



Evaluating The Financial Performances Of The Banks Listed On Istanbul Stock Exchange Banks Index By Data Envelopment Analysis And Malmquist Index¹

(Borsa İstanbul Banka Endeksine Kote İşletmelerin Finansal Performanslarının Veri Zarflama Analizi ve Malmquist Endeksine Göre Değerlendirilmesi)

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Keywords

Efficiency, Measurement of Performance, Istanbul Stock Exchange Banks Index (BIST XBANK), Data Envelopment Analysis (DEA), Malmquist Index.

Abstract

In order to compare the performances of the banks listed on Istanbul Stock Exchange Banks Index; efficiency values of the banks selected from the mentioned index are calculated by Data Envelopment Analysis (DEA) based on their financial ratios for each year of 2010-2013 period. The estimated efficiency rates are compared amongst themselves as a result of the analyses applied. Additionally; the efficiency changes of the banks in each term is calculated via Malmquist Index to determine the improvement or decline in the course of time.

Jel Classification

G32, L25.

Anahtar Kelimeler

Verimlilik, Performans Ölçümü, Borsa İstanbul Banka Endeksi (BIST XBANK), Veri Zarflama Analizi.

Özet

Borsa İstanbul Banka Endeksinde işlem gören işletmelerin performanslarının karşılaştırılması amacıyla endeksten seçilen işletmelerin verimlilik değerleri 2010-2013 dönemine ait her bir yıl için finansal oranları üzerinden Veri Zarflama Analizi ile ölçülmüştür. Uygulanan analizler neticesinde elde edilen verimlilik değerleri kendi aralarında karşılaştırılmıştır. Ayrıca bankaların her bir dönemki verimlilik değişimi zaman içindeki artış ve azalmaların görülebilmesi için Malmquist Endeksi ile hesaplanmıştır. Elde edilen bulguların sonucu, firmalar dönen varlıklarını arttırma ile daha ilgili olmalıdır. Kısa vadeli borçlar ve uzun vadeli borçların kontrolü tercih edilebilir. Stokların devir hızı daha iyi oranlar ile karşılaşmak için tekrardan ayarlanmalıdır.

Jel Sınıflandırması

G32, L25.

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1. Introduction

Due to the competitive character of the markets; using of the limited resources is reasonably crucial for the companies today so it is needed to apply beneficial performance measurement systems in order to evaluate the company's performance and carry efficient activities to be able to grow gradually. As efficiency is determined to be the adequate level of reaching goals; efficiency needs to be observed and measured in order to evaluate the consequences of different company policies (DPT, 2000: 75; Tarım, 2001). There are various methods to analyze the performance and the efficiency of companies as they are mentioned in the study.

Since banking sector is one of the most important factors about development of an economy, Turkish banks are evaluated continuously to achieve a stronger sector. The conditions of today's financial sector where the levels of terms of competition are high, force banks to make use of their resources in the most effective way (Doğan, 2013a: 215). Hereupon; evaluating the financial performances of the banks to measure their efficiency values and calculate their efficiency changes in time are aimed in the study.

Following the introduction section of the study; the second one includes literature review. In the third section DEA and Malmquist Index methodologies are explained thus aim, scope and limitations are described in the fourth section of the study. Consequently; findings of the banks measured via DEA and Malmquist Index are indicated in the fifth section so the sixth one comprehends the results.

2. Literature Review

There are plenty of studies in the literature held about performance measurement and efficiency in banking sector. Besides; multi-criteria decision-making methods such as Analytical Hierarchy Process (AHP), Analytical Network Process (ANP), Data Envelopment Analysis (DEA), TOPSIS (Technique for Order Preference by Similarity to An Ideal Solution), Gray Relational Analysis (GRA) and Electre methods are observed to be used in academic studies concerning measurement of financial performances of banks (Doğan, 2013a: 215-216). In this study; although analyses such as DEA and Malmquist Index are used for performance measurement in Turkish Banking Sector, all the studies having the same purpose and being held recently are mentioned below.

Özgür (2008) measured financial efficiency of Turkish public capitalized deposit banks via Data Envelopment Analysis due to its importance owing to the fact that public banks' share in economic system is realized as 28%.

Eken and Kale (2011) measured the efficiency of bank branches via DEA to determine their strengthful and weak characteristics. They comprehend that branch size and scale efficiency are related to each other; as branch size increases scale efficiency increases too additionally after the most productive scale size, however, as size increases efficiency decreases.

Ata (2009) compared the domestic and foreign banks operating in Turkey by their financial performances additionally analyzed the effect of foreign capital on the performances of the banks; consequently, domestic banks were evaluated to be more efficient than foreign banks with respect to performance criteria.

Doğan (2013a) measured and compared financial performances of banks traded in Istanbul Stock Exchange (ISE) between the years of 2005-2011 via Gray Relational Analysis (GRA) method and comprehended that a bank with high "Return on Assets" could also have a high financial performance.

Doğan (2013b) compared the financial performances of participation and conventional banks which have been active from 2005 to 2011 in Turkey and no statistical significant difference was detected between the mentioned bank groups about profitability rates.

As a similar study to Ata (2009); Doğan (2013c) compared the financial performances of foreign and domestic banks which operate in Turkish Banking Sector. It is determined that domestic banks are more efficient than foreign banks while foreign banks are suggested to have better capital adequacy ratios.

Aktaş and Avcı (2013) compared the efficiency values of participation banks, interest based private and public banks by using Data Envelopment Analysis also Malmquist Index. In consequence of their mutual study; public banking is evaluated as the most efficient while participation banking is the increasing one according to productivity rates.

Koçyiğit (2013) investigated the relation between the efficiency of listed deposit banks in Istanbul Stock Exchange and its stock returns for the period of 2006-2011 by using DEA and panel data analysis that a statistically significant relationship is not found between the efficiency of deposit banks and its stock returns.

Sakarya and Kaya (2013) conducted a comparative analysis between participation banks and deposit banks operating in Turkey and investigate the main areas of differentiation. They examined the Turkish banking system for 2005-2012 period in their study by using panel data analysis.

3. Data Envelopment Analysis (DEA) and Malmquist Index Methodologies

DEA is a linear programming-based approach developed by Charnes, Cooper and Rhodes in 1978 built on Farrell's (1957) theoretical study to determine performance efficiency. DEA evaluates the relative efficiency of Decision Making Units (DMUs) (Golany and Yu, 1997: 28) which can be defined as the entities responsible for converting input(s) into output(s) and whose performances are to be evaluated. The term "relative" is rather important since an institution identified by DEA as an efficient unit in a given data set may be deemed inefficient when compared to another set of data (Yeh, 1996: 981).

In efficiency analysis, observations are generated by a finite number of DMUs using the same kind(s) of input(s) and output(s); however, DEA offers the advantage of being able to process multiple inputs and outputs with each being stated in its own unit of measurement. Cenger (2011: 34) states that technical efficiency concept; meaning the process of acquiring maximum outputs by using minimum inputs or acquiring more outputs by using same amount of inputs, underlies in reasoning Data Envelopment Analysis method.

There are two basic kinds of DEA models: CCR (Charnes, Cooper, Rhodes) and BCC (Banker, Charnes, Cooper). The CCR model is built on the assumption of constant returns to scale (CRS) of activities, and the other one is about variable returns (VRS). The CCR model assumes frontier to have constant returns to scale (CRS) characteristics since Banker et al. (1984) (BCC) relaxed CRS assumption and introduced VRS frontier in 1984 (Eken and Kale, 2011: 890).

DEA model is a non-parametric approach to solve a linear programming formulation for each DMU, DEA measures efficiency of a DMU by maximizing the ratio of weighted outputs over weighted inputs so the ratio is normalized according to the best practical peers and efficiency is calculated to be between 0 and 1; as 1 representing the efficient unit (Boussofiane et al., 1991).

As in the other non-parametric measurement methods; DEA models can be characterized in the groups called as input orientated and output orientated. Due to the fact that firms in a highly competitive global market intend to minimize the costs; input orientated DEA models are more preferred but output orientated ones should be benefited if more outputs are intended to be obtained by the same amount of inputs (Coelli, 1998: 7 in Cenger, 2011: 35).

The constraints and necessary steps to implement the Data Envelopment Analysis (DEA) can be asserted as selection of DMUs, determining sets of input and outputs, measurement of the relative efficiency and evaluation of results; respectively (Özgür, 2008: 253).

The mathematical expression of output / input ratio introduced by Charnes, Cooper and Rhodes for Data Envelopment Analysis Model in 1978 is indicated below (Cooper and Seiford, 2000: 35 in Kaya et al., 2010: 134):

Efficiency = Output / Input

$$\text{Max } h_k = \frac{\sum_{r=1}^s u_{rk} y_{rj}}{\sum_{i=1}^m v_{ik} x_{ij}}$$

Herein; $x_{ij} > 0$ parameter indicates i inputs used by j DMUs and $y_{rj} > 0$ parameter denotes r outputs used by j DMUs. Reference variables for this equation meeting maximization condition are shown as v_{ik} and u_{rk} meaning the weights given by k decision making units for i inputs and r outputs.

The constraint obtaining the efficiency not to be counted as more than 100 % when reference weights of k organizational decision making units are also used by other decision making units is indicated as;

$$\frac{\sum_{r=1}^s u_{rk} y_{rj}}{\sum_{i=1}^m v_{ik} x_{ij}} \leq 1, \quad u_r \geq 0, v_i \geq 0$$

Herein j and $k = 1, \dots, n$

The businesses to be evaluated by DEA must have the same input-output sets in order to acquire reasonable results (Yolalan, 1993: 65 in Özcan, 2005: 25).

Data Envelopment Analysis (DEA) is a subject to study related to operations research, management and econometrics indicating the efficiency of activities in both production and services sectors (Wei, 2001).

The greatest number possible to be able to represent the amount of inputs and outputs are to be preferred to maximize decomposition ability of DEA and while there exist m inputs and p outputs, the number of DMUs evaluated should be at least $(m+p+1)$ or $2.(m+p)$ in terms of the significance of the study (Boussofiane et al., 1991: 7-8 in Özcan, 2005: 69).

Malmquist Index abbreviation for “Malmquist Total Factor Productivity Index” is used to measure the changes in total factor productivity and its components as Efficiency Change, Technical Efficiency Change, Scale Efficiency Change and Pure Efficiency Change, in time. The Malmquist Index value is comprehended to be the change in total factor productivity so that efficiency increases when the mentioned values excess 1.

Malmquist Index is calculated as the multiplication of Efficiency Change and Technical Efficiency Change (Karacabey, 2002: 191 aktaran Özgür, 2008: 252) while Efficiency Change is occurred by multiplying Scale Efficiency and Pure Efficiency changes (Işık ve Hassan, 2003: 302 in Çakır ve Perçin, 2012: 55).

4. Aim, Scope and Limitation of the Study

It is aimed to measure the financial efficiencies of the banks listed on Istanbul Stock Exchange Banks Index (XBANK) in the period of 2010-2013 by using DEA over their financial ratios.

Despite the existence of 16 banks listed on the mentioned index; 4 of them are excluded from the study due to the fact that there are 2 participation banks and 2 investment banks within the index. The excluded companies are as following; Albaraka Türk (ALBRK), Asya Katılım Bankası (ASYAB), Türkiye Kalkınma Bankası (KLNMA) and Türkiye Sınai Kalkınma Bankası (TSKB). Hence, the rest 12 depositary banks analyzed in the study are indicated in the table below:

Table 1: The Depositary Banks Analyzed in the Study

Code	Company	Code	Company
AKBNK	AKBANK	ISCTR	İŞBANKASI
ALNTF	ALTERNATİF BANK	SKBNK	ŞEKERBANK
DENİZ	DENİZBANK	TEBNK	TÜRK EKONOMİ BANKASI
FINBN	FİNANSBANK	TEKST	TEKSTİL BANK
GARAN	GARANTİ BANKASI	VAKBN	VAKIFBANK
HALKB	TÜRKİYE HALK BANKASI	YKBNK	YAPI ve KREDİ BANKASI

Due to the fact that input variables are more likely to be controlled in the competitive market, input orientated DEA models are mostly preferred for the similar studies; however, output orientated DEA is suggested to be applied in the study since profitability rates of the banks for long term are considered. Afterwards; input and output variables as Liquid Adequacy, Capital Adequacy, Loan Ratio, Return on Assets, Return on Equities and Management Effectiveness are selected in accordance with the decision of analysis to compare the financial performances of the mentioned DMUs.

The input and output variables benefited in the study are indicated below in Table 2.

Table 2: Input and Output Variables of the Study

Inputs	Outputs
Liquid Adequacy (Liquid Assets/Total Assets)	Return on Assets – ROA (Net Profit of the Period/Total Assets)
Capital Adequacy (Total Equities/Total Assets)	Return on Equity – ROE (Net Profit of the Period/Total Equities)
Loan Ratio (Total Loans/Total Deposits)	Management Effectiveness (Interest Income/Total Assets)

According to the model, input and output variables determined; data of the depositary banks analyzed are gathered from the official web site of Public Disclosure Platform (www.kap.gov.tr) via their balance sheets and income statement tables. Hence; the mentioned ratios are calculated and ran in Banxia DEA Frontier Software Program afterwards efficiency values belonged to each depositary bank are compared via DEAP 2.1 Program (Win4DEAP) to determine the improvements and decreases in terms of efficiency.

Since Boussofiane et al. (1991: 7-8 in Özcan, 2005: 69) declares that the number of DMUs evaluated should be at least $(m+p+1)$ or $2.(m+p)$ in terms of the significance of the study while m inputs and p outputs exist, as a limitation of the study, both of the conditions are met in the study.

5. Findings of the Analysis

Both CRS and VRS models are used in Banxia DEA Frontier Software Program while data related to the study are employed; consequently, it is observed that there is not much difference in the rates acquired. Thus; scale efficiency change is suggested to be insignificant so merely CRS model is preferred in the study to indicate the results of analysis. The efficiency values of the banks obtained via output orientated CRS model for each of the years between 2010 and 2013 are indicated below, respectively.

Table 3: Efficiency Values of the Banks in 2010

Decision Making Unit (DMU)	Score	Decision Making Unit (DMU)	Score
AKBNK	98,35%	ISCTR	84,32%
ALNTF	100,00%	SKBNK	74,07%
DENIZ	88,80%	TEBNK	94,65%
FINBN	88,03%	TEKST	67,11%
GARAN	87,58%	VAKBN	81,40%
HALKB	100,00%	YKBNK	99,45%

Efficiency values based on the financial performances of the banks analyzed in 2010 are indicated in Table 3 by their scores and it is observed that only ALNTF and HALKB are evaluated as efficient while the others have different efficiency values from 67% to 99%. Even though the 10 banks need improvement; it is clear that their scores can not be suggested to be very low in the year of 2010.

Table 4: Efficiency Values of the Banks in 2011

Decision Making Unit (DMU)	Score	Decision Making Unit (DMU)	Score
AKBNK	78,16%	ISCTR	66,86%
ALNTF	100,00%	SKBNK	100,00%
DENIZ	96,58%	TEBNK	75,10%
FINBN	96,82%	TEKST	80,90%
GARAN	80,77%	VAKBN	78,64%
HALKB	100,00%	YKBNK	85,50%

The efficiency values belonged to 2011 indicate that ALNTF, HALKB and SKBNK are efficient while the remaining 9 banks' performances are between 66% and 97%.

Table 5: Efficiency Values of the Banks in 2012

Decision Making Unit (DMU)	Score	Decision Making Unit (DMU)	Score
AKBNK	66,69%	ISCTR	66,68%
ALNTF	100,00%	SKBNK	100,00%
DENIZ	82,85%	TEBNK	77,92%
FINBN	84,35%	TEKST	77,40%
GARAN	73,78%	VAKBN	76,35%
HALKB	100,00%	YKBNK	67,86%

According to the efficiency rates of 2012; ALNTF, HALKB and SKBNK are evaluated to be efficient and the other banks analyzed have efficiency rates from 66% to 85%.

Table 6: Efficiency Values of the Banks in 2013

Decision Making Unit (DMU)	Score	Decision Making Unit (DMU)	Score
AKBNK	74,05%	ISCTR	71,03%
ALNTF	100,00%	SKBNK	100,00%
DENIZ	100,00%	TEBNK	89,64%
FINBN	97,33%	TEKST	86,62%
GARAN	78,23%	VAKBN	88,72%
HALKB	100,00%	YKBNK	100,00%

Table 6 indicates that while ALNTF, DENIZ, HALKB, SKBANK and YKBNK are efficient, the performances of the others are calculated between 71% and 98% in 2013.

So; 2010 and 2013 are observed to be better than 2011 and 2012 for banks according to their efficiency values in the period besides ALNTF and HALKB are evaluated to be efficient in each year of the period while SKBNK is suggested to be inefficient only in 2010. DENIZ and YKBNK are calculated as efficient banks merely in 2013 additionally AKBNK, FINBNK, GARAN, ISCTR, TEBNK, TEKST and VAKBN need improvement during the 2010-2013 period even though their performances deserve to be defined as fine.

Afterwards; efficiency values belonged to each of the DMUs are compared via DEAP 2.1 Program (Win4DEAP) to determine improvements and decreases. The results of

Malmquist Index Summary based on Total Factor Productivity Change and its components are shown in the tables below:

Table 7: Malmquist Index Summary 2011

Decision Making Unit (DMU)	Efficiency Change	Technical Efficiency Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
AKBNK	0.792	0.840	0.829	0.955	0.666
ALNTF	1.000	1.129	1.000	1.000	1.129
DENIZ	1.085	0.989	1.080	1.005	1.073
FINBN	1.099	0.908	1.000	1.099	0.998
GARAN	0.918	0.869	0.905	1.015	0.798
HALKB	1.000	0.912	1.000	1.000	0.912
ISCTR	0.793	0.942	0.710	1.117	0.747
SKBNK	1.349	0.995	1.270	1.062	1.343
TEBNK	1.056	1.277	1.000	1.056	1.348
TEKST	1.173	0.872	1.027	1.143	1.023
VAKBN	0.965	0.984	0.933	1.034	0.950
YKBNK	0.861	0.827	0.878	0.980	0.712
MEAN	0.996	0.955	0.960	1.037	0.951

All Malmquist index averages are geometric means.

According to Table 7; total factor productivity changes belonging to ALNTF, DENIZ, SKBNK, TEBNK and TEKST exceed 1 so that the efficiency values of the 5 mentioned banks are suggested to be improved.

Table 8: Malmquist Index Summary 2012

Decision Making Unit (DMU)	Efficiency Change	Technical Efficiency Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
AKBNK	0.855	1.106	0.968	0.883	0.945
ALNTF	1.000	1.362	1.000	1.000	1.362
DENIZ	0.859	1.026	0.858	1.001	0.881
FINBN	0.872	1.142	0.997	0.875	0.996
GARAN	0.916	1.031	0.940	0.975	0.945
HALKB	1.000	0.976	1.000	1.000	0.976
ISCTR	0.999	1.061	1.091	0.915	1.060
SKBNK	1.000	1.225	1.000	1.000	1.225
TEBNK	0.779	0.842	0.793	0.983	0.656
TEKST	0.982	1.290	0.949	1.035	1.266
VAKBN	1.017	1.092	0.994	1.024	1.111
YKBNK	0.793	1.012	0.873	0.908	0.802
MEAN	0.919	1.089	0.952	0.965	1.000

All Malmquist index averages are geometric means.

Rates in 2012 show that ALNTF, ISCTR, SKBNK, TEKST and VAKBN improve their efficiency, then. According to cumulative average data of 2012; total factor productivity is fixed, technical efficiency increase while the others decrease.

Table 9: Malmquist Index Summary 2013

Decision Making Unit (DMU)	Efficiency Change	Technical Efficiency Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
AKBNK	1.109	0.799	1.076	1.030	0.886
ALNTF	1.000	0.910	1.000	1.000	0.910
DENIZ	1.207	0.882	1.166	1.035	1.065
FINBN	1.154	0.716	1.003	1.150	0.826

Decision Making Unit (DMU)	Efficiency Change	Technical Efficiency Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
GARAN	1.060	0.823	1.052	1.008	0.872
HALKB	1.000	0.895	1.000	1.000	0.895
ISCTR	1.064	0.819	1.065	0.999	0.871
SKBNK	1.000	0.743	1.000	1.000	0.743
TEBNK	1.158	0.730	1.153	1.004	0.845
TEKST	1.119	0.655	1.208	0.926	0.733
VAKBN	1.109	0.779	1.124	0.987	0.864
YKBNK	1.473	0.820	1.304	1.129	1.208
MEAN	1.115	0.794	1.092	1.021	0.885

All Malmquist index averages are geometric means.

According to Table 9; merely DENIZ and YKBNK have improvement in total factor productivity. ALNTF and HALKB have decrease due to the decline in technical efficiency change. The cumulative average data of 2013 illustrate that total factor productivity decrease because of the change in technical efficiency even though pure efficiency and scale efficiency arise.

As it is indicated below in Table 10; total factor productivity decrease year by year except 2012 meaning that the mentioned rate is the same both in 2011 and 2012.

Table 10: Malmquist Index Summary of Annual Averages

Year	Efficiency Change	Technical Efficiency Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
2011	0.996	0.955	0.960	1.037	0.951
2012	0.919	1.089	0.952	0.965	1.000
2013	1.115	0.794	1.092	1.021	0.885
MEAN	1.007	0.938	0.999	1.007	0.944

Finally; Malmquist Index Summary of each bank's means is indicated below:

Table 11: Malmquist Index Summary of DMU Means

Decision Making Unit (DMU)	Efficiency Change	Technical Efficiency Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
AKBNK	0.909	0.905	0.952	0.954	0.823
ALNTF	1.000	1.119	1.000	1.000	1.119
DENIZ	1.040	0.964	1.026	1.013	1.002
FINBN	1.034	0.905	1.000	1.034	0.936
GARAN	0.963	0.903	0.964	0.999	0.870
HALKB	1.000	0.927	1.000	1.000	0.927
ISCTR	0.944	0.936	0.938	1.007	0.884
SKBNK	1.105	0.967	1.083	1.020	1.069
TEBNK	0.984	0.922	0.971	1.014	0.907
TEKST	1.089	0.903	1.056	1.031	0.983
VAKBN	1.029	0.943	1.014	1.015	0.970
YKBNK	1.002	0.882	1.000	1.002	0.883
MEAN	1.007	0.938	0.999	1.007	0.944

According to Table 11; ALNTF, DENIZ and SKBNK have decrease in total factor productivity in the 4-year period that most of the efficiency declines are results of technical efficiency changes.

6.Results and Conclusion

In the study; 12 depositary banks listed on Istanbul Stock Exchange Banks Index (BIST XBANK) are evaluated through their financial performances via DEA over financial ratios to compare themselves in 2010-2013 period.

Based on the results of DEA; ALNTF and HALKB are evaluated as efficient in 2010 while ALNTF, HALKB and SKBNK are suggested to be efficient in 2011. According to the results acquired; ALNTF, HALKB, SKBNK and ALNTF, DENIZ, HALKB, SKBANK, YKBNK are calculated as the efficient banks in the years of 2012 and 2013, respectively. Consequently; ALNTF and HALKB are the efficient banks in each of the years besides SKBNK is efficient in three years of the mentioned period. In respect of the analysis held;

most of the banks need improvement even though their performances deserve to be defined as fine.

Afterwards; efficiency values belonged to each of the banks are compared to determine improvements and decreases via Malmquist Index. According to their total factor productivity changes; ALNTF, DENIZ, SKBNK, TEBNK, TEKST improve their efficiency in 2011 and ALNTF, ISCTR, SKBNK, TEKST, VAKBN have better efficiency in 2012 comparing to the previous year. Finally in 2013; only DENIZ and YKBNK have improvement in total factor productivity so that the others decrease related to efficiency compared to 2012. In conclusion; ALNTF, DENIZ, ISCTR, SKBNK, TEBNK, TEKST, VAKBN and YKBNK have better efficiency rates in different years of the mentioned period even if non of them are able to improve efficiency rates in each of the following years.

The results illustrate that depositary banks listed on Istanbul Stock Exchange Banks Index can be suggested to be efficient as well in the period between the years of 2010 and 2013 according to the analyses held via DEA and Malmquist Index. For the following studies; the comparison of financial efficiency of the banks examined can be made with their share earnings, corporate governance ratings or foreign shares (if available).

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