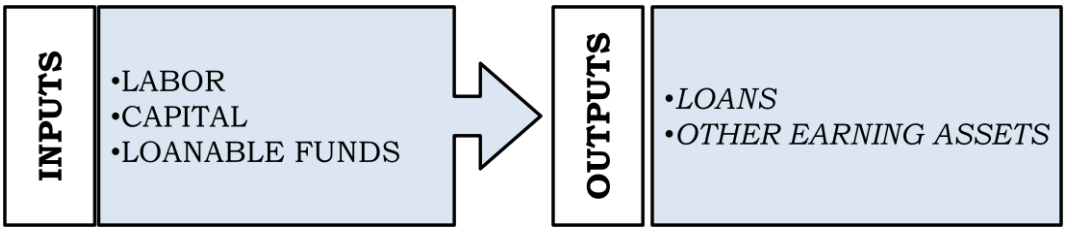

Figure 3 Inputs and outputs used in the analysis

3.2. Data and Methodology

Efficiency levels of 14 banks in Turkish Banking Sector are measured for the period 2006-2010 by using data from The Bank Association of Turkey in panel form.

The banks used in this analysis consist of 3 state-owned, 6 privately-owned and 5 foreign owned banks. Their names and shares in the sector are listed in Table 1. As the table shows, sum of their shares are about 90% in terms of asset, loan, deposit and personnel size. So, we can say that these banks can represent the Turkish Banking System in our efficiency analysis.

Figure 4 shows asset, loan, deposit and employee share of analyzed 14 banks by their groups (foreign, private and state). The banks excluded from the analysis have small shares. Among the analyzed 14 banks, the privately owned banks have the biggest shares (about 50%) in terms of asset, loan, deposit and employee share. The state owned banks also have big shares especially in deposit accounts. In Turkey per customer, the government assures 50,000 Turkish Liras deposit in a case of bank failure. So, customers having more than assured amount have a motivation to invest state-owned banks in order to keep their money safe. That is why; state owned banks have especially big shares in terms of deposit accounts. Foreign banks have lower levels of assets, loans and deposits.

The data used in this analysis is in panel form. We have 14 banks and 5 periods, so our sample size is 70.

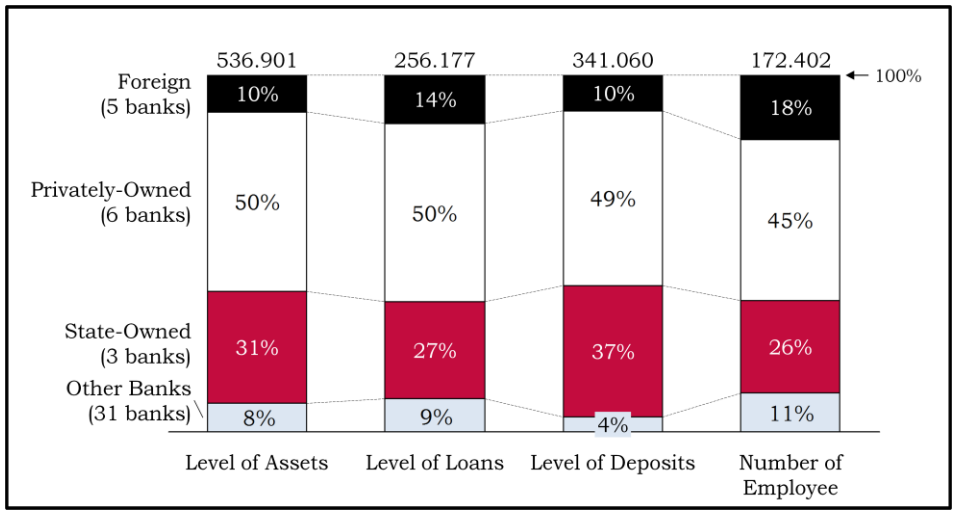

Figure 4 Level of assets, loans, deposits and number of employees of 14 banks in terms of their banking groups in 2009 (USD Million)

Source: Data obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

Banks are not such firms which have defined orders and use resources in order to meet these orders. Instead, they have defined inputs and try to maximize output. That is why, we use output oriented non-parametric data envelopment analysis (DEA) in order to measure level of efficiency for 14 banks between 2006 and 2010. Bank efficiency levels are calculated by using DEAP Version 2.1 (Coelli T.).

In this method, each bank is a single decision making unit and efficiency levels are calculated by comparing each decision making unit with others. By this comparison, the most efficient banks are found in the sample and their production levels build up the efficient frontier. These banks have 100% technical efficiency. Other banks in the sample produce below this frontier and their technical efficiency score is defined according to the distance from the efficient frontier. But producing on the efficient frontier is not enough for saying that this bank is the best. There is another concern, scale efficiency. A bank may produce maximum output from given inputs but the question *"Is it producing at optimum scale?"* should be asked also. Maybe the bank is at such a point that by increasing its input, it will produce much more output.

In this analysis, technical efficiency of banks is calculated under both constant returns to scale (CRS) and variable returns to scale (VRS) assumption in order to calculate scale efficiency of banks as well. Scale efficiency is the division of technical efficiency under constant returns to scale (CRS) assumption by technical efficiency under variable returns to scale (VRS) assumption also called pure technical efficiency.

Table 1 Shares of banks used in analysis in terms of asset, loan, deposit and personnel sizes (2009)

#	Bank	Groups	Share in Assets	Share in Loans*	Share in Deposits	Share in Personel Size
1	Ziraat	State-owned	15,6%	9,6%	19,4%	12,9%
2	İşbank	Privately-owned	14,2%	12,7%	14,2%	13,0%
3	Garanti	Privately-owned	13,2%	13,1%	12,4%	9,8%
4	Akbank	Privately-owned	11,9%	10,4%	11,0%	8,5%
5	Vakıfbank	State-owned	8,1%	9,1%	8,8%	5,9%
6	Yapıkredi	Privately-owned	8,1%	9,9%	8,0%	8,3%
7	Halkbank	State-owned	7,6%	8,5%	8,7%	7,3%
8	Finansbank	Foreign Banks	3,7%	4,6%	4,0%	5,9%
9	Denizbank	Foreign Banks	2,7%	3,7%	2,3%	4,5%
10	ING	Foreign Banks	1,9%	2,9%	1,9%	3,5%
11	TEB	Privately-owned	1,9%	2,4%	1,9%	3,4%
13	Fortis	Foreign Banks	1,4%	1,8%	1,1%	2,9%
14	Şekerbank	Privately-owned	1,1%	1,3%	1,3%	2,3%
15	Citibank	Foreign Banks	0,6%	0,5%	0,7%	1,1%
Total Share of Banks Used in			**92,0%**	**90,6%**	**95,8%**	**89,3%**
* Loans and Receivables+Loans under Follow-up- Specific Provisions						

Source: Data obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.asp

For measuring bank efficiency under constant returns to scale (CRS) assumption, our model is (Coelli T. J., 1996);

$$\begin{aligned} &min_{\lambda,\theta}\ \theta, \\ &st \quad -y_i + Y\lambda \geq 0, \\ &\quad \theta x_i - X\lambda \geq 0, \\ &\quad \lambda \geq 0 \end{aligned}$$

(Equation 1)

For measuring output oriented efficiency levels under variable returns to scale assumption, our model is (Coelli T. J., 1996);

$$\begin{aligned} &Max_{\phi,\lambda} \quad \phi \\ &st \quad -\phi y_i + Y\lambda \geq 0, \\ &\quad x_i - X\lambda \geq 0, \\ &\quad N1'\lambda = 1, \\ &\quad \lambda \geq 0 \end{aligned}$$

(Equation 2)

where θ and ϕ are scalars. λ is a vector of constants (For details, please check Appendix)

3.3. General Efficiency Levels

We analyze efficiency levels of the banks in our sample from different perspectives. These different efficiency levels are general efficiency including gross amounts, non-public efficiency including only non-public amounts and long term efficiency including only long term portion of the amounts used in our analysis. In this part, we measure and interpret the general bank efficiency.

Figure 5 shows pure technical, scale and technical efficiency scores of individual banks and banking groups.

Pure technical efficiency is the level of efficiency in getting maximum output from given inputs. Banks producing on frontier have 100% pure technical efficiency.

In terms of pure technical efficiency (VRS), almost all banks and banking groups are fully efficient. That is to say, in Turkey banks get maximum output from given inputs. Only ING (98%), Yapıkredi (97,2%) and Halkbank (99,6%) have efficiency levels less than 100%. However, their levels are still so high.

Scale efficiency (Scale) shows whether or not the bank produces at optimal scale, whether or not it should increase its inputs or decrease them. The banks having 100% scale efficiency are producing at optimal scale and they are at constant returns to scale point. Others have either increasing or decreasing returns to scale part of the production process. That is to say they should increase or decrease their production capacity.

In terms of scale efficiency, we are not as optimistic as in the case of pure technical efficiency. The most efficient banking group is the state banks, since all of them have almost 100% scale efficiency. Only Halkbank seems a little far from optimal scale production level, it is in decreasing returns to scale part.

Private banks are the least efficient banking group in terms of scale efficiency. İşbank (89%) and Şekerbank (85,9%) have low levels of scale efficiency. While İşbank is on the decreasing returns to scale part, Şekerbank is on the increasing part. That is to say İşbank should shrink its production capacity and Şekerbank should increase it. Yapıkredi (99,2%) also has inefficiency in terms of scale but this is so small.

Except Denizbank (92,9%), all foreign banks are scale efficient.

Technical efficiency score (CRS) under constant returns to scale assumption includes both pure technical efficiency and scale efficiency and it is the multiplication of them. So, it shows total effect of pure technical efficiency (VRS) and scale efficiency (Scale).

When we consider both pure technical and scale efficiency together, state-owned banks are the most efficient banks. On the average, their technical efficiency score is about 99,9%. As in other efficiency scores, Ziraat and Vakıfbank are fully efficient while Halkbank is very close to this level, 99,6%.

Private banks have about 95,2% technical efficiency on the average. Akbank, Garanti and TEB have 100% efficiency in all efficiency types. İşbank (89%) and Şekerbank(85,9%) have lower levels of technical efficiency due to scale inefficiency, while Yapıkredi has rather low level of technical efficiency (96,4%) because of both pure technical and scale inefficiency.

3.4. Productivity Change

There are two sources of productivity change; technology and efficiency improvement. Technology improvement refers to a shift in the production technology. Efficiency improvement can be divided into two parts; pure technical improvement and scale improvement. Pure technical improvement means improved efficiency in the firm's ability to use the available technology while scale improvement is the improvements in the scale of operations of the firm and its move

towards technologically optimum scale (TOPS) of operations (Coelli, Rao, ODonnell, & Battese, 2005).

Figure 6 shows average productivity changes of 14 banks in terms of the group they belong to from 2006 to 2007, 2007 to 2008, 2008 to 2009 and 2009 to 2010 calculated by using Malmquist Productivity Index.

As Figure 6 shows, in 2007 all banking groups increased their productivity and these increases are very close to each other. However, in 2008, with the effect of the global crisis in 2008, both foreign and private banks recorded productivity losses. As productivity level of foreign banks shows, the global crisis in 2008 affected them seriously. This is expected, because they have direct connection to the global crisis via their holders. Productivity of private banks stayed almost same in the global crisis period in 2008. On the other hand, despite the global crisis, state banks improved their productivity in 2008. Moreover in 2009, although state banks gained the highest productivity compared to other banking groups. The year 2010 was a very productive year for all banking groups. Especially foreign banks seem to get rid of bad atmosphere of the global crisis in 2008. They increased their productivity about 20%. Following them, private banks also had high level of productivity gain. State banks also kept their productivity gains in 2010.

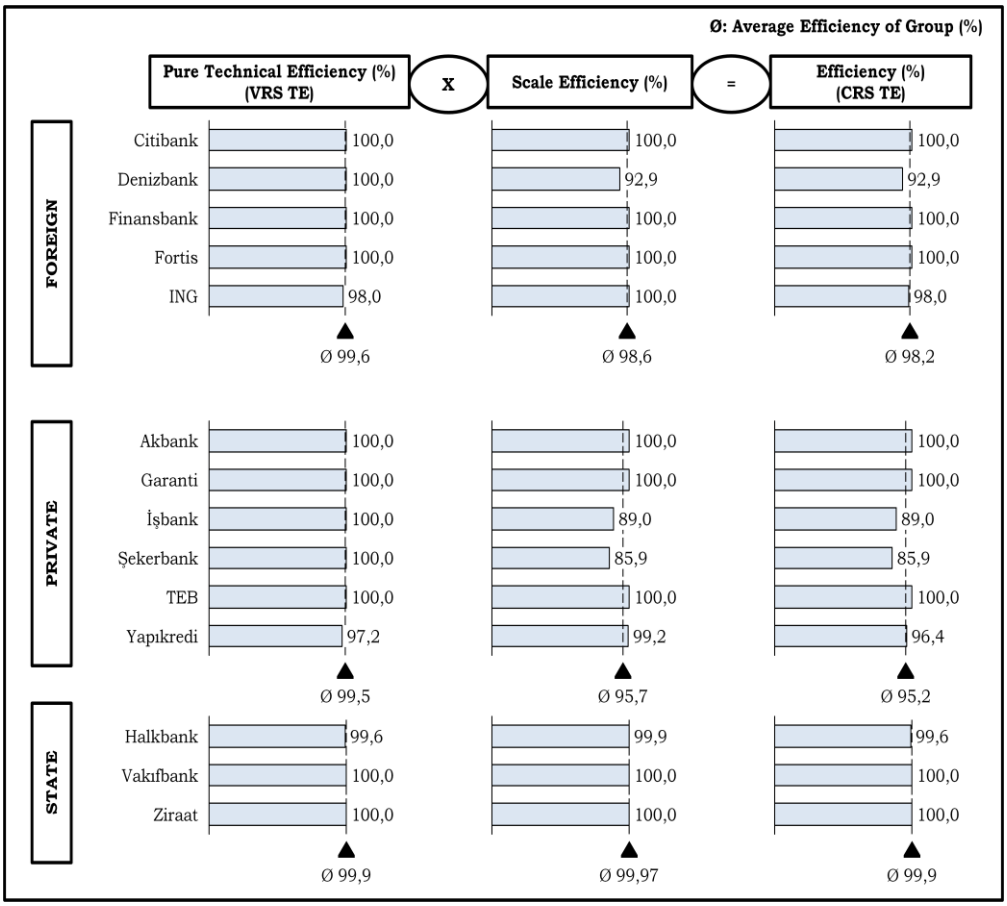

Figure 5 Pure technical, scale and efficiency scores of 14 banks and banking groups

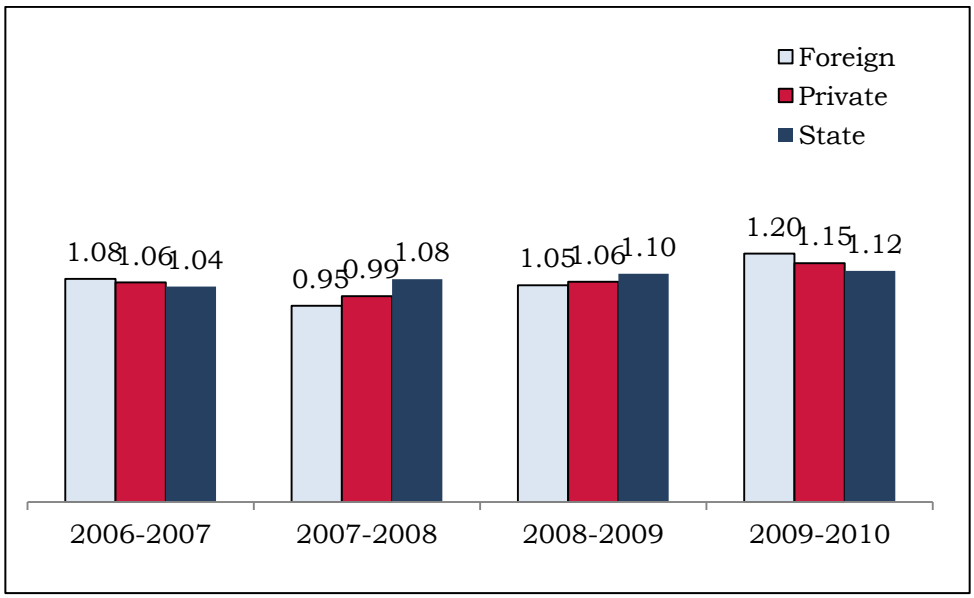

Figure 6 Total factor productivity change of 14 banks in terms of their banking groups

Details of these productivity changes are given in Table 2. Productivity change is the multiplication of the technology change and the efficiency change (the product of pure technical efficiency change and scale efficiency change).

As Table 2 shows, in 2007 productivity improvements were realized due to technological improvements in all banking groups while efficiency either decreased or stayed the same. In this year, for private and state banks, pure technical efficiency loses were the main reason of the losses in efficiency.

In 2008, this picture changed for foreign banks. Their technology decreased, while efficiency stayed same. Private Banks improved their technology but not their efficiency as in 2007. State banks improved both their technology and efficiency.

In 2009, all banking groups improved their productivity in terms of both technology and efficiency. In 2010, all banking groups improved their technology. Foreign and private banks also improved their efficiency while state banks decreased it in this year. This decrease in efficiency of state banks was resulted by pure technical efficiency losses.

3.5. Non-Public Efficiency

Some items in the state banks' balance sheets are a common discussion topic. Loans given to the public sector agencies, deposits of the government entities invested in state banks and public securities held by the these banks are criticized. Since state banks have advantage over other banks in terms of public related items, efficiency of them should also be analyzed by excluding these items. In order to do this, in this section, we repeat our analysis in general efficiency part by excluding public related items from our variables and compare the results. We measure the effect of public banking on the state banks' efficiency. Figure 7 shows public / private ratio of loans, securities and deposits of the banks analyzed in terms of the banking groups by taking average of the years between 2006 and 2010.

As Figure 7 shows and expected, ratio of public related loans to gross loans is the biggest for state banks (4%) followed by private (3%) and foreign banks (1%). In general, public related loans have a small portion in total loan amount for all banking groups.

Table 2 Average output orientated Malmquist DEA results of 14 banks in terms of their banking groups

Type of Change	2006-2007	2007-2008	2008-2009	2009-2010
Foreign Productivity Change	1.077	0.947	1.046	1.199
Technology Change	1.070	0.946	1.045	1.193
Efficiency Change	1.006	1.001	1.001	1.005
Pure Technical Efficiency Change	1.003	1.001	0.995	1.000
Scale Efficiency Change	1.003	1.000	1.006	1.004
Private Productivity Change	1.059	0.994	1.063	1.153
Technology Change	1.071	1.005	1.028	1.126
Efficiency Change	0.989	0.988	1.035	1.025
Pure Technical Efficiency Change	0.984	0.989	1.032	1.003
Scale Efficiency Change	1.005	0.999	1.002	1.022
State Productivity Change	1.040	1.075	1.101	1.115
Technology Change	1.075	1.068	1.081	1.130
Efficiency Change	0.966	1.006	1.019	0.987
Pure Technical Efficiency Change	0.975	0.999	1.019	0.985
Scale Efficiency Change	0.991	1.008	1.000	1.002

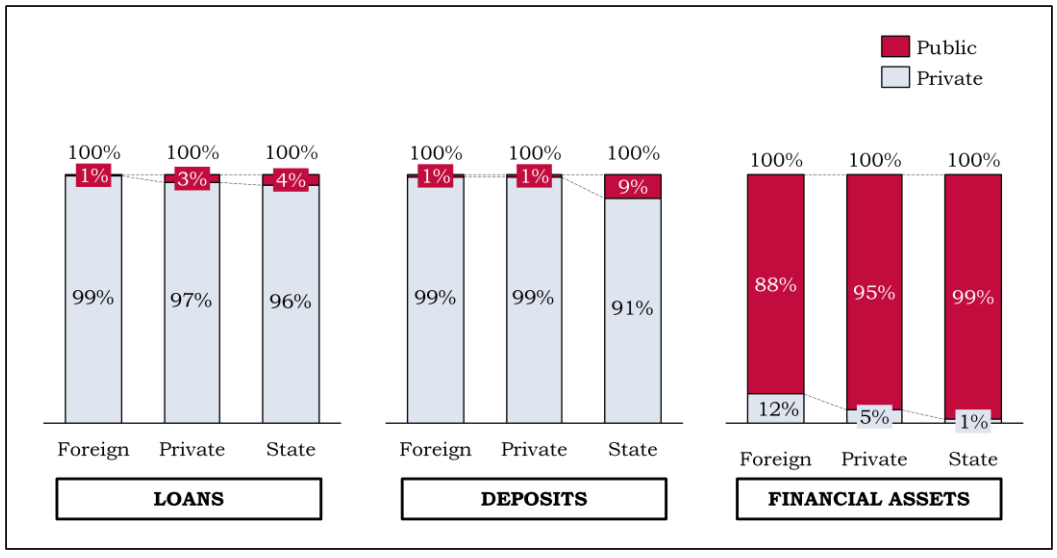

Figure 7 Public / Private ratio of loans, securities and deposits of 14 banks in terms of their banking groups (average of years)

Source: Data obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / Veri Sorgulama Sistemi), http://www.tbb.org.tr/tr/Banka_ve_Sektor_Bilgileri/Veri_Sorgulama_Sistemi.aspx

On the other hand, in all groups' balance sheets, public securities have a very important ratio. Again in securities, the biggest share, 99% belongs to state banks. These big portions of public securities in all groups' security balances are resulted by market maker role of these banks. Between these 14 banks, 3 out of 5 foreign banks, 4 out of 6 private banks and all 3 state banks are market maker and because of this role, they should keep these securities.

Public deposits in foreign and private banks' balance sheets are negligible, while in state banks' sheets, it consist an important portion.

Figure 8 shows average general and non-public efficiency levels of 14 banks in terms of their banking groups and their market maker role. As it can be seen from the figure, foreign banks have a negligible amount of increase (from 98,18% to 98,20%) in efficiency when we exclude public related items from variables. On the other hand, private banks have small decrease (from 95,22% to 95,60%) with the exclusion of public related balance sheet items. This may be as a result of close relationship between old private banks and the government. As expected, state banks records larger efficiency losses when public related items (their competitive advantage) are excluded. Their full efficiency levels in general concept decreased to 96,70%. However, they are still more efficient than private banks.

Figure 8 also shows change in efficiency levels of 14 banks according to their market maker role. Efficiency levels for non-market maker banks have not changed. On the other hand, as expected, market maker banks are affected by the exclusion of public related items; their efficiency level on the average is decreased from 98,30% to 96,99%.

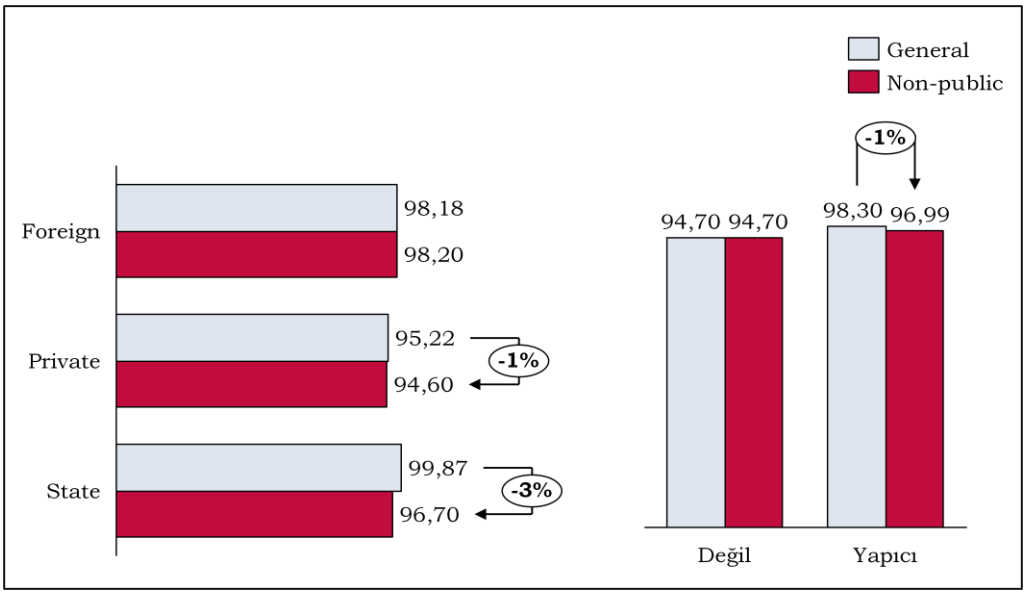

Figure 8 General and non-public efficiency levels of 14 banks in terms of their banking groups and market maker role

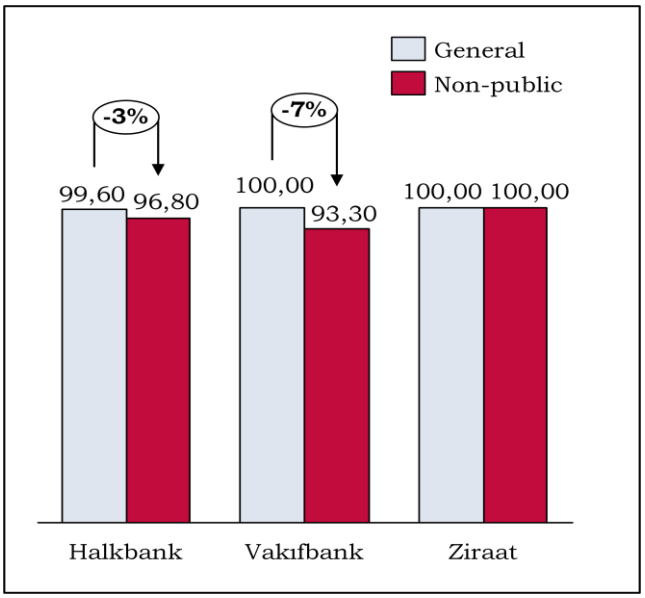

Figure 9 General and non-public efficiency levels of state banks

Figure 9 shows general and non-public efficiency levels for state banks individually. Interestingly, efficiency of Ziraat does not change after this exclusion. Before exclusion, Vakıfbank seemed fully efficient, however when public effect is eliminated, its efficiency level decreased to 93,3%. Following Vakıfbank, Halkbank records an efficiency loss from 99,6% to 96,8%. But this level of efficiency is still over the average efficiency level of all banking groups in non-public efficiency concept. To sum up, Ziraat and Halkbank are less affected from public exclusion, while Vakıfbank records a sharp decrease in its efficiency level.

3.6. Long Term Efficiency

Maturity of banks' balance sheet items is currently discussed topic in Turkey. For the soundness of the banking system, long term items in balance sheets have a great importance. In order to make banks to hold long term items, Central Bank of Republic of Turkey brings some important implementations such as lower reserve ratio for long term deposits than for short term deposits.

In this chapter, we evaluate long term efficiency of banks. In order to do this, we disaggregate loans, financial assets and loanable funds into long term (more than 1 year) and short term (1 year or less). This disaggregation has been done in previous studies in the literature and they have used both short term and long term items as variables. Different from these studies, in order to measure long term efficiency, we only use long term part of the variables.

In Figure 10, average of long term and short term ratio of loans, securities and deposits of 14 banks in terms of banking groups of all years is shown.

In Figure 10, averages of long term and short term ratio of loans, securities and deposits of 14 banks in terms of their banking groups are shown. In general, while long term loans and securities are an important portion of total amount, long term loanable funds account is a very small portion of total loanable fund balance.

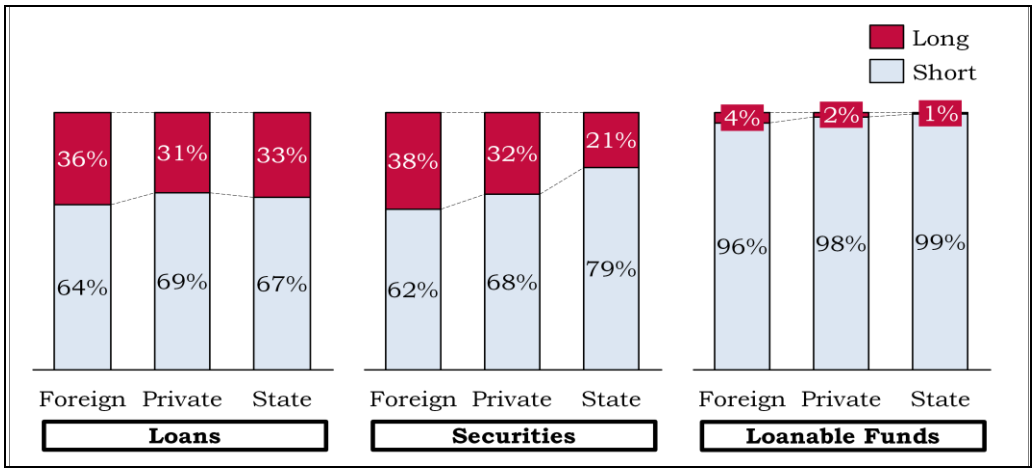

Figure 10 Long term / short term ratio of loans, securities and deposits of 14 banks in terms of their banking groups (average of years)

Source: Data obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / Veri Sorgulama Sistemi), http://www.tbb.org.tr/tr/Banka_ve_Sektor_Bilgileri/Veri_Sorgulama_Sistemi.aspx

In all categories, foreign banks have the highest percentage in long term balance sheet items. On the average, ratios of long term loans, securities and loanable funds in their portfolios are 36%, 38% and 4% respectively.

Following foreign banks, private banks have high long term balances. In loans and securities portfolios, long term items have 31% and 32% ratios respectively. On the other hand, their long term loanable funds balance is only 2%.

State banks have low percentages in long term balances. In securities and loanable funds, they have the lowest ratios, 21% and 1% respectively. They keep pace with raito of long term loans of other banking groups, 33%.

In figure 11, general, non-public and long term efficiency levels of 14 banks in our sample are shown under constant returns to scale assumption. Efficiency of banks under CRS assumption includes both pure technical efficiency and scale efficiency. That is why; we use this type of efficiency in our comparison.

General efficiency and non-public efficiency levels of foreign banks are almost the same. However, in terms of long term efficiency, efficiency levels decrease. Citibank is the only bank which has full efficiency in all categories. Although general and non-public efficiency levels of Denizbank is about 93%, the bank has full efficiency in long term balances. For Finansbank and Fortis, this is vice versa. They have full efficiency in general and non-public balances but about 70% efficiency in long term banking. ING is very consistent as Citibank; it has almost full efficiency in all categories.

Despite being the least efficient group in general and non-public banking, private banks are the most efficient group in long term banking. All of the banks in the group except Şekerbank have full efficiency levels. On the other hand, Şekerbank is the least efficient bank in all banks, 37,8% efficiency at long-term banking.

State banks decrease their efficiency from general to non-public. However, when we move to long-term efficiency, this scene gets worse. On the average, they have about 80% efficiency in terms of long term balances. While saying this, we should discriminate Ziraat. It has full efficiency in all categories. Vakıfbank is the least efficient bank in terms of non-public efficiency and Halkbank is the least efficient one in terms of long term efficiency among state banks.

To sum up, state banks are the least efficient banking group in terms of long term efficiency and private banks are the most efficient ones.

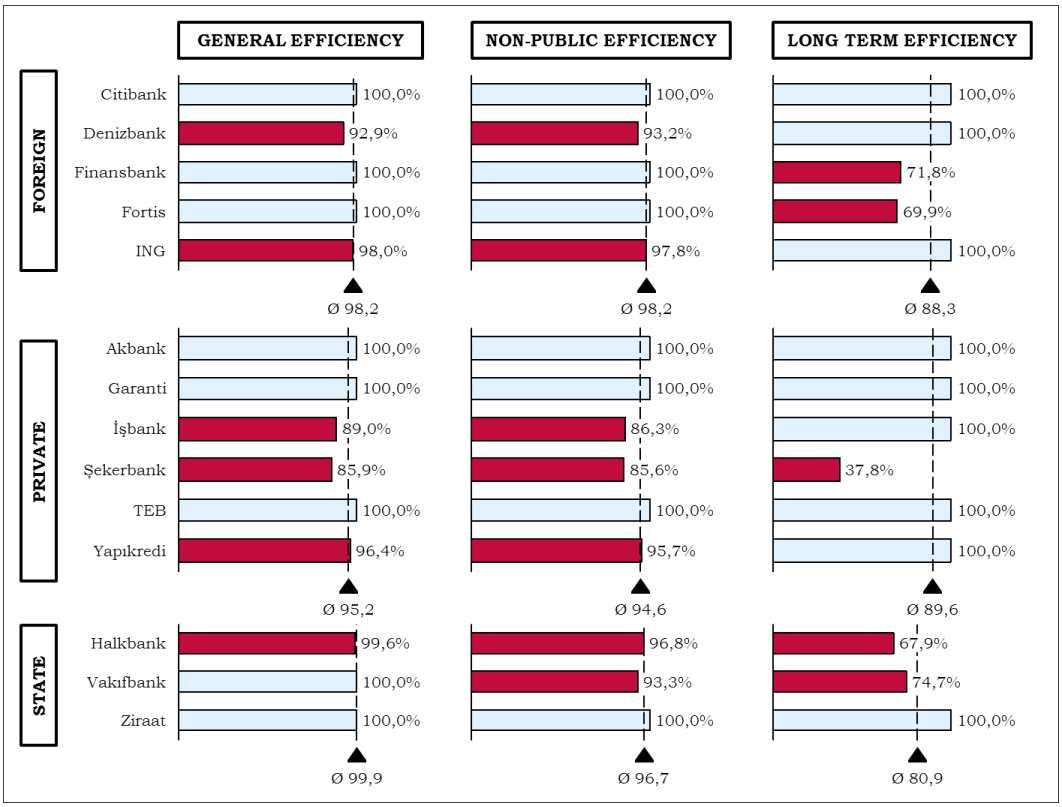

Figure 11 General, non-public and long term efficiency levels of 14 banks

Figure 12 shows general, non-public and long term efficiency of 14 banks in terms of their market maker role. As it can be seen from the figure, market maker banks have higher efficiency in long term balances. This may be the result of being obliged to keep government securities in their balances. Market maker banks have 88,4% efficiency while non-market maker banks have 84,5% in terms of long term efficiency. However, for both groups, long term efficiency is lower than other efficiency concepts.

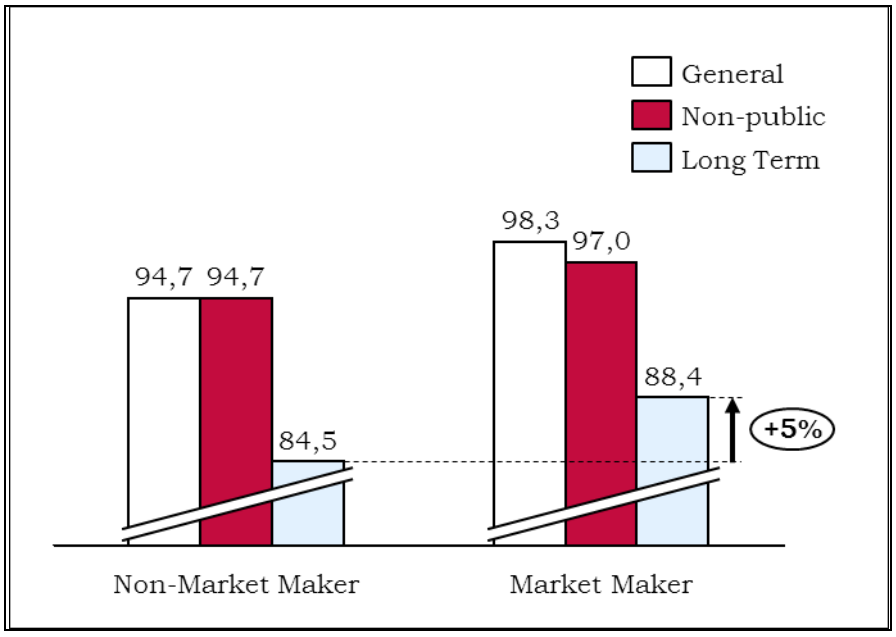

Figure 12 General, non-public and long term efficiency levels of 14 banks in terms of their market maker role

CHAPTER 4

4. CAMELS ANALYSIS

In bank efficiency part, we analyze the performance of the banks and the banking groups from input and output perspective. However, in the banking sector, financial ratios are the most frequently used indicators in order to analyze performance levels of banks. In this part, we will measure performance levels of banks with financial ratios perspective in CAMELS framework. First part is about CAMELS methodology and in second part; we use this methodology to measure CAMELS ratings of different banks and banking groups.

4.1. Methodology

CAMELS is an acronym representing six factors;

C ➔ Capital Adequacy

A ➔ Asset Quality

M ➔ Management Quality

E ➔ Earnings

L ➔ Liquidity

S ➔ Sensitivity to Market Risk

CAMELS analysis is developed by federal regulators in the USA in the early 1970's. Motivation for creating this method was to determine when to schedule on-site examination of a bank (Dash & Das, 2009). This purpose is then converted into a motivation to identify banks' overall condition, their strengths and weaknesses in terms of financial, operational and managerial perspectives. In this method, "*each bank is assigned a uniform composite rating based on six elements.*" (Trautmann, 2006). This rating is between 1 and 5. Performance interpretation of each rating is as follows (Wirnkar & Tanko, 2008);

1 ➔ sound in every respect

2 ➔ sound but has modest weaknesses

3 ➔ weaknesses

4 ➔serious weaknesses

5 ➔critical weaknesses

Considerations of each element are as follows:

Capital Adequacy: In general, it shows the ability of a bank's capital to cover its risks. Its main considerations are:

> …n*ature and volume of problem assets in relation to total capital and adequacy of LLR and other reserve, balance sheet structure including off balance sheet items, market and concentration risk, nature of business activities and risks to the bank, asset and capital growth experience and prospects, earnings performance and distribution of dividends, capital requirements and compliance with regulatory requirements, access to capital markets and sources of capital, ability of management to deal with above factors.* (Trautmann, 2006).

Asset Quality: This ratio shows a bank's ability to manage its assets. That is to say, it measures the performance of a bank in terms of minimizing problem, overdue or rescheduled loans, collecting problematic loans like overdue or rescheduled loans, diversifying investment, optimizing concentration of loans and insider loans in portfolio, building healthy portfolio management procedures, allocating enough Loan Loss Reserves in relation to problem credits and other assets and finally keeping growth of loans volume in accordance with the bank's capacity (Trautmann, 2006).

Management: It shows *"quality of the monitoring and support of the activities by the board and management and their ability to understand and respond to the risks associated with these activities in the present environment and to plan for the future."* (Trautmann, 2006). Main considerations of this ratio are financial performance of bank, policy development and implementation, audit function, level of delegation of authority, human resources practices, that is to say overall performance of the bank and its risk profile (Trautmann, 2006).

Earnings: Main aim of this ratio is to measure sufficiency of earnings to cover potential losses, provide enough capital and please its shareholders. In this concept, composition of income, expense level compared to operations, level of extraordinary items, nontraditional sources in financial statements, adequacy of budgeting, forecasting and controlling income and expenses with correct procedures, level of provisions and risk return relation are considered (Trautmann, 2006).

Liquidity: It is simply the bank's *"ability to generate cash or turn quickly short term assets into cash"*. Main considerations are performance of liquid funds to meet short term obligations, speed of being available of other funds, level of diversification and maturity of funds available, performance in planning, controlling and measuring liquidity (Trautmann, 2006).

Sensitivity to Market Risk: The ratio shows transitivity level of changes and fluctuations in market interest rate, foreign exchange rates, commodity prices, share prices on bank's performance. Sensitivity of earnings and value of equity to negative changes in market conditions and performance of management in terms of forecasting and controlling this risk are main concerns (Trautmann, 2006).

The procedure for calculating CAMELS ratio of a bank is as follows (Kaya, 2001);

- Calculating related ratios reflecting performance in terms of **C**apital Adequacy, **A**sset Quality, **M**anagement, **E**arnings, **L**iquidity and **S**ensitivity to Market Risk

- Finding a reference value for each ratio by taking the average of all banks' score at this ratio for the given year.

  Reference value of a ratio = Average value of each bank's ratio

- Finding index value for each ratio of each bank by;

  *Index value of a bank= (Bank's ratio / Reference value of the ratio)*100*

- Determining a sign of a relationship between the ratio and performance indicator

  For example: capital adequacy ratio and capital adequacy have a positive relationship because as ratio increases, level of capital adequacy increases. On the other hand, non-performing loan ratio and asset quality have negative relationship because as the level of non-performing loans in total assets increases, asset quality decreases.

- Calculating performance value of the bank in each performance indicator by;
    - If sign of relationship (+)
      Performance note= Index value – 100
    - If sign of relationship (-)
      Performance note= 100 - Index value
- Calculating consolidated CAMELS performance value by;

  Consolidated CAMELS performance = Average of each performance value

- Assigning rates from 1 to 5 according to consolidated CAMELS performance value of each bank.

4.2. Calculations

4.2.1. Financial Statements of Banks

In this part, financial statements of banks are shown in order to be clearer about the ratios used in the CAMELS analysis.

Table 3 shows balance sheet of a bank. Like other company types, the bank balance sheet has two parts. Assets part represents left hand side of the table and it shows what the bank owns. It is mainly composed of loans and securities. Liabilities and Equity part shows the sources of these assets. While liabilities represent external sources, equities are the internal sources of a company. In the bank balance sheet, the main liability item is deposit.

Table 3 Balance sheet of banks

ASSETS	**LIABILITIES**
Cash and Balances with the Central Bank	Deposits
Fin.ass.where fair value cha. is refl.to I/S (Net)	Derivative Finan. Liabilities Held for Trading
Banks	Funds Borrowed
Money Market Securities	Money Market Takings
Financial Assets Available for Sale (Net)	Marketable Securities Issued (Net)
Loans	Funds
Factoring Receivables	Miscellaneous Payables
Investments held to Maturity (Net)	Other External Resources
Investments and Associates (Net)	Factoring Payables
Subsidiaries (Net)	Leasing Transactions Payables (Net)
Joint Ventures (Business Partners) (Net)	Derivative Finan. Liabilities Held for Hedging
Recivables From Leasing Transactions	Provisions
Derivative Financial Assets Held for Hedging	Liabilities for Tax
Property and Equipment (Net)	Lia.for Pro.&Equ.for Sale p. and from Term.Op.(Net)
Intangible Assets (Net)	Subordinated Loans
Real Estates for Investment Purpose (Net)	
Assets for Tax	**EQUITY**
Prop.&Equ.for Sale p. and from Term.Op.(Net)	Shareholders' Equity
Other Assets	
Total Assets	Total Liabilities and Equity

Source: Figure obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

Table 4 shows income statement of a bank. In the first part of the statement, interest revenues and expenses of a bank are shown. By subtracting interest expenses from interest revenues, net interest income / loss is found. After this part, non interest income and expenses part comes. At last parts, together with net profit / loss from continuing operations, net profit / loss from terminated operations is also shown. Final line shows net income / loss of a bank.

Table 4 Income statement of banks

Interest Income Interest Expenses
Net Interest Income/Expenses
Net Fees and Commissions Income/Expenses Dividend Income Trading Profit/Loss (net) Other Operating Income Total Operating Income/Expenses Net Operating Profit/Loss
Profit/Loss Before Taxes from Continuing Operations Net Profit/Loss from Continuing Operations
Net Profit/Loss Before Taxes from Terminated Operations Net Profit/Loss from Terminated Operations
Net Profit/Losses

Source: Figure obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

4.2.2. Calculating Related Ratios

Ratios used in our analysis and the signs of the relationships between ratios and the performance indicators are presented in Table 5.

Capital Adequacy

We have used two ratios for this performance indicator;

- *Shareholders' Equity / (Amount subject to credit risk+ market risk + operational risk):* This ratio is the basic and generally used ratio for performance evaluation. It is called "Capital Adequacy Ratio". It measures the power of capital in terms of covering different risks namely credit, market and operational risks.

- *Shareholders' Equity / Total Assets:* Equity multiplier is the ratio of total assets to shareholders' equity so this ratio is equal to 1/Equity multiplier. It shows the ratio of internal resources. In other words, it shows level of cushion for debt holdings.

Table 5 Ratios used in the CAMELS analysis

Performance İndicator		Ratio	Effect
C	Capital Adequacy	Shareholders' Equity / (Amount subject to credit + market + operational risk)	+
		Shareholders' Equity / Total Assets	+
A	Asset Quality	Loans Under Follow-up (gross) / Total Loans and Receivables	-
		Specific Provisions / Loans Under Follow-up	+
M	Management	Asset Growth	+
		Profit Growth	+
		Net Profit (Losses) per Branch	+
E	Earnings	Net Profit (Losses) / Total Assets	+
		Net Profit (Losses) / Total Shareholders' Equity	+
L	Liquidity	Liquid Assets / Total Assets	+
		Liquid Assets / Short-term Liabilities	+
S	Sensitivity to Market Risk	Amount Subject to Market Risk / Total Shareholders' Equity	-

Source: Figure obtained from Banking Association of Turkey (BAT) (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

Asset Quality

Asset quality of banks is measured with the following ratios;

- *Loans under Follow-up (gross) / Total Loans and Receivables:* This ratio is called "non-performing loan ratio". Loans are the most important part of assets and hence loan quality of a bank helps us to assess its asset quality. In this sense, the ratio of non-performing loans to total amount of loans can be used as an important indicator of a bank's asset quality and its performance level.
- *Specific Provisions / Loans under Follow-up:* Banks should allocate provisions for potential loan losses. The level of a provision changes according to the follow up stage. As the time passed after the last payment period increases, the level of the provision must increase. This ratio measures how much provisions can cover these deferred loans.

Management

We have used three ratios for this performance indicator;

- *Asset Growth:* This ratio is the rate of change in assets in a year. It shows a bank's management performance in expanding its operating activities.
- *Profit Growth:* This ratio is the rate of change in profits in a year. It shows performance of the management in increasing its earnings more than its expenses and getting higher profit.
- *Net Profit / Losses per Branch:* Branches are the most important channels of banks for reaching customer. So, general expectation is that as a bank reaches more and more customers, its profit level should increase. This ratio measures whether or not this expectation is met.

Earnings

We have used two ratios for this performance indicator;

- *Net Profit (Losses) / Total Assets:* It is one of the most commonly used financial ratios in the banking sector. This ratio is called Return on Assets (ROA) ratio. It shows level of performance of a bank in terms of using its assets to generate profit.
- Net Profit (Losses) / Total Shareholders' Equity*:* This ratio is called Return on Equity (ROE) ratio. It shows level of performance in using its shareholders' money to generate profit, that is to say amount of profit per one unit of money invested in a bank by shareholders. It is also one of the most commonly used ratios in the banking sector.

Liquidity

For liquidity as a performance indicator, we use the following ratios;

- *Liquid Assets / Total Assets:* Liquid Assets include cash and central bank, banks, money market securities, fair value change reflected to income statement financial assets and available for sale financial assets. The ratio of liquid assets to total assets shows how liquid a bank's assets. That is to say, it is the ratio of assets due less than 1 year in total assets.
- *Liquid Assets / Short-term Liabilities:* This is called "Current Ratio". It is one of the most widely used ratios in liquidity measurement (Jordan, Ross, & Westerfield, 2003). Short term liabilities are debts due less than or equal to one year. So this ratio shows a bank's ability to meet its short term obligations.

Sensitivity to Market Risk

To measure a bank's sensitivity to market risk, we use the following ratio;

- *Amount Subject to Market Risk / Total Shareholders' Equity:* This ratio shows the capacity of a bank's level of equity to cover its market risk.

4.2.3. Finding a Reference Value

The reference value of a ratio for a given year is calculated by taking the average of all banks' score in this ratio for the given year. Table 6 shows calculated reference values of the ratios for the years between 2006 and 2010.

In terms of capital adequacy, we calculate two ratios; capital adequacy ratio and inverse of equity multiplier. Average capital adequacy is the highest (19%) in 2006, following this 2009 has the second highest value (18.4%). The global crisis in 2008 affected this ratio; the lowest score (16.2%) was recorded in 2008. This effect is seen in the inverse of equity multiplier, it also has the lowest value (10.9%) in 2008. This ratio reaches its highest value (12.8%) in 2009.

To measure asset quality, we use both the non-performing loan ratio and the provision rate. The non-performing ratio is about 4% for all years except 2009. The effect of the global crisis in 2008 on power of repayment is reflected on 2009 balances, so in 2009 asset distortion via non-performing loans is 6.7%. Provisions were realized at about 80% in years. The highest provision is allocated in 2006, while the lowest one is in 2008.

Management skills are evaluated by three ratios namely; asset growth, profit growth and profit per branch in our analysis. Assets expand for all years except in 2008 due to the global crisis (2008). The same situation can be observed in profits. However, after 2008, maybe because of low

values in 2008, profit growth was so high that it is about 119%. Branch profitability increases except 2008.

The return on assets (ROA) and the return on equity (ROE) are the most widely used ratios to measure earning performance in the banking sector. So we have used these two ratios to evaluate earnings. As Table 6 shows, just before the global crisis (2008), in 2007, the earning performance is at the highest level, ROA and ROE are 2.27 and 19.22 respectively. However, as expected, in 2008 they both have the lowest levels in all years.

The global crisis (2008) period creates liquidity shortages also. In 2008, level of liquid assets in total assets decreases to 27% while coverage rate of short term assets to short term obligations declines to 45%. These two levels are the lowest ratios of all years. The highest liquidity and coverage are realized in 2006.

As table 6 shows, sensitivity to market risk has been almost stable since 2006. It moves in 25% and 27% range.

4.2.3. Finding Performance of Banks for Different Indicators

In this section, we focus on finding performance indicators for 14 banks with different approaches. By using the scores of banks in the different ratios and the relevant reference values for them, we find index value for each ratio of each bank by;

> *Index value of a bank= (Bank's score in the ratio / Reference value of the ratio)*100*

Afterwards, sign of the relationship between the ratio and performance indicator is determined. By considering this sign, we calculate performance value of the bank in the performance indicator by;

- If sign of relationship (+): *Performance note= Index value – 100*
- If sign of relationship (-): *Performance note= 100 - Index value*

Table 6 Reference values of the ratios for the years between 2006 and 2010

Performance Indicator		2006	2007	2008	2009	2010
C	Shareholders' Equity / (Amount subject to credit + market + operational risk)	19.04	16.49	16.2	18.4	16.84
	Shareholders' Equity / Total Assets	10.21	12.01	10.93	12.8	12.45
A	Loans Under Follow-up (gross) / Total Loans and Receivables	4.29	3.61	4.14	6.71	4.79
	Specific Provisions / Loans Under Follow-up	84.88	84.25	75.67	79.73	81.07
M	Asset Growth	41.42	41.79	-3.16	11.09	21.68
	Profit Growth	8.21	84.05	-27.06	118.99	6.14
	Net Profit / Losses per Branch	931	1431	782	1773	1868
E	Net Profit/Losses / Total Assets	1.91	2.27	1.56	2.06	1.85
	Net Profit/Losses / Total Shareholders' Equity	18.69	19.22	15.04	17.27	15.54
L	Liquid Assets / Total Assets	39.39	34.8	26.99	31.74	31.82
	Liquid Assets / Short-term Liabilities	60.79	56.84	45.32	52.06	47.23
S	Amount Subject to Market Risk / Total Shareholders' Equity	25.53	27.03	25.48	25.65	24.86

Source: Our calculations based on the data obtained from Banks Association of Turkey (BAT), (Banka ve Sektör Bilgileri / İstatistiki Raporlar)
http://www.tbb.org.tr/tr/Banka_ve_Sektor_Bilgileri/Tum_Raporlar.aspx

The results of this calculation are shown in Figure 13. According to the graph, Akbank and Ziraat are over the average performance of 14 banks in all indicators. Moreover, Akbank has the highest capital adequacy and the most qualitative assets on the average. On the other hand, Ziraat has the highest earning performance.

In terms of management skills, Finansbank is the best bank. Its performance is very high when compared to average of 14 banks. Its weaknesses are in liquidity and sensitivity to market risk, these performance rates are below the average. That is to say, Finansbank is less liquid than sector and more sensitive to market risk. Being less liquid is good for profitability but this is risky also.

In contrast to Finansbank, Citibank is very liquid. However, its asset quality is the lowest in our banking sample. While its capital adequacy and sensitivity to market risk performances are above the average value of banks for the period between 2006 and 2010, it has a poor performance in terms of management and earnings.

Management and earnings performances of Fortis are the lowest. Especially management performance is far from the average. Moreover, sensitivity to market risk is the highest in Fortis. Its asset quality is also low, but capital adequacy is above the sector.

Following Fortis, ING has also low management and earnings performance. Its capital adequacy and liquidity is lower than other banks' average. However, it is not volatile against market fluctuations.

Like Akbank and Ziraat, Garanti almost has full performance in all indicators except capital adequacy. However, we cannot say adequacy is low, because it is very close to the relevant reference value.

Halkbank has low performance in terms of asset quality and liquidity but have high performance in management and earnings. Moreover, its sensitivity to market risk is very low and its capital adequacy is very close to banks' average.

İşbank is good at all performance indicators except being very sensitive to market risk. In contrast to İşbank, Şekerbank has low performance almost all indicators except having low level of sensitivity.

TEB should increase their capital since it has the lowest performance in capital adequacy indicator. Moreover, it should increase earnings performance to catch sector. On the other hand, the bank is good at asset quality, management and sensitivity.

Vakıfbank is less sensitive to market risk than average of 14 banks and its management performance has been realized above the average between 2006 and 2010. It is also liquid and asset quality is on the average of all banks. However, it has little weaknesses in terms of capital adequacy and earnings side.

Finally, Denizbank has weaknesses in terms of capital adequacy, management and liquidity but it has higher asset quality and lower sensitivity to market risk than the average.

As we do in efficiency side, in CAMELS side we have also analyze the banks in terms of banking groups they belong to by taking average of banks in that group (Figure 14).

According to this analysis, in terms of capital adequacy state banks are the best and the private banks are the worst performing groups. Asset quality, management and earnings performance levels of the foreign banks are the lowest. Again in these categories, state banks have superior performance. Following them, private banks are also good at keeping performance high in these performance indicators. However, in terms of liquidity foreign banks are the most liquid banks. Liquidity of state and private banks is low. On the other hand, private and state banks are not very sensitive to market risk while foreign banks are prone to be affected by market fluctuations.

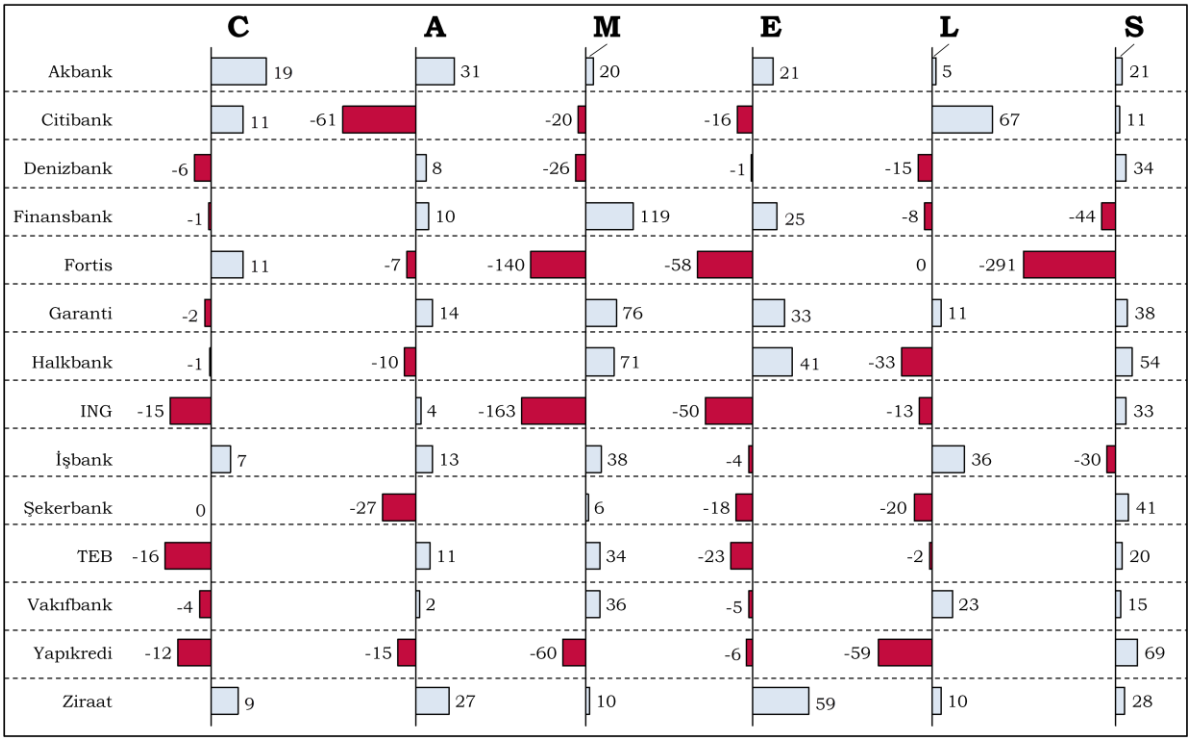

Figure 13 Average performance index values of 14 banks in terms of CAMELS performance indicators for the years between 2006 and 2010

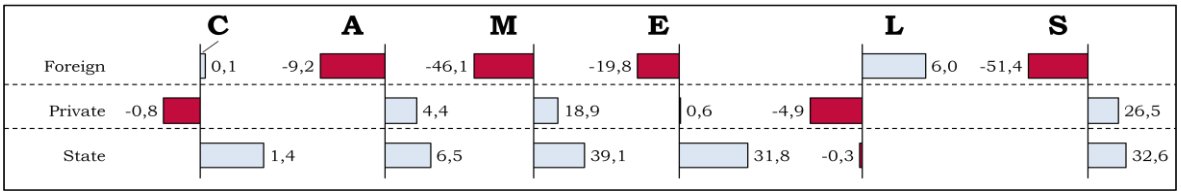

Figure 14 Average performance index values of banking groups in terms of CAMELS performance indicators for the years between 2006 and 2010

4.2.5. Finding the CAMELS rate

In order to find CAMELS rate, averages of all performance values are obtained. Afterwards, we have assigned a CAMELS rating according to the range they are in. The ranges used are -∞/-30, -30/-10, -10/+10, +10/+30 and +30/+∞. Different from other approaches, (in order to make the interpretation of econometric analyzes easier) we have assigned 5 to the highest performance and 1 to the lowest.

Table 7 shows the CAMELS ratings of the banks in our sample for the years between 2006 and 2010. As stated, in the table, as the CAMELS rating increases, the performance of a bank increases. In this framework, as Table 7 shows, Garanti is the most successful bank on the average. In 2006, 2007 and 2009, it has full performance value and in 2008 and 2010, Garanti performed as one of the best banks.

Following Garanti, Ziraat is the second best performer. However, it decreases its performance over the years in our sample. 2006 and 2007 are the best years but 2010 is the worst for the bank.

The third and fifth best performers are again state banks, Halkbank and Vakıfbank respectively. While Halkbank's CAMELS performance is affected by the crisis, Vakıfbank decreases its performance in 2010 like Ziraat.

Akbank and İşbank are also good performers in the group. Citibank, Finansbank, Denizbank and Şekerbank have very volatile CAMELS performance values. TEB performes above the average CAMELS performance value.

Yapıkredi, ING and Fortis are the worst performers on the average. However, among them Yapıkredi increases its performance over the years and in 2010 it realizes a big jump. It has full performance in this year. Although ING realizes some movements to get closer to the average, Fortis is not able to catch these levels since 2006.

Table 7 CAMELS performance ratings of banks for the years between 2006 and 2010

Bank	2006	2007	2008	2009	2010	Average
Garanti	5.00	5.00	4.00	5.00	4.00	4.60
Ziraat	5.00	5.00	4.00	4.00	3.00	4.20
Halkbank	5.00	4.00	3.00	4.00	4.00	4.00
Akbank	4.00	4.00	4.00	4.00	3.00	3.80
Vakıfbank	4.00	4.00	4.00	4.00	2.00	3.60
İşbank	4.00	3.00	3.00	3.00	4.00	3.40
Citibank	1.00	5.00	4.00	2.00	4.00	3.20
Finansbank	5.00	2.00	2.00	3.00	4.00	3.20
TEB	3.00	3.00	3.00	3.00	4.00	3.20
Denizbank	4.00	2.00	3.00	4.00	2.00	3.00
Şekerbank	3.00	4.00	2.00	3.00	3.00	3.00
Yapıkredi	1.00	2.00	3.00	3.00	5.00	2.80
ING	1.00	2.00	2.00	2.00	1.00	1.60
Fortis	1.00	1.00	1.00	1.00	1.00	1.00

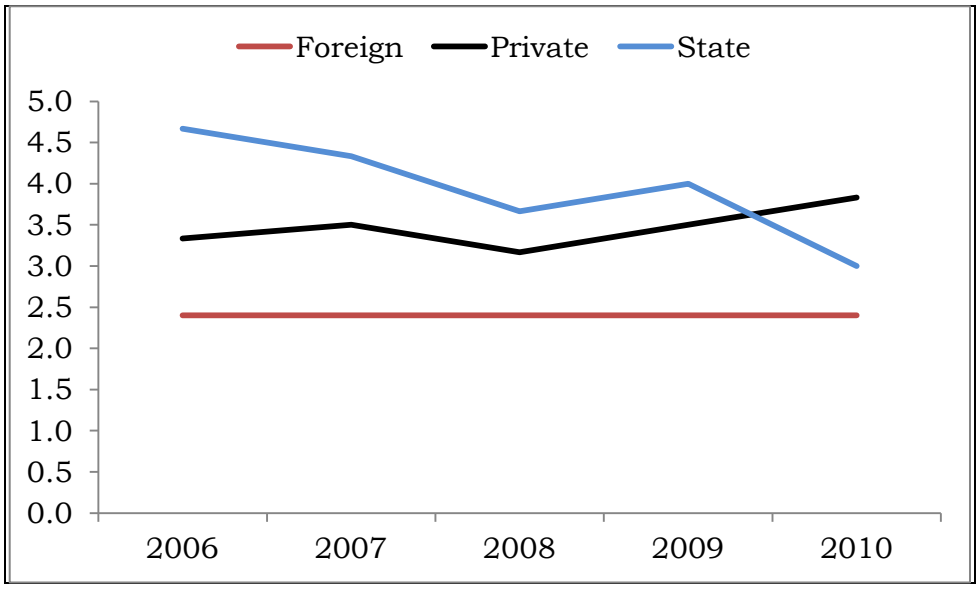

Figure 15 Average CAMELS ratings of banking groups for the years between 2006 and 2010

Figure 15 shows average CAMELS ratings of banking groups for the years between 2006 and 2010. As the figure shows, foreign banks have the lowest CAMELS performance values and their average is fixed during 2006-2010 period. The CAMELS performance value of Private Banks increases except 2008 and it exceeded state banks in 2010. In contrast to private banks, the performance value of State Banks decreases during 2006 and 2010 period except 2009.

CHAPTER 5

5. FACTORS AFFECTING BANK PERFORMANCE

In third and fourth chapters, we measure bank performance from bank efficiency and the CAMELS ratio perspectives, respectively. In this chapter, we analyze factors having a potential to affect bank performance. We do this by grouping the factors. First part is about factors related to governance of a bank namely; ownership type, being publicly traded or not and delegation of power. Second part is related to rivalry and it includes loan shares, deposit shares and net income shares of the banks as the variables. Third part is about distribution channel variables namely; ATM net, branch number and agglomeration of branches in İstanbul. In the fourth part, we use five different variables namely; gross domestic product (GDP), inflation, interbank lending rate, exchange rate (USD) and the ratio of current account deficit to GDP to represent macroeconomic variables. Final part includes variables that are not under the groups we discussed in the previous parts. These variables are asset size and the ratio of employees having a graduate degree in all employees.

5.1. Governance

To analyze the relationship between governance and bank efficiency in the literature, mostly used variables are ownership type of a bank (state owned, foreign owned, privately owned) and whether or not the CEO is the chairman of the board. In our analysis, we only include ownership type from the literature, because in Turkey, from 2006 to 2010, none of the CEOs of 14 banks analyzed are the chairman of the board. So, using this variable is meaningless. That is why; we do not use it. Instead of this, we use two other variables. One of them is the level of delegation of power to Executive Vice Presidents. As far as we know, this variable has not been used in bank efficiency analysis in the literature before. Our second variable is being a publicly traded company or not.

5.1.1. Ownership Type

We have 14 banks in our sample. Among them, Citibank, Denizbank, Finansbank and Fortis are the foreign owned banks. ING was a private bank in 2006 and it was called Oyakbank. However, since the middle of 2007, it has been a foreign bank also. Akbank, Garanti, İşbank, Şekerbank, TEB and Yapıkredi are privately owned banks. Finally, Ziraat, Vakıfbank and Halkbank are the state owned banks. We assign dummies according to this information.

5.1.2. Delegation of Power

There are significant differences in terms of the number of Executive Vice Presidents of the banks in our sample. In order to understand whether or not the delegation level is important and what the direction of the relationship of it with performance measures, we use total assets / the number of executive vice presidents ratio. That is to say, the amount of asset managed by an Executive Vice Presidents is used in our analysis.

Table 8 Asset sizes per an executive vice president of banking groups

Banking Group	Asset Size per an Executive Vice President
Foreign	1,292,217
Private	4,355,929
State	6,214,612

Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

As you can see from Table 8, the highest delegation of power is realized by the foreign banks since the level of assets per an Executive Vice Presidents is the lowest in this banking group. On the other hand, the level is the highest for the state banks. That is to say state banks have the lowest delegation of power in the banking groups. In Table 9 average asset size per an Executive Vice President for the banks are shown. While Citibank, Fortis and Şekerbank have the highest delegation, in other words the lowest asset size per an Executive Vice President, İşbank, Ziraat and Garanti have the lowest delegation of power.

5.1.3. Publicly Trading

Being publicly traded or not is an important criterion for a bank in terms of motivation to perform high because of market value concerns. So we use this variable in our analysis. Among the banks in our sample, only Ziraat, Citibank and ING are not publicly traded. Moreover, Halkbank had not been publicly traded until 2006. It first issued its shares in May 2007. So we assign dummies according to this information.

Table 9 Asset size per an executive vice president of banks

Bank	**Asset Size per an Executive Vice President**
İşbank	8,990,956
Ziraat	8,893,734
Garanti	6,686,443
Akbank	5,932,720
Vakıfbank	5,381,493
Halkbank	4,368,608
Yapıkredi	3,249,926
Denizbank	1,951,373
Finansbank	1,853,048
ING	1,348,927
TEB	1,203,516
Fortis	854,091
Şekerbank	647,831
Citibank	490,567

Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

5.2. Rivalry

Rivalry part includes loan shares, deposit shares and net income shares of the banks as the variables.

5.2.1. Loan Share

As Figure 16 shows, average loan share of foreign banks are the lowest. Since 2006, there has been a harsh rivalry among private and state banks. While in 2006 while private banks had the highest share, in 2010 state banks surpassed them and had the highest pies from the loan cake.

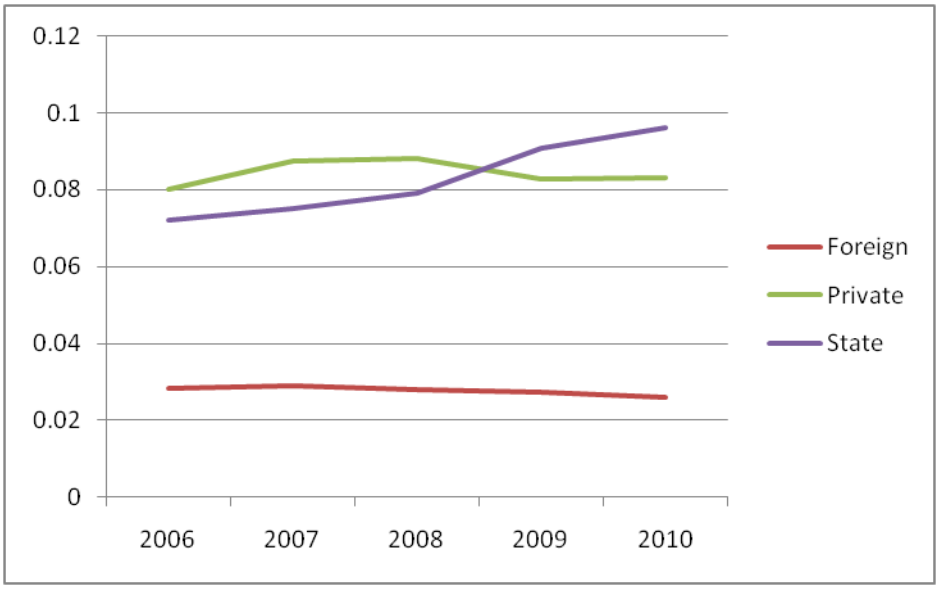

Figure 16 Average loan shares of banking groups for the years between 2006 and 2010

Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

5.2.2. Deposit Share

Figure 17 shows average deposit shares of banking groups for different years. As expected, the state banks have the highest share in deposits on the average for all periods in our sample. This is because deposits are such an investment instruments that trust is very important especially after the crisis of Turkey in 2001. Since the state banks are the most trusted banks, they have high shares in deposit. Other reason for these high levels is that state banks have an important portion of the salary accounts. Following them, the private banks also have high shares. Both of the groups realize slight increases in their shares between 2006 and 2010. The foreign banks have the lowest shares and their pies decreased more after the global crisis in 2008.

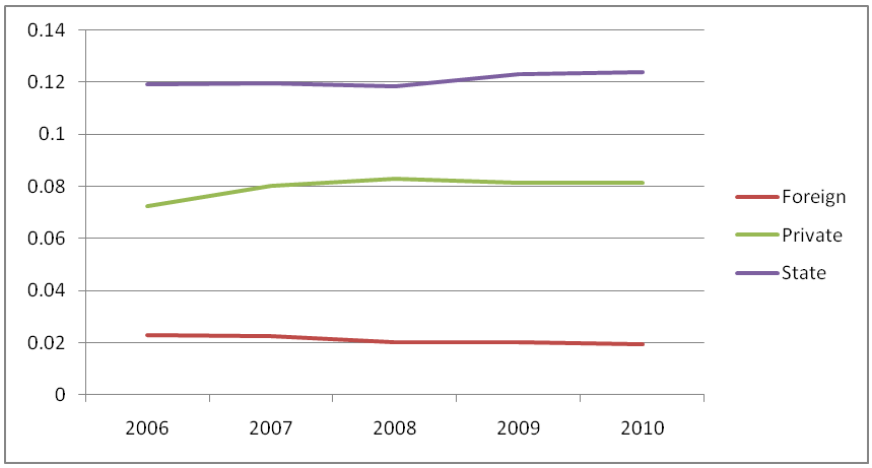

Figure 17 Average deposit shares of banking groups for the years between 2006 and 2010

Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

5.2.3. Net Income Share

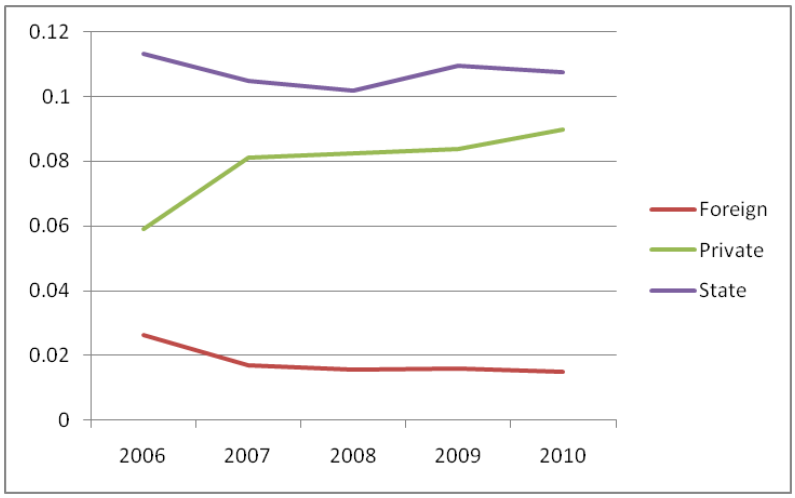

Figure 18 Average net income shares of banking groups for the years between 2006 and 2010

Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

As it can be seen from Figure 18, net income share is more volatile when compared to other shares. The state banks have the highest shares this may be because they can find fund at lower costs. Following them, the private banks have also high shares and they also have an increasing line in the figure. In the banking sector, as interest margin shrinks as a result of rivalry and other factors, the importance of non-interest income increases more and more. The private banks have taken actions about non-interest income recently. This is reflected on the figure also. The private banks get closer to the state banks in terms of net income share. So, to keep their position in the top, the state banks should also give importance to non-interest income. The foreign banks have the lowest shares in net income cake and after the global crisis in 2008, shares shrank more. Low shares of the foreign banks may be the result of their size because at the top of the asset size list, the state and the private banks are polarized.

5.3. Distribution Channels

Banks serve their customers through their distribution channels. In this part, we use variables about two banking channels; branch and ATM. We do not use the data of call center and internet banking because available data for them is not at bank level. Moreover period of the data available is shorter than our sample period.

For the branch channel, we have two variables; the number of branches and the agglomeration of branches in İstanbul. Recently, the banks try to serve their customers from alternative distribution channels instead of branch. So importance of branch decreases day by day. In order to analyze whether or not, number of branches is a significant factor and the direction of the effect on efficiency, we use branch number as a variable. Moreover, İstanbul is the most crowded and important city of Turkey. Government tries to make İstanbul the centre of finance in Turkey. For this reason, the importance of the banking sector in İstanbul is very high. So banks try to open more branches in this city. To cover this concept, we use

agglomeration of branches in İstanbul, in other words the ratio of İstanbul branches in total number of branches.

Finally, as stated before, serving from alternative distribution channels is an important concept. Success of this channel depends on their availability. In order to test this, we use ATM net as a dummy variable in our analysis.

5.3.1. Number of Branches

Table 10 shows average number of branches by banking groups for different years. The state banks have the highest number of branches on the average of years, 803 branches. Following them, private banks also have high level of branches, on the average 628. Foreign banks is weak in this channel, their yearly average branch number is only 295, less than the half of the private banks' average. After the global crisis in 2008, the increase in bank size was limited for especially foreign banks but the crisis does not seem to make the state banks' to slow their pace down in opening new branches.

Table 10 Average number of branches of banking groups for different years

Bank	2006	2007	2008	2009	2010
Foreign	213	284	316	321	326
Private	483	571	680	698	730
State	716	734	805	843	915

Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

In terms of the banks' individual branch numbers, Ziraat and İşbank have above one thousand branches for the average of the years between 206 and 2010 while Citibank has the lowest branch number.

5.3.2. Agglomeration of Branches in İstanbul

As the Figure 19 shows, level of agglomeration is the highest for the foreign banks and the lowest for the state banks. Low level of agglomeration for the state banks may be resulted from their mission to serve in every part of the country and having headquarters in Ankara. However, the state banks slightly increased their shares in İstanbul between 2006 and 2010. They try to keep pace with other banking groups. The first step has been taken by Vakıfbank via moving its headquarter to İstanbul. We expect the current level of agglomeration of the state banks in İstanbul to increase more and more. Finally, the foreign banks decreased their agglomeration in İstanbul between 2006 and 2010. The private banks are rather stable.

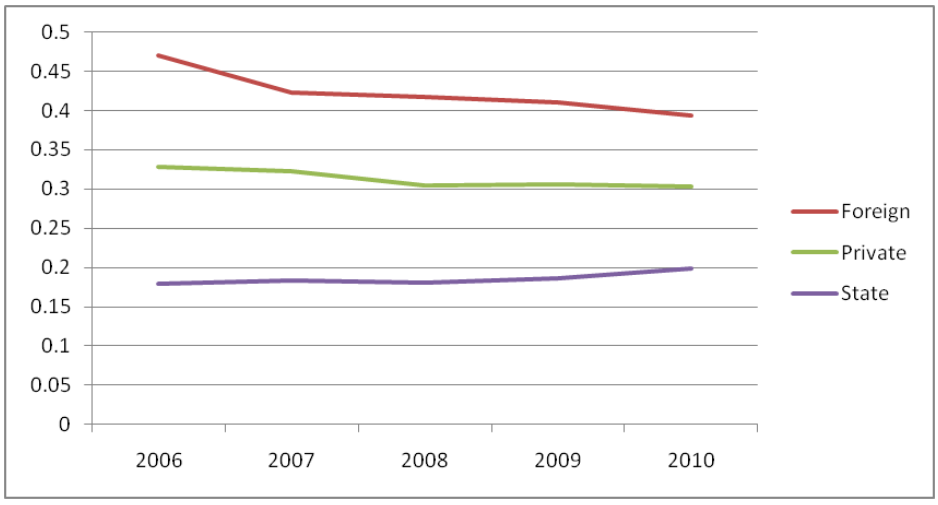

Figure 19 Average agglomeration levels of banking groups for the years between 2006 and 2010
Source: Our calculations based on the Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

5.3.3. ATM Net

In 2009, all banks become a member of the shared ATM network. Before this, Akbank, Garanti, Vakıfbank, Fortis and Yapı Kredi gathered to build "Altın Nokta" while HSBC, Halk, Bank Asya, Albaraka Türk, Denizbank, Finansbank, ING, Citibank, Kuveyt Türk, TEB, Tekstilbank, Eurobank Tekfen, Türkiye Finans Katılım Bankası, Alternatifbank, Anadolubank, Turkish Bank, Millennium Bank, Şekerbank and T-Bank were the members of "Ortak Nokta". However, two of the largest banks; İşbank and Ziraat were neither in "Altın Nokta" nor in "Ortak Nokta". After 2009, all banks including İşbank and Ziraat became the members of the shared ATM network.

5.4. Macroeconomic Indicators

In this part of the analysis, we use five different variables; gross domestic product (GDP), inflation, interbank lending rate, exchange rate (USD) and the ratio of current account deficit to GDP.

5.4.1. Gross Domestic Product (GDP)

Gross domestic product (GDP) refers to the market value of all final goods and services produced within a country in a given period. It is one of the most frequently used indicators in the studies because it shows the production performance of a country. The banking sector is one of the most important sectors of Turkey. So performance of the sector should also be related to GDP.

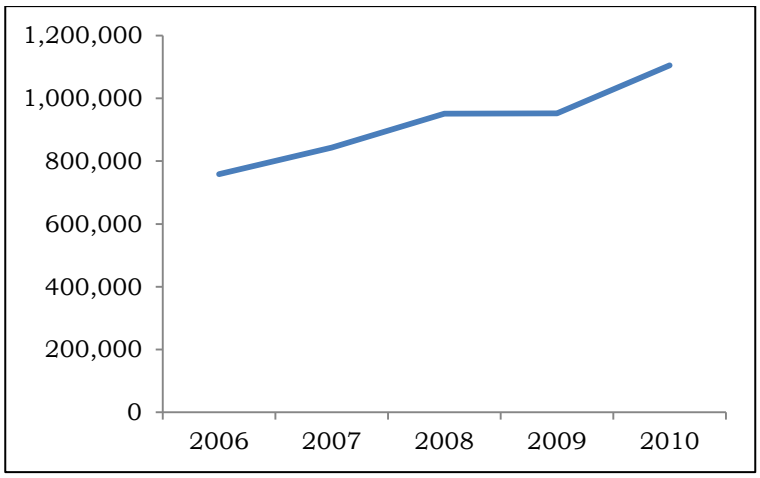

Figure 20 Gross Domestic Product (GDP) of Turkey with current prices for the years between 2006 and 2010 (mio TL)
Source: Data obtained from Association of Treasury Controllers website (Economy / Basic Indicators) http://www.hazine.org.tr/en/economy.php

Turkey is a growing country and as Figure 20 shows, the market value of all final goods and services in Turkey increases rapidly every year except 2009 (as a result of the global crisis in 2008). The average growth rate of GDP among the years is about 10%.

5.4.2. Inflation

In this analysis, we have used consumer price index (CPI) based on 2003 prices as the inflation variable. While the inflation increases, purchasing power of the public decreases. This situation affects demand for loan and level of money left for saving. Loans and deposits are the main products of banking, so high inflation is supposed to have a negative effect on it.

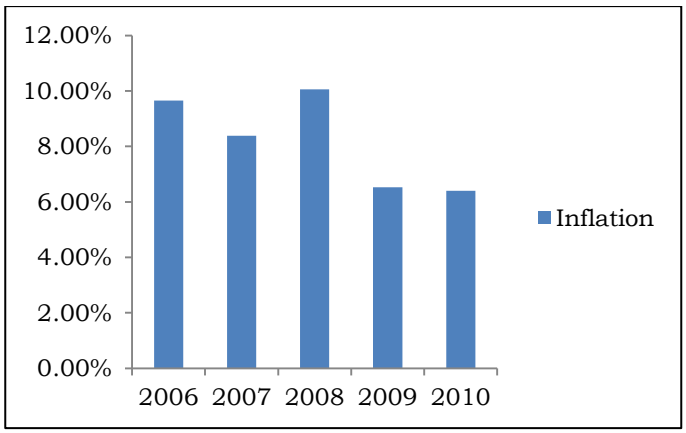

Figure 21 Percentage change in Consumer Price Index (CPI) based on 2003 prices for the years between 2006 and 2010
Source: Data obtained from Association of Treasury Controllers website (Economy / Basic Indicators) http://www.hazine.org.tr/en/economy.php

As the Figure 21 shows, the level of inflation has decreased except 2008. This shows that negative impact of the inflation reduces every year.

5.4.3. Interbank Lending Rate

Interest rates are very important for banks because their main tool for gaining money is the interest. So this variable is thought to be one of the most important factors in bank performance. We use interbank lending rate to represent interest rates in our analysis.

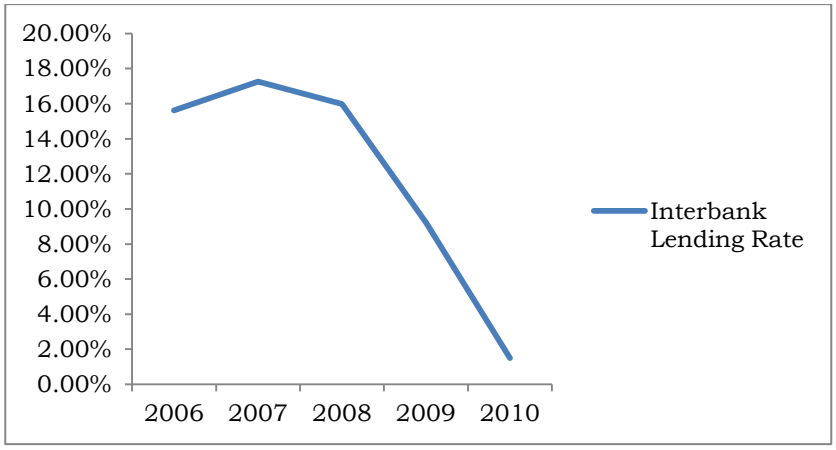

Figure 22 Interbank lending rate for the years between 2006 and 2010
Source: Data obtained from Association of Treasury Controllers website (Economy / Basic Indicators) http://www.hazine.org.tr/en/economy.php

As Figure 22 shows, from 2007 to 2010, interbank lending rate decreased sharply especially after 2008.

5.4.4. Exchange Rate (USD)

Exchange rate is very important for the banks because banks borrow and lend in other currencies as well as Turkish Lira. They have open positions in their balance sheets and this situation bears currency risk for the banks. So the performance of them is affected by the exchange rate. USD is the main currency circulating globally. For this reason, we use exchange rate for US dollars in our analysis. In 2006, yearly rate was 1.43. Between 2007 and 2008, it decreased to 1.30 and 1.29 respectively. After these years, it increased. Exchange rate for dollar reached 1.55 and 1.50 in 2009 and 2010 respectively.

5.4.5. Current Account Deficit

Current account deficit shows net capital outflow of a country. Recently, it becomes a big problem for the Turkish economy. Among policies to solve the deficit problem of Turkey, bank related cautions take an important part. Policy makers believe that banks affect current account deficit. In our analysis, we do reverse of it and test the effect of current account deficit on bank performance.

We use the ratio of current account balance to gross domestic product to represent this concept.

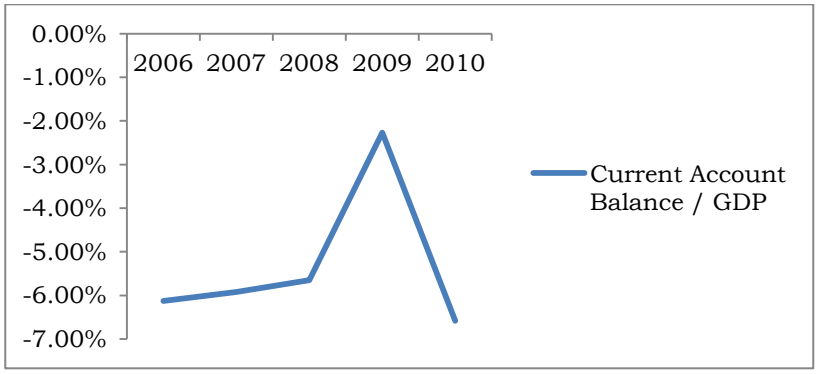

Figure 23 Ratio of current account balance to Gross Domestic Product (GDP) for the years between 2006 and 2010
Source: Data obtained from Association of Treasury Controllers website (Economy / Basic Indicators) http://www.hazine.org.tr/en/economy.php

As Figure 23 shows, the ratio of current account balance to gross domestic product is very volatile and it decreased in 2010 very sharply. That is to say, in 2010 current account deficit increased sharply when compared to GDP.

5.5. Other Variables

In this part, we analyze two concepts; size of the bank and education level of its employees.

Size of the bank means level of bank assets. As the size of the bank increases, not only sources for an efficient management increases but also degree of complexity in managing the bank increases.

Education level is calculated by the ratio of number of employees having a graduate degree to the total number of employees.

5.5.1. Asset Size

As the Figure 24 shows, on the average, the state banks have the biggest asset sizes and they have a deep increasing line. Following them, the private banks also have big asset sizes and as the state banks they also increase their size every year. On the contrary to the state and the private banks, the foreign banks have smaller asset sizes and they rather have a flatter increasing line.

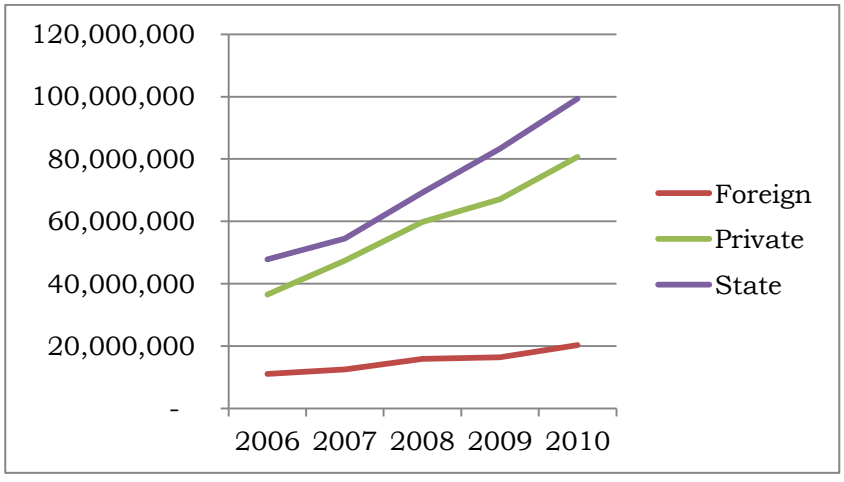

Figure 24 Average asset sizes of banking groups for the years between 2006 and 2010
Source: Data obtained from Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

5.5.2. Education Level

The figure 25 shows the ratio of employees having a graduate degree to the total number of employees for different banking groups. Figure 25 gives us interesting information that the state banks realized a jump in terms of level of education. While in 2006 this level was below the private and the foreign banks, in 2010, the state banks surpassed other banking groups. As far as we know, the state banks let their employees to continue their education while working. That is to say, employees are allowed to go to school during working hours. The private and the foreign banks rather seem being reluctant to do this. This difference may be the reason for the sharp increase in the education level for state banks.

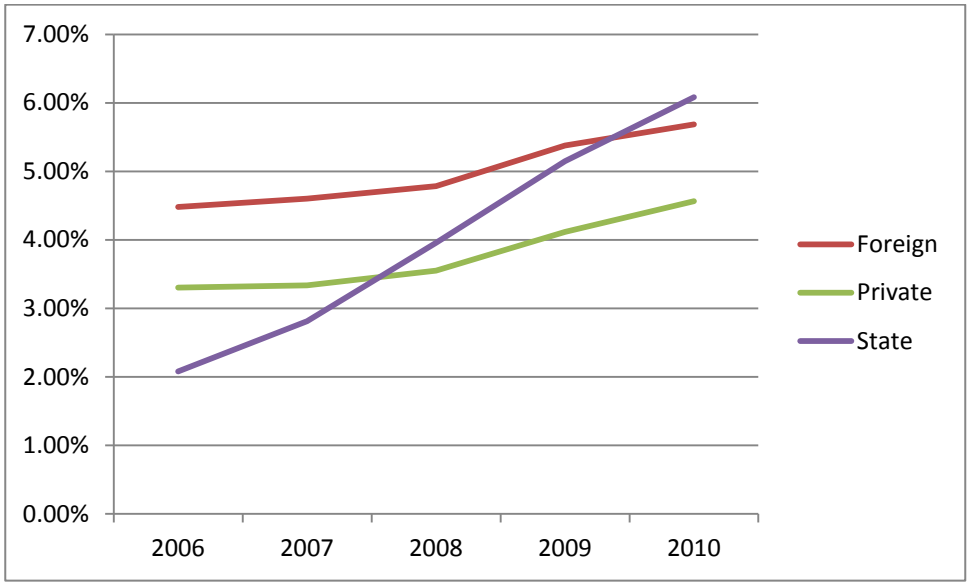

Figure 25 Average ratios of employees having a graduate degree to total number of employees of banking groups for the years between 2006 and 2010
Source: Data obtained from Banks Association of Turkey (BAT) database (Banka ve Sektör Bilgileri / İstatistiki Raporlar), http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Istatistiki_Raporlar.aspx

CHAPTER 6

6. RELATIONSHIPS

In this part, we analyze the relations of bank performance measures and the factors affecting bank performance. Firstly, we analyze the relation between two indicators; bank efficiency and CAMELS. The following parts are about the relations of these indicators with variables affecting bank performance. That is to say, second part and third part are about regressions of variables affecting bank performance on bank efficiency and CAMELS, respectively.

To do this, we use the *Panel Data Analysis* which takes into account both temporal and cross sectional dimensions of a data set. Here, we have a data set with 14 banks' observations over 5 years period. By using the panel data, we get 70 units which are the product of 5 and 14 in our analysis. Our calculations are done by E-views 5.1.

There are different types of panel data analysis namely; constant coefficient model, fixed effects model and random effects model. If there are not any significant temporal or cross sectional effects in our data, then the constant coefficient model is used. This method is also called "*Pooled Regression Model*". As the name suggests, all data is pooled, that is to say the intercepts and the slopes do not change from period to period or cross sectional unit to another unit. In the context of our analysis, if we believe

that there are not any significant differences among the banks or among the years, then we should use the Pooled Regression Model.

If we believe that significant differences are available among the years or the banks then we should not use the pooled regression model. Instead, either the fixed effects model or the random effects model should be used. To cover these differences, dummy variables are used in the fixed effects model. That is why; this model is also called "*Least Squares Dummy Variable Model*". However using dummy variables creates costs in terms of degrees of freedom. So, in order to overcome this drawback, the random effects model is used. Instead of assigning a fixed coefficient or a fixed slope to each period or each cross sectional unit, in this approach a general mean value is assigned for the whole model. Moreover, to cover periodic or cross sectional differences, a random error term is assigned for them. This approach is advantageous in terms of degrees of freedom, but it requires no correlation between random errors of the periodic / cross sectional errors and the errors of variables. Both of the models have pros and cons (Yaffee, 2003). In order to decide among the fixed effects model and the random effects model, the Hausman Test is used. We use panel data in the following sections together with the analyses we discussed above.

6.1. Bank Efficiency and CAMELS Relation

In this part of the analysis, we analyze the relationship between bank efficiency and the CAMELS ratings. In this context, we build equations for testing the relationship between CAMELS and different efficiency types (technical efficiency, pure technical efficiency, scale efficiency) under different efficiency concepts (general, non-public and long term efficiencies).

Our sample includes the period between 2006 and 2010. In this period, an event having a huge impact for both the global economy and the Turkish economy was realized. The global crisis in 2008 hit the economy and as all

sectors, the banking sector was also affected by this crisis. Our previous analyses also prove this. So we can say that there are significant differences among the periods. Moreover, our sample includes 14 banks which have different ownership characteristics and which are in different sizes. So, we can also say that there are significant differences among cross sectional units. To sum up, pooling the data and using the constant coefficient model do not seem to be the proper way of doing the regression analysis. So we should decide among fixed or random effects to make the analysis with panel data.

6.1.1. Testing for Fixed Effects

In order to test, whether or not the cross sectional or the periodical effects are significant, that is to say whether or not we can pool the data, we make Fixed Effects Testing. Our hypotheses are;

H_{0A}=*Periodical effects are insignificant*

H_{0B}=*Cross sectional effects are insignificant*

H_{0C}=*Cross sectional and periodical effects are insignificant*

Table 11 shows p-values results of fixed effects hypothesis testing. At 0.05 significance level, we can reject the null hypothesis that the cross sectional effects are insignificant for all efficiency types. That is to say, the effects of the differences among banks are valid. So we cannot pool the cross sectional units. On the other hand, again at 0.05 significance level, the periodical effects are not significant for all efficiency types, so we can pool the periodical data for them.

6.1.2. Testing for Correlated Random Effects

The fixed effects model has a drawback of losing degrees of freedom and the random effects model is an alternative model to this approach. But in order to use the random effects model, we need cross sectional or

periodical random effects to be uncorrelated with explanatory variables. To check this, we use Hausman Test. In this test, our hypotheses are;

H_{0A}= Periodical effects are uncorrelated with the other regressors

H_{0B}= Cross sectional effects are uncorrelated with the other regressors

H_{0C}= Cross sectional and periodical effects are uncorrelated with the other regressors

Table 11 shows the p values of Hausman test results. According to these p-values in the table, we have not got enough confidence to reject the null hypothesis that the individual effects are uncorrelated with the other regressors and saying that the random effects model is not suitable. However, we have not also got enough evidence to use this model.

So by building and testing models under fixed effect and random effect assumptions and comparing the results, we decide to use the Fixed Effects Model. Our models include dummies for cross sectional effects while for fixed effects fixed effects dummy variables are not used.

Table 11 Fixed effects testing and Hausman Test results with estimated p-values for different efficiency types and concepts

	CRS (general)	**VRS (general)**	**Scale (general)**	**CRS (non-public)**	**VRS (non-public)**	**Scale (non-public)**	**CRS (long term)**	**VRS (long term)**	**Scale (Long)**
Fixed Effects Testing									
Cross-section F	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Cross-section Chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Period F	0.15	0.25	0.16	0.45	0.22	0.39	0.06	0.29	0.15
Period Chi-square	0.06	0.13	0.07	0.29	0.11	0.24	0.02	0.15	0.06
Cross-Section/Period F	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Cross-Section/Period Chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Significance of cross sectional effect (alpha 0.05)	+	+	+	+	+	+	+	+	+
Significance of periodic effect (alpha 0.05)									
Hausman Fixed versus Random Effects Testing									
Cross-section random	0.71	0.15	0.84	0.90	0.19	0.74	0.93	0.89	0.67
Period random	0.90	1.00	0.81	0.99	1.00	0.35	0.98	0.88	1.00
Cross-section and period random	0.77	0.24	0.97	0.91	0.27	0.78	0.94	0.84	0.67

6.1.3. Bank Efficiency and CAMELS Relation

In this part, we test the significance of the CAMELS rating on the efficiencies and the direction of this relation.

Table 12 Regression results of the relation between CAMELS rating and bank efficiency

Efficiency Type	Coefficient	p-value
CRS (general)	0.00592	***0.00
VRS (general)	0.00567	***0.00
Scale (general)	0.00001	***0.01
CRS (non-public)	0.00118	***0.00
VRS (non-public)	0.00543	***0.00
Scale (non-public)	0.00001	0.24
CRS (long term)	0.00017	0.32
VRS (long term)	0.00002	0.21
Scale (long term)	0.00005	0.40

***Significant at 0.01 significance level

The table above shows the results of the regression between the CAMELS rating and the efficiency levels. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights for all efficiency types except for CRS (general), VRS (general) and VRS (non-public). We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this level of significance, CAMELS rating is an important variable for CRS (general), VRS (general), Scale (general), CRS (non-public) and VRS (non-public). Among these efficiency types, as CAMELS rating increases, CRS (general), VRS (general) and VRS (non-public) increase most, since they have higher coefficients. On the other hand, this variable has smaller impact on Scale (general) and CRS (non-public). Moreover, all effects are positive.

6.2. Relationship between Factors Affecting Bank Performance and Bank Efficiency

In this part, we analyze the relationship between different factors affecting bank performance and different efficiency concepts (CRS, VRS and scale efficiency) under general, non-public and long term efficiency concepts.

6.2.1. Governance

We use three variables to represent the governance factor namely; ownership type, being publicly traded or not and delegation of power. We use dummy variables for ownership type and being publicly traded or not. Moreover, we have only 70 observations. So in order not to lose degrees of freedom more, we use pooled data in this analysis and whenever we use dummies in our study.

Table 13 Interpretation of the regression results of the governance variables at 0.1 significance level

Efficiency Type	**Ownership**	**Publicly Traded**	**Delegation**
CRS (general)	significant	significant	not significant
VRS (general)	significant	significant	significant
Scale (general)	significant	significant	significant
CRS (non-public)	significant	significant	significant
VRS (non-public)	significant	significant	significant
Scale (non-public)	significant	significant	significant
CRS (long term)	significant	significant	significant
VRS (long term)	significant	significant	significant
Scale (long term)	significant	significant	significant

Table 13 shows the interpretation of the results of the regression between governance variables and efficiency types. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights for CRS (general) and VRS (non-public). We use white cross section as coefficient covariance method. Moreover, degrees of freedom

option is chosen as no. Alpha is taken as 0.1. At this level of significance, p-value and t-statistic results of this analysis show that the ownership type and being publicly traded or not are important factors for all efficiency types. Moreover, the delegation of power is an important variable for all efficiency types except CRS (general).

Table 14 Sign of the effect for the governance variables on efficiency types

Efficiency Type	**Ownership**	**Publicly Traded**	**Delegation**
CRS (general)	positive	positive	positive
VRS (general)	positive	positive	positive
Scale (general)	positive	positive	negative
CRS (non-public)	positive	positive	negative
VRS (non-public)	positive	positive	positive
Scale (non-public)	positive	positive	negative
CRS (long term)	positive	positive	positive
VRS (long term)	positive	positive	positive
Scale (long term)	positive	positive	positive

Table above shows sign of the effect of governance variables on efficiency types. According to this table, ownership type and being publicly traded or not variables have positive impacts on efficiencies but the effects of delegation of power change. The effect is positive for CRS (general), VRS (general), VRS (non-public), CRS (long-term), VRS (long-term) and Scale (long-term) while it is negative for Scale (general), CRS (non-public) and Scale (non-public).

6.2.2. Rivalry

In the rivalry part, we use loan share, deposit share and net income share values. These variables seem highly correlated. In order to test this, we make correlation analysis.

Table 15 Correlation matrix of the rivalry variables

	INCSHARE	DEPSHARE	LOANSHARE
INCSHARE	1.00	0.95	0.86
DEPSHARE	0.95	1.00	0.85
LOANSHARE	0.86	0.85	1.00

As Table 15 shows, the rivalry variables are highly correlated. The correlations between income share and deposit share, income share and loan share, deposit share and income share are 95%, 86% and 85% respectively. So we cannot use these variables in the same equation because of multicollinearity problems.

In order to use information in these variables without dealing with multicollinearity problem, we make *Principal Component Analysis (PCA)*.

> *"It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analyzing data. The other main advantage of PCA is that once you have found these patterns in the data, and you compress the data, i.e. by reducing the number of dimensions, without much loss of information."* (Smith, 2002)

Table 16 shows results for the principal component analysis of the rivalry variables. Eigenvalues in the table are listed in descending order and they show the explanation power of each component. Moreover, variance proportion gives the level of explanation power in percentage terms. Component 1 has the highest eigenvalue and it explains about 93% of the variation. So we can only use Component 1 for explaining the rivalry. Second part of the table shows eigenvectors which are linear combinations of observed values in order to calculate the component values.

Since we reduce our rivalry variables into one principal component, we do not need to pool the data. So we should make the fixed effects testing and the random effects testing.

Table 18 shows the fixed effects testing and the random effects testing results. According to the test, cross sectional effects are significant for all efficiency types while periodic effects are not. In order to decide between the fixed effects and the random effects models, we make a further analysis called Hausman Test. According to the test, we have not got enough evidence to reject the null hypothesis that the cross sectional effects and the periodical effects are uncorrelated with other regressors. So we cannot be sure about this relation. For this reason, we use fixed effects models.

Table 16 Results of principal component analysis for rivalry variables

	Component 1	**Component 2**	**Component 3**
Eigenvalue	2.775860	0.175049	0.049091
Variance Prop.	0.925287	0.058350	0.016364
Cumulative Prop.	0.925287	0.983636	1.000000
Eigenvectors			
Variable	**Vector 1**	**Vector 2**	**Vector 3**
INCSHARE	-0.585743	-0.349291	-0.731369
DEPSHARE	-0.582713	-0.445709	0.679551
LOANSHARE	-0.563338	0.824221	0.057535

Table 17 Regression results of principal component 1 of rivalry variables and efficiency types

Efficiency Type	**Coefficient**	**p-value**
CRS (general)	-0.0100	0.25
VRS (general)	0.0000	0.11
Scale (general)	-0.0092	***0.00
CRS (non-public)	-0.0005	*0.07
VRS (non-public)	0.0000	0.58
Scale (non-public)	-0.0090	**0.04
CRS (long term)	0.0001	0.28
VRS (long term)	-0.0482	*0.06
Scale (long term)	0.0339	**0.04

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

Table 17 shows the regression results of principal component 1 with the efficiency types under fixed effects assumption for cross sectional units. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights for VRS (general), CRS (non-public), VRS (non-public) and CRS (long-term). We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, Scale (general), CRS (non-public), Scale (non-public), VRS (long-term) and Scale (long-term) are significant variables. Moreover, their effects are all negative except Scale (long-term).

Table 18 Fixed effects testing and Hausman Test results with estimated p-values for different efficiency types and concepts

	CRS (general)	VRS (general)	Scale (general)	CRS (non-public)	VRS (non-public)	Scale (non-public)	CRS (long term)	VRS (long term)	Scale (Long)
Fixed Effects Testing									
Cross-section F	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Cross-section Chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Period F	0.17	0.23	0.19	0.48	0.21	0.43	0.06	0.31	0.13
Period Chi-square	0.07	0.11	0.08	0.32	0.09	0.27	0.02	0.17	0.05
Cross-Section/Period F	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Cross-Section/Period Chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Significance of cross sectional effect (alpha 0.05)	+	+	+	+	+	+	+	+	+
Significance of periodic effect (alpha 0.05)									
Hausman Fixed versus Random Effects Testing									
Cross-section random	0.66	0.95	0.44	0.53	0.87	0.41	0.57	0.72	0.17
Period random	1.00	0.97	1.00	0.62	0.99	0.20	0.64	0.15	1.00
Cross-section and period random	0.84	0.98	0.76	0.68	0.87	0.63	0.48	0.92	0.14

6.2.3. Distribution Channels

For branch channel we use the number of branches and the ratio of İstanbul branches to the total number of branches while for ATM channel, the ATM network dummy is used. Since we have 3 variables including dummy variables and only 70 observations, we pool the data instead of using the fixed effects model and the random effects model (as we do in other models including dummy variable).

Table 19 Interpretation results for the regression between distribution channel variables and efficiency types and concepts

Efficiency Type	ATM net	Branch number	Agglomeration of Branches in İstanbul
CRS (general)	significant	significant	significant
VRS (general)	significant	not significant	significant
Scale (general)	significant	significant	significant
CRS (non-public)	significant	significant	significant
VRS (non-public)	significant	not significant	significant
Scale (non-public)	significant	significant	not significant
CRS (long term)	significant	significant	significant
VRS (long term)	significant	significant	significant
Scale (long term)	significant	significant	significant

Table 19 shows the interpretation of the results for the regression between the efficiency types and the distribution channels. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights for all efficiency types except VRS (general). We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, ATM Net is significant for all efficiency types. On the other hand, number of branches is not important for VRS (general) and VRS (non-public). Agglomeration of branches is a significant variable for all efficiency types except Scale (non-public).

Table 20 shows sign of the effect of distribution channel variables on efficiency types. All distribution channel variables have positive impact on all efficiency types except branch number for VRS (general). Number of branches has negative impact on VRS (general).

Table 20 Sign of the effect of distribution channel variables on efficiency types

Efficiency Type	ATM net	Branch number	Agglomeration of Branches in İstanbul
CRS (general)	positive	positive	positive
VRS (general)	positive	negative	positive
Scale (general)	positive	positive	positive
CRS (non-public)	positive	positive	positive
VRS (non-public)	positive	positive	positive
Scale (non-public)	positive	positive	positive
CRS (long term)	positive	positive	positive
VRS (long term)	positive	positive	positive
Scale (long term)	positive	positive	positive

6.2.4. Macroeconomic Indicators

In this part of the analysis, we use five different variables namely; gross domestic product (GDP), inflation, interbank lending rate, exchange rate (USD) and ratio of current account deficit to GDP. Since all of these variables are the indicators of the Turkish economy, they seem to be correlated. In order to test this, we make correlation analysis.

Table 21 Correlation matrix of macroeconomic variables

	Current Account Deficit / GDP	Exchange Rate (USD)	GDP	Interbank Lending Rate	Inflation
Current Account Deficit / GDP	1.00	0.49	0.04	(0.06)	(0.40)
Exchange Rate (USD)	0.49	1.00	0.37	(0.75)	(0.77)
GDP	0.04	0.37	1.00	(0.84)	(0.65)
Interbank Lending Rate	(0.06)	(0.75)	(0.84)	1.00	0.83
Inflation	(0.40)	(0.77)	(0.65)	0.83	1.00

As the table above shows, the macroeconomic variables are highly correlated with each other. The ratio of current account deficit to GDP is highly correlated with the exchange rate, while the exchange rate and GDP have high correlations with the interbank lending rate and the inflation. So we cannot use these variables in the same equation because of multicollinearity problems.

In order to use the information in these variables without dealing with multicollinearity problem, we make *Principal Component Analysis (PCA)*.

Table 23 shows results for the principal component analysis of these macroeconomic variables. According to the table, Principal Component 1 has an eigenvalue above 3 and it explains 65% of the variation in the macroeconomic variables. Since we have only 70 observations in our sample, we can say that 65% coverage is enough for our analysis and we can reduce the number of variables from five to one by using only Principal Component 1.

Table 22 Results for the regression between principal component 1 of macroeconomic variables and efficiency types

Efficiency Type	Coefficient	p-value
CRS (general)	-0.0043	***0.0002
VRS (general)	-0.0018	*0.0938
Scale (general)	-0.0026	***0.0048
CRS (non-public)	-0.0032	***0.0047
VRS (non-public)	-0.0001	**0.0233
Scale (non-public)	-0.0018	**0.0137
CRS (long term)	-0.0021	**0.0378
VRS (long term)	-0.0018	***0.0053
Scale (long term)	-0.0004	0.1309

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

Table 22 shows the regression results for the principal component 1 of the macroeconomic variables and efficiency types. Our assumption in this regression is that the effects for the differences between cross sections are significant while for periods vice versa and we use fixed effects model. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights for VRS (non-public) and efficiencies under long term concept. We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, principal component of macroeconomic variables is significant for all efficiency types except for Scale (long-term). Moreover, it has negative impact on all efficiency types.

Table 23 Results for principal component analysis of macroeconomic variables

	Comp. 1	**Comp. 2**	**Comp. 3**	**Comp. 4**	**Comp. 5**
Eigenvalue	3.232469	1.168641	0.428501	0.170389	4.12E-16
Variance Prop.	0.646494	0.233728	0.085700	0.034078	0.000000
Cumulative Prop.	0.646494	0.880222	0.965922	1.000000	1.000000
Eigenvectors					
Variable	**Vector 1**	**Vector 2**	**Vector 3**	**Vector 4**	**Vector 5**
CURACDEF_GDP	-0.218393	0.795258	0.489208	0.156734	-0.236599
EXCHANGERATE	-0.474659	0.290682	-0.588961	0.377937	0.447762
GDP	-0.430647	-0.436378	0.618772	0.285764	0.399472
INFLATION	0.520075	-0.060683	0.004290	0.844012	-0.116041
INTBANKRATE	0.520642	0.298264	0.175792	-0.19642	0.755306

6.2.5. Other Properties

In the other properties section, we use asset size and the ratio of employees having a graduate degree to the total number of employees. Again in this regression, we pool the data to make panel data analysis.

Table 24 The results for the regression between other property variables and efficiency types

	Coefficient		**p-value**	
Efficiency Type	**Asset Size**	**Education**	**Asset Size**	**Education**
CRS (general)	1.09E-10	0.46	**0.02	***0.00
VRS (general)	1.38E-11	-0.06	0.85	0.75
Scale (general)	1.07E-10	0.23	**0.02	***0.00
CRS (non-public)	1.44E-10	0.71	***0.00	***0.00
VRS (non-public)	1.17E-11	0.07	0.29	**0.03
Scale (non-public)	-1.4E-10	1.14	***0.00	***0.00
CRS (long term)	1.98E-09	2.37	***0.00	***0.01
VRS (long term)	5.61E-10	0.55	***0.00	***0.00
Scale (long term)	5E-10	1.61	***0.00	***0.00

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

Table 24 shows the regression results for asset size and education variable on efficiency types. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights for all efficiency types except for Scale (non-public) and CRS (long-term). We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, asset size is significant for all efficiency types except for VRS (general) and VRS (non-public). Moreover, it has positive impact on all efficiency types except for Scale (non-public). On the other hand, education variable is important for all efficiency types except for VRS (general). This variable has positive impact on all efficiency types except for VRS (general).

6.2.6. Combined Models

In this part, we build combined models by including significant variables from different factor parts (governance, rivalry, distribution channels, macroeconomic variables and other variables). Since efficiency under CRS assumption includes both the effect of VRS and scale, we make model building for CRS under different efficiency concepts (general, non-public, long term) separately.

CRS (general)

CRS (general) shows bank technical efficiency under constant returns to scale assumption by including input and output variables with their gross values.

All variables included in factor parts (governance, rivalry, distribution channels, macroeconomic variables, other variables) excluding delegation of power and principal component 1 of rivalry variable are significant for explaining CRS (general) bank efficiency. But, non-dummy variables and non-principal component seem to be correlated. In order to test this, we make correlation analysis. Table 25 shows the

results of this analysis and we see that there are high correlations among variables.

Table 25 Correlation results of significant variables for CRS (general)

	Branch number	Agglomoration of branches in İstanbul	Asset size	Education
Branch number	1.00	-0.59	0.92	-0.19
Agglomoration of branches in İstanbul	-0.59	1.00	-0.45	0.43
Asset size	0.92	-0.45	1.00	-0.10
Education	-0.19	0.43	-0.10	1.00

So we cannot use these variables in the same equation because of multicollinearity problems. In order to use the information in these variables without dealing with multicollinearity problem, we make *Principal Component Analysis (PCA)*.

Table 26 Results for the principal component analysis of significant variables for CRS (general)

	Component 1	**Component 2**	**Component 3**	**Component 4**
Eigenvalue	2.443090	1.054340	0.439946	0.062623
Variance Prop.	0.610773	0.263585	0.109987	0.015656
Cumulative Prop.	0.610773	0.874358	0.984344	1.000000
Eigenvectors				
Variable	**Vector 1**	**Vector 2**	**Vector 3**	**Vector 4**
BRANCHNUM	-0.60081	0.266993	-0.140038	-0.740359
POLAR	0.502989	0.315509	-0.791532	-0.144683
ASSETSIZE	-0.559974	0.392021	-0.319534	0.656237
EDUC	0.269182	0.821881	0.501762	-0.01696

Table 26 shows results for the principal component analysis of these variables. According to the table, Principal Component 1 has an eigenvalue above 2 and it explains 61% of the variation in the variables. Since we have only 70 observations in our sample, we can say that 61% coverage is enough for our analysis and we can reduce the number of variables from four to one by using only Principal Component 1.

Table 27 Interpretation of the regression results for significant variables from factor parts and CRS (general)

Variable	**Significance**	**Sign of the Coefficient**
Ownership	significant	positive
Publicly Trading	significant	positive
ATM Net	significant	positive
Principal Component of Macroeconomic Variables	significant	negative
Principal Component of Other Significant Variables	significant	positive

Table 27 shows the regression results for significant variables from factor parts and efficiency types. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights. We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, all variables (dummies and principal components) are significant. Moreover, they have all positive impact on efficiency excluding principal component 1 of macroeconomic variables.

CRS (non-public)

CRS (non-public) shows bank efficiency under constant returns to scale assumption calculated by using input and output variables including only non-public values.

All variables included in factor parts (governance, rivalry, distribution channels, macroeconomic variables, other variables) are significant for explaining CRS (non-public) bank efficiency. But, non-dummy variables and non-principal component seem to be correlated. In order to test this, we make correlation analysis. Table 28 shows the results of this analysis and we see that there are high correlations among variables.

Table 28 Correlation results of significant variables for CRS (non-public)

	Delegation of power	Branch number	Agglomoration of branches in İstanbul	Asset size	Education
Delegation of power	1.00	0.90	-0.51	0.96	-0.18
Branch number	0.90	1.00	-0.59	0.92	-0.19
Agglomoration of branches in İstanbul	-0.51	-0.59	1.00	-0.45	0.43
Asset size	0.96	0.92	-0.45	1.00	-0.10
Education	-0.18	-0.19	0.43	-0.10	1.00

So we cannot use these variables in the same equation because of multicollinearity problems. In order to use the information in these variables without dealing with multicollinearity problem, we make *Principal Component Analysis (PCA)*.

Table 29 shows results for the principal component analysis of these variables. According to the table, Principal Component 1 has an eigenvalue above 2 and it explains 66% of the variation in the variables. Since we have only 70 observations in our sample, we can say that 66% coverage is enough for our analysis and we can reduce the number of variables from five to one by using only Principal Component 1.

Table 29 Results for the principal component analysis of significant variables for CRS (non-public)

	Comp.1	**Comp. 2**	**Comp. 3**	**Comp. 4**	**Comp. 5**
Eigenvalue	3.292068	1.116737	0.462335	0.099202	0.029659
Variance Prop.	0.658414	0.223347	0.092467	0.019840	0.005932
Cumulative Prop.	0.658414	0.881761	0.974228	0.994068	1.000000
Eigenvectors					
Variable	**Vector 1**	**Vector 2**	**Vector 3**	**Vector 4**	**Vector 5**
ASSETSIZE	-0.515145	0.278928	0.209553	-0.120326	-0.773585
BRANCHNUM	-0.527358	0.133858	0.014400	0.790675	0.280359
EDUC	0.179905	0.826386	-0.531727	-0.023632	0.037803
DEL	-0.522402	0.193638	0.189914	-0.583181	0.559851
POLAR	0.388909	0.428803	0.798173	0.140342	0.090015

Table 30 shows interpretation of the regression results for significant variables from factor parts and CRS (non-public). Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights. We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, all variables (dummies and principal components) are significant. Moreover, they have all positive impact on efficiency excluding principal component 1 of rivalry variables.

Table 30 Interpretation of the regression results for combined model for CRS (non-public)

Variable	Significance	Sign of the Coefficient
Ownership	significant	positive
Publicly Trading	significant	positive
ATM Net	significant	positive
Principal Component of Rivalry Variables	significant	negative
Principal Component of Macroeconomic Variables	significant	positive
Principal Component of Other Significant Variables	significant	positive

CRS (long term)

CRS (long term) shows bank efficiency under constant returns to scale assumption calculated by using input and output variables including only long term values.

All variables included in factor parts (governance, rivalry, distribution channels, macroeconomic variables, other variables) excluding principal component of rivalry variables are significant for explaining CRS (long-term) type of bank efficiency. But, non-dummy variables and non-principal component seem to be correlated. In order to test this, we make correlation analysis. Table 31 shows the results of this analysis and we see that there are high correlations among variables.

Table 31 Correlation results of significant variables for CRS (long-term)

	Delegation of power	Branch number	Agglomoration of branches in İstanbul	Asset size	Education
Delegation of power	1.00	0.90	-0.51	0.96	-0.18
Branch number	0.90	1.00	-0.59	0.92	-0.19
Agglomoration of branches in İstanbul	-0.51	-0.59	1.00	-0.45	0.43
Asset size	0.96	0.92	-0.45	1.00	-0.10
Education	-0.18	-0.19	0.43	-0.10	1.00

So we cannot use these variables in the same equation because of multicollinearity problems. In order to use the information in these variables without dealing with multicollinearity problem, we make *Principal Component Analysis (PCA)*.

Table 32 shows results for the principal component analysis of these variables. According to the table, Principal Component 1 has an eigenvalue above 2 and it explains 66% of the variation in the variables. Since we have only 70 observations in our sample, we can say that 66% coverage is enough for our analysis and we can reduce the number of variables from five to one by using only Principal Component 1.

Table 32 E-views results for the principal component analysis of significant variables for CRS (long-term)

	Component 1	**Component 2**	**Component 3**	**Component 4**	**Component 5**
Eigenvalue	3.292068	1.116737	0.462335	0.099202	0.029659
Variance Prop.	0.658414	0.223347	0.092467	0.019840	0.005932
Cumulative Prop.	0.658414	0.881761	0.974228	0.994068	1.000000
Eigenvectors					
Variable	**Vector 1**	**Vector 2**	**Vector 3**	**Vector 4**	**Vector 5**
ASSETSIZE	-0.515145	0.278928	0.209553	-0.120326	-0.773585
BRANCHNUM	-0.527358	0.133858	0.014400	0.790675	0.280359
EDUC	0.179905	0.826386	-0.531727	-0.023632	0.037803
DEL	-0.522402	0.193638	0.189914	-0.583181	0.559851
POLAR	0.388909	0.428803	0.798173	0.140342	0.090015

Table 33 shows the regression results for significant variables from factor parts and CRS (long-term). Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign no weights. We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, dummies and principal component of macroeconomic variables are significant while principal component of other significant variables is not an important factor for explaining bank efficiency. Moreover, while dummies have positive impacts, principal components have vice versa.

Table 33 Interpretation of the regression results of combined model for CRS (non-public)

Variable	Significance	Sign of the Coefficient
Ownership	significant	positive
Publicly Trading	significant	positive
ATM Net	significant	positive
Principal Component of Macroeconomic Variables	significant	negative
Principal Component of Other Significant Variables	not significant	negative

6.3. Relationship between Factors Affecting Bank Performance and CAMELS Rating

In this part, we analyze the relationship between factors affecting bank performance and the CAMELS rating.

6.3.1. Governance

We use three variables to represent the governance factor namely; ownership type, being publicly traded or not and delegation of power. We use dummy variables for ownership type and being publicly traded or not. Moreover, we have only 70 observations. So in order not to lose degrees of freedom more, we use pooled data in this analysis and whenever we use dummies as in the relationship part of these variables with bank efficiency.

Table 34 shows results of this regression. In table, GOV 1, 2 and 3 show private, foreign and state banks respectively. Moreover, PUBTRAD 1 and 0 shows publicly traded and not publicly traded dummies. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross

section weights and we use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. Under these conditions, all variables are significant and their effects are all positive.

Table 34 Regression results of governance variables and CAMELS rating

Variable	Coefficient	p-value
GOV=1 AND PUBTRAD=0	0.936636	***0
GOV=1 AND PUBTRAD=1	3.233247	***0
GOV=2 AND PUBTRAD=0	2.071021	***0
GOV=2 AND PUBTRAD=1	2.414166	***0
GOV=3 AND PUBTRAD=0	4.122635	***0
GOV=3 AND PUBTRAD=1	3.487668	***0
DEL	4.29E-08	*0.0961

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

6.3.2. Rivalry

In the rivalry part, we use loan share, deposit share and net income share values. These variables seem highly correlated and in order to test this, we make correlation analysis.

Table 35 Correlation matrix of rivalry variables

	INCSHARE	DEPSHARE	LOANSHARE
INCSHARE	1.00	0.95	0.86
DEPSHARE	0.95	1.00	0.85
LOANSHARE	0.86	0.85	1.00

As table 35 shows, the rivalry variables are highly correlated. Correlations between income share and deposit share, income share and loan share, deposit share and income share are 95%, 86% and 85% respectively. So we cannot use these variables in the same equation because of multicollinearity problems.

In order to use information in these variables without dealing with multicollinearity problem, we make *"Principal Component Analysis (PCA)"*.

Table 36 shows results of principal component analysis of rivalry variables. Eigenvalues in the table are listed in descending order and they show the explanation power of each component. Moreover, variance proportion gives the level of explanation power for the components in percentage terms. Component 1 has the highest eigenvalue and it explains about 93% of the variation. So we can only use Component 1 for explaining rivalry. Second part of the table shows eigenvectors which is linearly combined with observed values in order to calculate Component Values.

Table 36 Results of principal component analysis of rivalry variables

	Component 1	**Component 2**	**Component 3**
Eigenvalue	2.775860	0.175049	0.049091
Variance Prop.	0.925287	0.058350	0.016364
Cumulative Prop.	0.925287	0.983636	1.000000
Eigenvectors			
Variable	**Vector 1**	**Vector 2**	**Vector 3**
INCSHARE	-0.585743	-0.349291	-0.731369
DEPSHARE	-0.582713	-0.445709	0.679551
LOANSHARE	-0.563338	0.824221	0.057535

Table 37 Fixed effects testing and Hausman Test results with estimated p-values for the CAMELS rating

Fixed Effects Testing	
Cross-section F	0.00
Cross-section Chi-square	0.00
Period F	0.90
Period Chi-square	0.83
Cross-Section/Period F	0.01
Cross-Section/Period Chi-square	0.00
Significance of cross sectional effect (%80 confidence interval)	+
Significance of periodic effect (%80 confidence interval)	
Hausman Fixed versus Random Effects Testing	
Cross-section random	0.67
Period random	0.96
Cross-section and period random	0.61

Table 37 shows the results of fixed and random effects testing results for the relation between principal component 1 and the CAMELS Rating. According to the table, the cross sectional effects are significant while the periodic effects are not. Moreover, Hausman Test shows that we have not got enough evidence to reject the hypothesis that effects are not correlated with other regressors and use random effects model. So we use cross sectional fixed effects model in this equation.

Table 38 shows results of this regression. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign no weights and we use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. Under these conditions, principal component 1 of rivalry variable is significant and its effect is negative.

Table 38 Results for the regression between principal component 1 and CAMELS rating

Variable	Coefficient	p-value
C	3.185714	***0
PCRIVALRY1	-0.668593	*0.0589

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

6.3.3. Distribution Channels

For branch channel we use the number of branches and the ratio of İstanbul branches to the total number of branches while for ATM channel, the ATM network dummy is used. Since we have 3 variables and only 70 observations, we pool the data instead of using the fixed effects model and the random effects model as we do in other models including dummy variable.

Table 39 shows results of this regression. In table, ATMNET 1,2,3 and 4 represents Altın Nokta, Ortak Nokta, None and Shared ATM Net (for all banks) respectively. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights and we use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. Under these conditions, all variables are significant. Effects of ATM Net and number of branches are positive while the effect of agglomeration of branches is negative.

Table 39 Results for the regression between distribution channel variables and CAMELS rating

Variable	Coefficient	p-value
ATMNET=1	3.97678	***0
ATMNET=2	3.582036	***0
ATMNET=3	3.663694	***0
ATMNET=4	3.57055	***0
BRANCHNUM	0.000578	***0.0011
AGGLOM	-2.135215	**0.0398

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

6.3.4. Macroeconomic Indicators

In this part of the analysis, we use five different variables namely; gross domestic product (GDP), inflation, interbank lending rate, exchange rate (USD) and ratio of current account deficit to GDP. Since all of these variables are the indicators of the Turkish economy, they seem to be correlated. In order to test this, we make correlation analysis.

The results show that the macroeconomic variables are highly correlated with each other. The ratio of current account deficit to exchange rate is highly correlated with exchange rate, while exchange rate and GDP have high correlations with interbank lending rate and inflation. So we cannot use these variables in the same equation because of multicollinearity problems.

In order to use the information in these variables without dealing with multicollinearity problem, we make *"Principal Component Analysis (PCA)"*.

According to the results for principal component analysis of macroeconomic variables, Principal Component 1 has an eigenvalue above 3 and it explains 65% of variation in macroeconomic variables. Since we have only 70 observations in our sample, we can say that 65% coverage is enough for our analysis in order not to lose degrees of

freedom and we can reduce the number of variables from five to one by using only Principal Component 1.

Table 40 shows results of this regression. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights and we use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. Under these conditions, principal component 1 of macroeconomic variable is not significant.

Table 40 Results for the regression between distribution channel variables and CAMELS rating

Variable	Coefficient	p-value
C	3.315921	***0
PCMACRO1	-0.027708	0.4241

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

6.3.5. Other Properties

In the other properties section, we use asset size and the ratio of employees having a graduate degree to the total number of employees. Again in this regression, we pool the data to make panel data analysis.

Table 41 shows results of this regression. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign cross section weights and we use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. Under these conditions, asset size is a significant variable while education is not. Moreover, effect of asset size is positive.

Table 41 Results for the relation between other property variables and CAMELS rating

Variable	Coefficient	p-value
C	3.351115	***0
ASSETSIZE	8.45E-09	***0.0005
EDUC	-10.13141	0.1885

*Significant at 0.1 significance level
**Significant at 0.05 significance level
***Significant at 0.01 significance level

6.3.6. Combined Model

In this part, we build combined model for the CAMELS rating by including significant variables from different factor parts namely; governance, rivalry, distribution channels, macroeconomic variables and other variables.

All variables included in factor parts (governance, rivalry, distribution channels, macroeconomic variables, other variables) excluding education level and principal component of macroeconomic variables are significant for explaining CAMELS rating. But, non-dummy variables and non-principal component seem to be correlated. In order to test this, we make correlation analysis. The table below shows the results of this analysis and we see that there are high correlations among variables.

Table 42 Correlation results of significant variables for CAMELS

	Asset size	Branch number	Delegation of power	Agglomoration of branches in İstanbul
Asset size	1.00	0.92	0.96	-0.45
Branch number	0.92	1.00	0.90	-0.59
Delegation of power	0.96	0.90	1.00	-0.51
Agglomoration of branches in İstanbul	-0.45	-0.59	-0.51	1.00

So we cannot use these variables in the same equation because of multicollinearity problems. In order to use the information in these variables without dealing with multicollinearity problem, we make *Principal Component Analysis (PCA)*.

Table 43 shows results for the principal component analysis of these variables. According to the table, Principal Component 1 has an eigenvalue above 2 and it explains 80% of the variation in the variables and we can say that 80% coverage is enough for our analysis and we can reduce the number of variables from four to one by using only Principal Component 1.

Table 43 Results for the principal component analysis of significant variables for CRS (general)

	Component 1	**Component 2**	**Component 3**	**Component 4**
Eigenvalue	3.216537	0.653117	0.099590	0.030756
Variance Prop.	0.804134	0.163279	0.024897	0.007689
Cumulative Prop.	0.804134	0.967414	0.992311	1.000000
Eigenvectors				
Variable	**Vector 1**	**Vector 2**	**Vector 3**	**Vector 4**
ASSETSIZE	-0.531836	0.328677	-0.115215	-0.771911
BRANCHNUM	-0.538141	0.078407	0.788810	0.286419
DEL	-0.534659	0.235665	-0.590368	0.556837
POLAR	0.376423	0.911200	0.126372	0.109773

Table 44 shows interpretation of the regression results for significant variables from factor parts and CAMELS. Assumptions about GLS weights, coefficient covariance method and degrees of freedom correction are made. In terms of GLS weights, we assign no weights. We use white cross section as coefficient covariance method. Moreover, degrees of freedom option is chosen as no. Alpha is taken as 0.1. At this significance level, dummies and principal components are all significant

and they all have positive impacts excluding principal component 1 of rivalry variables.

Table 44 Interpretation of the regression results of combined model for CRS (non-public)

Variable	**Significance**	**Sign of the Coefficient**
Ownership	significant	positive
Publicly Trading	significant	positive
ATM Net	significant	positive
Principal Component of Rivalry Variables	significant	negative
Principal Component of Other Significant Variables	significant	positive

CHAPTER 7

7. DISCUSSION AND CONCLUSION

Banking sector is very important for the Turkish economy. Banks do not make intermediation only to individuals; they also intermediate to the firms in other sectors. So the performance and soundness of the banking sector is very important for almost all sectors, consequently for the Turkish economy.

To keep performance of the banking sector high, knowing dynamics of it is very important. Our study aims to analyze the performance of the sector in different perspectives and determine factors affecting performance.

In terms of general bank efficiency (under CRS assumption to include both scale and pure technical efficiency), the most efficient group is the state banks. All state banks have efficiencies about 100%. Following them foreign banks come. On the average, they are 98% efficient. Except Denizbank and ING, all foreign banks have full efficiency. The private banks are the least efficient group on the average but they have still high levels of efficiency, 95% on the average. Among them, Akbank, Garanti and TEB have full efficiency levels while İşbank, Şekerbank and Yapıkredi have rather low levels of efficiency.

The banks and banking groups in our sample have always productivity gains except the period between 2007 and 2008. In this period, while state banks still have productivity gains, private and especially foreign banks record productivity losses.

When we exclude public related items from the levels we use, state banks lose about 3% efficiency. Among them, the biggest lose is recorded by Vakıfbank, 7% while Halkbank lose 3%. Surprisingly, the biggest state bank is still at full efficiency level after the exclusion of public related items. Following state banks, private banks decrease their efficiency levels by 1% while foreign banks keep their levels of efficiency same. Moreover, market maker banks lose 1% efficiency as non-market maker banks stay at same levels.

On the contrary to general efficiency levels, in terms of long term efficiency levels state banks are the least efficient group, about 80% on the average. Altought Ziraat is still at full efficiency levels; Vakıfbank and Halkbank have very low levels of efficiency. All private banks except Şekerbank have full long term efficiency. Foreign banks have about 90% efficiency in terms of long term banking and among them except Finansbank and Fortis, all banks have full efficiency levels. In terms of market making role, maker banks have higher levels of long term efficiency than non market maker banks.

In our analysis, another performance indicator used is the CAMELS rating. According to the indicator, state banks are the most efficient groups as in general efficiency results. Among them, Ziraat have high performances in all rating points. Following state banks, private banks have also high performances. They record low performance only in capital adequacy and liquidity criteria. On the contrary to private banks, foreign banks have only positive performances in these two criteria. In other 4 criteria (asset quality, management, equity and sensitivity to market risk), they record negative performances.

In terms of final CAMELS rate, Garanti and Ziraat have the highest rates and they are at the beginning of our performance list. On the other hand, at the end of the list ING and Fortis come. When we analyze the changes in final CAMELS rates of the banking groups, we see that state banks are the most volatile group. While in 2006 they have the highest score, in 2010 they decrease below private banks. Group performance of foreign banks in terms of CAMELS rate is always poor compared to other two groups.

The relation between bank efficiency levels and CAMELS rating is also analyzed. According to the results, at 0.1 significance level, the CAMELS rating is significant and sufficient to explain CRS (general), VRS (general), Scale (general), CRS (non-public) and VRS (non-public).

In our analysis, as governance variables, ownership type, delegation of power and being publicly traded (or not) are used. In terms of delegation of power, the highest delegation is realized by foreign banks, they have the lowest asset size per an Executive Vice President. State banks have the lowest delegation such that an Executive Vice President controls an important level of asset.

Regression results of governance variables with bank efficiency show that ownership and being publicly traded (or not) are significant variables for all efficiency types. The delegation of power is also an important variable for all types of efficiency except CRS (general) Moreover, governance variables are significant to explain CAMELS rating also.

Rivalry variables include loan shares, deposit shares and net income shares of the banks as the variables. On the average of years and banks in the groups, foreign banks have the lowest shares in loan, deposit and net income levels. In terms of deposit and net income share, state banks have the highest shares. On the other hand, in loans market, a harsh rivalry among state and private banks is realized among the years. While in 2006, private banks have the highest share, in 2010 state banks come over them. Since these variables are highly correlated, we find their principal component and make our regression analysis with it. The principal component found is significant for Scale (general), CRS (non-public), Scale (non-public), VRS (long-term) and Scale (long-term). It is also an important variable for CAMELS rating.

In distribution channel part, we use three variables; the number of branches, agglomeration of branches in İstanbul and ATM net. The number of branches is the highest in state banks and the lowest in foreign banks. For agglomeration of branches in İstanbul, this is vice versa. While before 2009 some banks share ATMs under different nets,

after this year all banks are in a shared ATM net. ATM net is a significant variable for all efficiency types. On the other hand, for most of the efficiency types, branch number and agglomeration of branches in İstanbul are important variables. Branch number is not significant for VRS (general) and VRS (non-public) while agglomeration of branches in İstanbul is not significant only for Scale (non-public). All distiribution channel variables are significant for the CAMELS rating.

In macroeconomic part of the analysis, we use five different variables; gross domestic product (GDP), inflation, interbank lending rate, exchange rate (USD) and the ratio of current account deficit to GDP. While the average growth rate of GDP among the years is about 10%, the level of inflation decreases except 2008. Moreover, the interbank lending rate decreased sharply especially after 2008. Exchange rate and current account deficit are very volatile variables and they currently become problematic indicators for the Turkish economy. Since macroeconomic variables are highly correlated, we find their principal component and make our regression analysis with it. The results show that except Scale (long-term), Principal Component 1 is a significant variable for all efficiency types at 0.1 significance level. On the other hand, it is not a significant variable for explaining CAMELS rating.

Two variables are outside our main groupings so we name them as other factors. These variables are size of the bank and education level of its employees. The state banks have the biggest asset sizes and the foreign banks have the lowest. The education data gives us so interesting information that the state banks realized a jump in terms of level of education. While in 2006 education level was below the private and the foreign banks, in 2010, the state banks surpassed other banking groups. When we make regression analysis, we see that for most of the efficiency types, asset size and education are important variables. Asset size is not significant for VRS (general) and VRS (non-public) while education is not significant only for VRS (general).

In order to combine significant variables find in different factor groups, we make combined models for CRS (general), CRS (non-public), CRS (long term) and CAMELS rating. For CRS (general), our combined model includes all variables excluding delegation of power and principal component 1 of rivalry variables. For CRS (non-public), all variables are included in the model. CRS (long term) also includes most of the variables excluding principal component 1 of rivalry variables. In the combined model for CAMELS rate, there are all variables except principal component 1 of macroeconomic variables and education.

To sum up, in terms of general efficiency the most efficient group is the state banks. On the contrary to general efficiency levels, in terms of long term efficiency levels state banks are the least efficient group, about 80%. When we exclude public related items from the levels we use, state banks lose about 3% efficiency. In terms of CAMELS rating, state banks are the most efficient groups as in general efficiency results. Following them, private banks have also high performances. In terms of final CAMELS rate, Garanti and Ziraat have the highest rates and they are at the beginning of our performance list. CAMELS rating is significant and sufficient to explain some of the efficiency types. The factors affecting bank efficiency are also analyzed and found to be generally important for efficiency types and CAMELS rating.

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APPENDICES

Appendix A: Measuring Bank Efficiency

A firm is an organization which converts its inputs into outputs via a determined process. So efficiency of a firm means its performance in this conversion process. In order to attain a value to this factor and compare it with other firms, lots of methods generated.

First method is the traditional method. In this method, efficiency was simply the ratio of output to input.

Efficiency = Output / Input

But this method is not satisfactory especially for the firms producing multiple outputs from multiple inputs. In real life, almost all firms use multiple inputs and produce multiple outputs. Moreover, this method does not consider quality and environmental conditions (Pasupathy, 2002).

In order to avoid drawbacks of traditional efficiency measurement, Farell (1957) introduced a new measure called "technical efficiency" which measures efficiency via considering all inputs and outputs. In this new method, all decision making units are analyzed and the most efficient firms are determined. Afterwards, other decision making units are compared to these ideal firms (Pasupathy, 2002).

Technical efficiency can be measured from two perspectives; input oriented and output oriented measurements.

Input Oriented Measures

Input oriented measures are suitable for the firms having particular orders and these firms determine the amount of resources used in order to fill this orders. Figure 26 is the graphical representation of this concept. Suppose the firm uses two inputs (x_1, x_2) to produce output q under the assumption of constant returns to scale. SS' represents isoquant curve on which same level of output is produced by different combinations of input, while AA' represents isocost line which has a slope value equals to the ratio of input prices. Suppose the firm produces at point P. This means that the firm is producing output level q by using more input than actually needed, that is to say the firm is technically inefficient. Technical Efficiency (TE) refers to "*…the ability of a firm to obtain maximal output from a given set of inputs.*". In that sense technical efficiency level of the firm can be measured as OQ/OP (Coelli T. J., 1996).

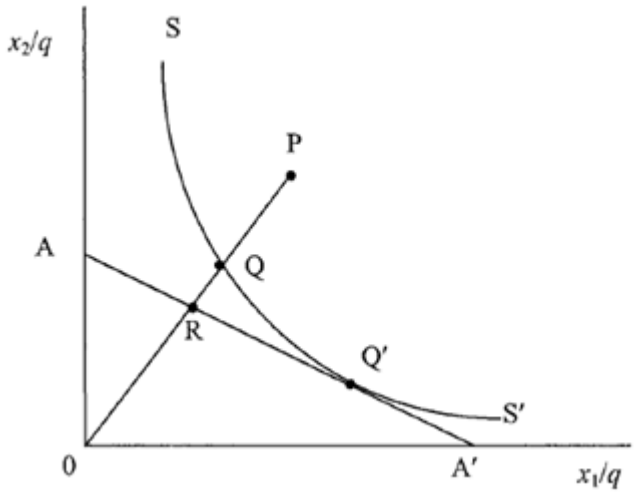

Figure 26 Graphical representation of input oriented measure of bank efficiency
Source: (Coelli, Rao, ODonnell, & Battese, 2005)

Suppose firm is now producing at Q that is to say it is fully technically efficient. But this does not mean that it is also cost efficient. Cost efficiency can be realized by producing at a point where isoquant curve and isocost line intersects, point Q'. In order to be fully cost efficient, allocative efficiency should also be provided. Allocative Efficiency (AE) refers to "*…ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology.*" and can be measured as OR/OQ. From these definitions, it can be derived that cost efficiency includes both technical efficiency and allocative efficiency and it can be measured by the multiplication of them. That is to say, cost efficiency can be calculated as TE*AE which is OQ/OP*OR/OQ and equal to OR/OP (Coelli, Rao, ODonnell, & Battese, 2005).

Output Oriented Measures

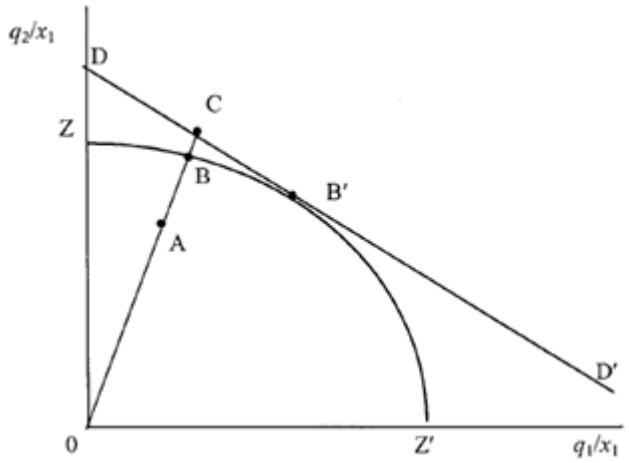

Figure 27 Graphical representation of output oriented measure of bank efficiency
Source: (Coelli, Rao, ODonnell, & Battese, 2005)

Output oriented measures are suitable for the firms having fixed quantity of resources and producing as much output as possible. Figure 27 is the graphical representation of this concept. Suppose the firm

produces two outputs (q_1, q_2) by single input x_1 under the assumption of constant returns to scale. ZZ' represents production possibility curve on which same level of input is used to produce different combinations of output, while DD' represents isorevenue line which has a slope value equals to the ratio of output prices. Suppose the firm is producing at point A. To be technically efficient, it should produce on production possibility curve. Therefore, Technical Efficiency (TE) level of the firm can be measured as OA/OB. But being on the curve is not enough for having efficient revenue levels. The firm should also produce at a point where production possibilities curve and isorevenue line intersect point B'. That is to say, the firm should be allocative efficient also. Allocative Efficiency (AE) can be measured by OB/OC. Multiplication of Technical Efficiency (TE) and Allocative Efficiency (AE) gives the level of Revenue Efficiency. The level of Revenue Efficiency can be measured by TE*AE which is OA/OB*OB/OC resulted in OA/OC (Coelli, Rao, ODonnell, & Battese, 2005).

Scale Efficiency

Being technically efficient and allocative efficient is not enough for a firm to be called "*efficient*". The operation scale of the firm may be at an inefficient level.

If a firm is at Constant Returns to Scale (CRS) level of the production process, we can automatically call this firm as scale efficient. But if it is at Variable Returns to Scale (VRS) level of the production process, then scale of the production should be examined. If the firm produces at Increasing Returns to Scale part of the production function then it should increase scale, and if it produces at Decreasing Returns to Scale part vice versa (Coelli, Rao, ODonnell, & Battese, 2005).

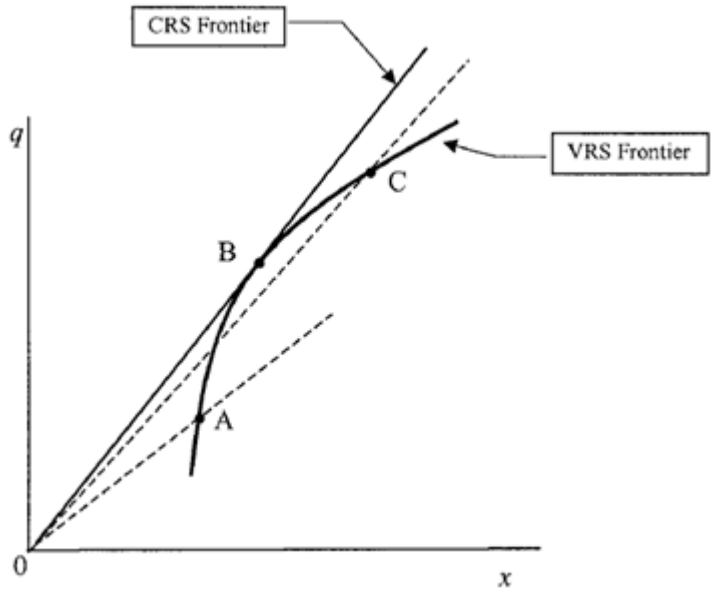

Figure 28 Graphical representation of VRS and CRS assumptions for bank efficiency
Source: (Coelli, Rao, ODonnell, & Battese, 2005)

In Figure 28, points A, B and C are technically efficient. However, in order to measure scale efficiency of these points, we should draw a ray from the origin representing Constant Returns to Scale frontier. The point at which CRS Frontier and VRS Frontier intersect is the scale efficient point. In the figure, point B is both technical and scale efficient point (Coelli, Rao, ODonnell, & Battese, 2005).

Relative Efficiency

Another method introduced by Farrell (1957) in order to overcome weaknesses of traditional method in terms of multiple inputs and outputs case is relative efficiency measurement. In this method, a weight is assigned to every input and output and efficiency of them is measured via ratio of weighted sum of outputs to weighted sum of inputs (Pasupathy, 2002).

Efficiency = Weighted sum of outputs / Weighted sum of inputs

The weights assigned to each input and output is generally same for all firms. Mostly used weights for this method are the prices for outputs and the costs for inputs. However, finding general levels for prices and costs are difficult. Moreover,

> *…by assigning a common set of weights, the individual firms are not given the freedom to choose their own set of weights for their inputs and outputs. Thus the efficiencies of the firms are determined under this predefined set. Thus, in the case there is no possibility of increasing the efficiency score of a firm by way of assigning the weights that are most favorable for that firm.* (Pasupathy, 2002).

Appendix B: Data Envelopment Analysis

To overcome drawbacks of relative efficiency measurement, data envelopment analysis (DEA) is introduced by Charnes, Cooper and Rhodes (1978). It is a mathematical programming technique. Different from relative efficiency measurement, the program determines the best set of weights for each decision making unit (DMU). These weights are determined such a way that analyzed DMU's efficiency score is maximum while efficiency of other decision making units are less than or equal to 1 under same set of determined weights (Pasupathy, 2002).

Suppose there are K inputs and M outputs for N decision making units. x_i and y_i are input and output vectors and v' and u' are vector of weights assigned to inputs and outputs respectively. Then mathematical representation of the DEA problem under constant returns to scale assumption also called *"CCR Model"* is (Coelli T. J., 1996);

$$max_{u,v}\ (u'y_i / v'x_i),$$

$$st \qquad u'y_j / v'x_j \leq 1$$

$$j=1,2,\ldots,N$$

$$u, v \geq 0$$

(Equation 3)

Since this model is a fractional model, it cannot be solved by linear program. In order to make computation simpler, the model is converted into linear form via normalizing it by equalizing denominator of objective function one. Then the problem becomes (Coelli T. J., 1996);

$$max_{u,v}\ u'y_i\ ,$$

$$st \quad v'x_i = 1$$

$$u'y_j - v'x_j \leq 0$$

$$j=1,2,\ldots,N$$

$$u, v \geq 0 \qquad \text{(Equation 4)}$$

This problem has K+M variables and 1+K+M+N constraints. So the dual of this has 1+K+M+N variables and K+M constraints. Since the dual form has less constraints, solving dual is easier. So the problem becomes as (Coelli T. J., 1996);

$$min_{\lambda,\theta}\ \theta,$$

$$st \quad -y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0,$$

$$\lambda \geq 0 \qquad \text{(Equation 5)}$$

θ, a scalar, shows efficiency score of i^{th} decision making unit and is less than or equal to one. λ is a vector of constants and includes (Nx1) elements. By solving this problem, θ for each decision making unit, that is to say efficiency of them, is calculated (Coelli T. J., 1996).

The results of CCR model include both technical efficiency and scale efficiency. This assumption is suitable when all decision making units are at the same scale. But in banking sector especially, banks have different scales. So variable returns to scale is more appropriate in order

to measure technical efficiency of banks. By calculating both constant and variables returns to scale assumptions, scale efficiency of banks can be calculated from their division also. So in order to done these, the model called BCR under variables returns to scale assumption should also be calculated. In order to add this assumption into model, the convexity constraint N1'λ = 1 should also be included in the model. Then the model turns out to be;

$$\begin{aligned} &min_{\lambda,\theta}\ \theta, \\ &st \quad -y_i + Y\lambda \geq 0, \\ &\quad \theta x_i - X\lambda \geq 0, \\ &\quad N1'\lambda = 1, \\ &\quad \lambda \geq 0 \end{aligned} \qquad \textit{(Equation 6)}$$

where N1 is Nx1 vector of one's (Coelli T. J., 1996).

Under constant returns to scale (CRS) assumption, both input and output oriented measures give the same solution. However, under variables returns to scale assumption, they are different, so their models are different also. The model for output oriented DEA under variables returns to scale assumption is;

$$\begin{aligned} &Max_{\phi,\lambda}\ \phi \\ &st \quad -\phi\, y_i + Y\lambda \geq 0, \\ &\quad x_i - X\lambda \geq 0, \\ &\quad N1'\lambda = 1, \\ &\quad \lambda \geq 0 \end{aligned} \qquad \textit{(Equation 7)}$$

ф-1 is the proportional increase in outputs and it is equal or more than 1. Moreover, 1/ ф gives TE score which is between zero and one (Coelli T. J., 1996).