Performance Evaluation of Turkish Commercial Banks Using AHP and TOPSIS

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ABSTRACT

Measuring performance and determining the key factors of performance have been an important research topic in different sector in recent years. The main goal of this study is to evaluate the performance ranks of the Commercial banks in Turkey due to the fact that performances of Commercial banks are important at the stage of economic growth. In this research, the Commercial banks in Turkey ranked by TOPSIS method using weights of capital ratios obtained from AHP. The performance ranks of Commercial banks sorted according to their TOPSIS scores for the period 2009-2013. In this study, capital ratios of Turkish Commercial banks are placed in a hierarchical decision structure to establish pair-wise comparisons between the model parameters which are based on the subjective judgment of a group of experts. In order to find the performance order of the Commercial banks in Turkey according to financial ratios, calculated criteria and sub-criteria weights for each banks by using AHP to use in TOPSIS method. Performance scores of Commercial the banks obtained by TOPSIS method related with banks' financial ratios of AHP weights. Consequently, the performances and also the sector share of the commercial banks weren't changed for analyzed period.

Keywords: AHP, TOPSIS, Turkish Commercial banks, financial ratios, performance ranking

JEL-Clasification: C52, G22

AHP ve TOPSIS kullanarak Türk Ticari Bankalarının Performans Değerlendirmesi

ÖZET

Performansın ölçümü ve performansa dair kilit unsurlar son yıllarda farklı sektörlerde önemli bir tartışma konusudur. Çalışmanın başlıca hedefi, Türkiye'de ekonomik büyüme sürecinde önemli yerleri olan ticari bankaların performanslarına göre sıralanmasıdır. Araştırmada ele alınan ticari bankalar AHP yöntemi yardımıyla ağırlıklandırılan oranlar kullanılarak TOPSIS

yöntemine göre sıralanmıştır. 2009-2013 döneminde söz konusu bankaların performans sıralaması TOPSIS skorlarına göre yapılmıştır. Çalışmada ticari banka oranları uzmanlık alanlarını temel alan model parametreleri arasında parçalı karşılaştırmalar yapılabilmesi için hiyerarşik bir karar yapısında konumlandırılmıştır. Ticari bankaların performansını belirlemek için hesaplanan kriter ve alt kriter ağırlıkları herbir banka bazında AHP kullanılarak yapılmıştır. TOPSIS yöntemiyle elde edilen performans skorları bu AHP ağırlıkları ile ilişkilidir. Analiz sonucunda, ticari bankaların performansları ile sektördeki paylarının incelenen dönemde kayda değer bir değişme göstermediği belirlenmiştir.

Anahtar Kelimeler: AHP, TOPSIS, Türk ticari bankaları, finansal rasyolar, performans sıralaması

1 Introduction

Performance measurement for business success is a result of globalization and increasing competition in the business environment. In general, measurement of performance is traditionally important for strategic decision-makers. Performance measurement has great deal of attention by the researchers in the past decades (Kagioglou et al., 2001; Bassioni et al., 2004). Competition in the banking sector as well as in all sectors force banks to measure performances and use resources effectively. Commercial banks have great role for determining the allocation of resources in different economic sectors.

A variety of decision making methods and tools are available to measure performance ranks of financial companies. In general, MCDM (Multi Criteria Decision Making) methodologies are well–suited to the complexity of economic decision problems and robustness of financial analysis for business decisions (Balzentis et al. 2012). TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution), AHP (Analytical Hierarch Process) and in collaboration of both techniques have been utilized as efficient tools in many finance and economy fields by financial regulators.

In this study, the combination of AHP and TOPSIS was chosen as a suitable methodology to measure performance ranks of Commercial commercial banks. The performance ranks of Turkish Commercial banks obtained by using TOPSIS method based on the AHP weights of capital ratios that take into account company-level capital ratios that allows us to use quantitative information to rank Commercial banks in Turkish banking sector. In Turkish banking sector, totally 26 sub-ratios covered with 7 main financial ratios are evaluated by governmental institution for banks. The study showed that highly weighted sub-ratios of banks are in accordance with their performance orders.

2 Literature Survey

Traditionally, bank performance evaluation is based on the analysis of financial ratios. However, nonfinancial performance criteria have been recognized significantly and taken in to account to fully satisfy bank operations' efficiency (Secme et al 2009, Toloie-Eshlaghy et al 2011, Amile et al 2013, Islam et al 2013).

Financial performance of foreign banks operating in Turkish banking sector is measured by TOPSIS method for the years 2003-2013 by Gundogdu (2015). Akkoç and Vatansever (2013) measured financial performance of 12 banks in Turkey using AHP and TOPSIS methods and the research results

are similar for both methods. Yayar and Baykara (2012) measured efficiency and activity of banks in Turkey for the period 2005-2011. Yılmaz (2013) analyzed the efficiency of the 30 commercial banks in Turkey by using DEA (Data Envelopment Analysis) for the period 2007-2010. Onder and Hepsen (2013) combined AHP and TOPSIS methodologies and used for the ranking of 3 state banks,9 Commercial banks and 5 foreign banks of Turkish banking sector during 2002-2011 using 57 ratios based on subjective and objective opinions of financial actors.

Gilbert et al. (1985) formally introduced capital ratios in regulation and applied in a different way. Bank regulators have relied on financial ratios for a very long time in formally or informally ways. Bank regulators have not always used capital ratios in the same way. Capital ratios have long been a valuable tool for assessing the safety of banks. The informal use of ratios by bank regulators and supervisors goes back well over a century.

3 Methodology
3.1. Analytical Hierarchy Process

The AHP is an intuitively easy method for formulating and analyzing decisions (Saaty, 1980). Numerous applications of the AHP have been used since its development and it has been applied to many types of decision problems (Zahedi, 1986). Researchers interested in more detail could refer to the most recent book by written (Saaty & Penivati, 2008).

In cases where many alternatives need to be evaluated the AHP ratings approach is often used. This approach requires that a series of ratings or intensities to be developed for each criterion (for example, excellent, very good, good, fair, and poor). In AHP decision elements of each component are compared pair-wise with regard to their importance in the direction of their control criterion and components are also compared pair-wise and in respect of their contribution to the achievement of the objective.

The relative important values are determined with a scale of from 1 to 9, where a score of 1 represents equal importance between the two elements and a score of 9 indicates the extreme importance of one element (row component in the matrix) compared to the other one (column component in the matrix) (Meade & Sarkis, 1999; Saaty, 2009). The basic approach for deriving weights with AHP is obtained by way of pair-wise relative comparisons. In general, a nine-point numerical scale is recommended for the comparisons (Saaty,1980) given in Table 1.

Table 1. Fundamental Scale*

1	equal importance
3	moderate importance of one over another
5	strong or essential importance
7	very strong or demonstrated importance
9	extreme importance
2, 4, 6, 8	intermediate values

(*) Use reciprocals for inverse comparisons.

An AHP analysis uses pairwise comparisons to measure the impact of items on one level of the hierarchy on the next higher level. At each level, the pairwise comparisons are organized into a matrix and the weights of the items being compared are determined by computing the maximum eigenvalue of the matrix. A weighted averaging approach is used to combine the results across levels of the hierarchy to compute a final weight for each alternative.

In AHP is made in the framework local priority vector can be derived as an estimate of relative importance associated with the elements (or components) being compared by solving the following formulae:

$$A.w = \lambda_{max}.w$$

where A is the matrix of pair-wise comparison, w is the eigenvector, and λ_{max} is the largest eigenvalue of A. If A is a consistency matrix, eigenvector X can be calculated by $(A - \lambda_{max}I)X = 0$. In AHP, consistency index (C.I.) and consistency ratio (C.R.) to verify the consistency of the comparison matrix are defined as;

$$C.I. = (\lambda_{max} - n)/(n-1), \ \ C.R. = C.I./R.I.$$

where R.I. represents the average consistency index over numerous random entries of same order reciprocal matrices. If $C.R. \leq 0.1$, the estimate is accepted; otherwise, a new comparison matrix is solicited until $C.R. \leq 0.1$.

Another important advantage of the AHP is that it allows for inconsistency in judgment. The consistency ratio provides a numerical assessment of how inconsistent these evaluations might be. If the calculated ratio is less than 0.10, consistency is considered to be satisfactory (Meade, 1996). The geometric mean of all evaluations is also used to obtain the required pair-wise comparison matrix (Lin et al., 2009).

3.2. TOPSIS Method

The TOPSIS method developed by Hwang and Yoon (1981) basically depending on closest distance to positive-ideal solution and most distance to negative-ideal solution. TOPSIS method procedure steps as follows;

1. Step - The Constitution of Decision Matrix (A): Alternatives are positioned as decision points on rows and evaluation criteria about decision positioned on columns in the decision matrix. In the A_{mxn} decision matrix, m and n represent decision point number and evaluation factor numbers respectively (Rao 2008).

$$A_{mn} = \{a_{ij} \ | i \in (1, \ 2, \ ..., m) \ and \ \ j \in (1, \ 2, \ ..., n)\}$$

2. Step - Normalized Decision Matrix (R): Normalizing by square root of the sum of the squares scores or features belong to decision matrix criteria, calculated from A matrix by applying following equation (Opricovic and Tzeng, 2004).

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}}$$

where $(r_{ij} \in R \text{ and } i : 1, 2, \ldots, n : criteria \ numbers, \ j : 1, 2, \ldots, m : alternative \ numbers)$.

3. Step - Weighted Normalized Decision Matrix (V): In this step firstly weighted values are determined (w_j: for each j. criteria, relative weight values of elements of normalized decision matrix) according to purpose, (Monjezi et al., 2010). V matrix is formed by multiplying elements in the R matrix each column with w_j value. It is obtained as follows:

$$V = \{V_{ij} \mid w_j a_{ij} \mid i \in (1, 2, ..., m) \ and \ j \in (1, 2, ..., n)\} \ \text{ where } \sum_{j=1}^{n} w_j = 1$$

4. Step - Construction of Positive Ideal (A⁺)and Negative Ideal (A⁻) Solutions: The biggest ones which are the weighted factors of the column values in the V matrix selected in order to get the ideal solution set, in other words (smallest value is selected if related evaluating factor have direction of minimization). Positive ideal (A^+) and negative ideal (A^-) solutions sets obtained from V matrix as follows respectively,

$$A^+ = \left\{ (\max_i v_{ij} \mid j \in J), (\min_i v_{ij} \mid j \in J') \right\}, \text{ represented by } A^+ = \left\{ v_1^+, v_2^+, ..., v_n^+ \right\}$$

$$A^- = \left\{ (\min_i v_{ij} \mid j \in J), (\max_i v_{ij} \mid j \in J') \right\}, \text{ represented by } A^- = \left\{ v_1^-, v_2^-, ..., v_n^- \right\}$$

Furthermore set which will be calculated from formula can be showed as In both formulas, J demonstrates the benefit (maximization) and J' demonstrates the cost (minimization) value.

5. Step - Calculation of Distance Between Alternatives: Distance between alternatives is obtained by n sized Euclidean Distance Approach. Distance from Positive Ideal (S⁺)and Negative Ideal (S⁻) Solutions for each alternative are calculated by formulas which are given below respectively.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2} \ \text{ and } \ S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}$$

6. Step - Calculation of Relative Closeness to the Ideal Solution: Distinction measurements are used to calculation of relative closeness (C*) to the ideal solution has shown in the following, (Olson 2004).

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*}$$

where $0 \leq C_i^* \leq 1$.

7. Step - Closeness of the Alternatives to the Ideal Solution: Closeness of the alternatives to the ideal solution is sorted according to the value C_i^*, alternative which have highest C_i^* is chosen.

4 Implementation and Results
4.1. Implementation

In Turkish banking sector, financial ratios are categorize as capital ratios, assets quality, liquidity, profitability, income-expenditure structure, share in group and share in sector and totally 26 sub-ratios related with the ratios. Turkish governmental institution, namely Turkish Bank Association, evaluates ratios for each Commercial and governmental banks. The ratios considered in this research are Shareholders' Equity / Total Risk Weighted Assets, Shareholders' Equity / Total Assets and (Shareholders' Equity - Permanent Assets) / Total Assets which are sub-ratios of Capital Ratios which are obtained from Turkish Bank Association open source (www.tbb.org.tr). In this study, the application of AHP, the relative importance or weights of the criteria weighing each attribute by experts are determined and arranged in a hierarchy. *Expert Choice©* software was used to evaluate pairwise-comparison judgments and obtained criteria and sub-criteria weights. The consensus of the groups was calculated using the geometric mean of individual judgments.

Table 2. AHP Combined All Ratios Weights

Capital Ratios	**0.161**
Shareholders' Equity / Total Risk Weighted Assets	0.576
Shareholders' Equity / Total Assets	0.172
(Shareholders' Equity - Permanent Assets) / Total Assets	0.252
Assets Quality	**0.191**
Total Loans / Total Assets	0.142
Loans Under Follow-up (net) / Total Loans	0.048
Specific Provisions / Loans Under Follow-up	0.215
Permanent Assets / Total Assets	0.052
FX Assets / Total Assets	0.175
FX Liabilities / Total Liabilities	0.058
Net On Balance Sheet Position / Total Shareholders' Equity	0.145
Net On and Off Balance Sheet Position / Total Shareholders' Equity	0.165

Table 2. (Continue)

Liquidity	**0.152**
Liquid Assets / Total Assets	0.573
Liquid Assets / Short-term Liabilities	0.427
Profitability	**0.145**
Net Profit/Losses / Total Assets	0.501
Net Profit/Losses / Total Shareholders' Equity	0.499
Income-Expenditure Structure	**0.272**
Net Interest Income / Total Assets	0.223
Net Interest Income / Total Operating Income	0.378
Non-interest Income / Total Assets	0.320
Non-interest Expenses / Total Operating Income	0.047
Provision for Loan Losses or other Receivables / Total Assets	0.032
Share in Group	**0.032**
Total Assets	0.223
Total Loans	0.457
Total Deposits	0.320
Share in Sector	**0.047**
Total Assets	0.333
Total Loans	0.315
Total Deposits	0.352
Inconsistency	**0.09**

In cases where inconsistency is above 10% during the assessment of prioritizing one criterion than the other one so the consistency of the judgments is tracked to validate for decision process.

4.2. Results

AHP weighted scores are utilized by TOPSIS method for each year for the period 2009-2013 to obtained performance ranks of Commercial banks of Turkish banking sector. Performance ranking results of Commercial banks of Turkish banking sector for the period of 2009 - 2013 years evaluated TOPSIS method based on AHP capital ratios weights are given Table 3. In this research shows that the banks such as Deutsche Bank, Citibank and Arap Türk Bankası owned by foreign investors have better performance rank than national Commercial banks. Study also shows that performance ranks of Commercial banks in consistency with banks' raw data of Shareholders' Equity / Total Risk Weighted Assets weights. On the other hand, there is almost no change performance rank of Turkish Commercial commercial banks for investigated period.

Tablo 3. Performance Ranks of Commercial Banks Based on Financial Ratios (2009-2013)

Panel-A

	Banks	2009		Banks	2009
1	T.C. Ziraat Bankası A.Ş.	3,965	13	Türkiye İş Bankası A.Ş.	3,57
2	Türkiye Halk Bankası A.Ş.	3,028	14	Yapı ve Kredi Bankası A.Ş.	2,80
3	Türkiye Vakıflar Bankası T.A.O.	3,203	15	Alternatifbank A.Ş.	1,92
4	Adabank A.Ş.	2,455	16	Arap Türk Bankası A.Ş.	2,98
5	Akbank T.A.Ş.	3,638	17	Burgan Bank A.Ş.	2,30
6	Anadolubank A.Ş.	2,436	18	Citibank A.Ş.	2,67
7	Fibabanka A.Ş.	2,453	19	Denizbank A.Ş.	2,70
8	Şekerbank T.A.Ş.	2,365	20	Deutsche Bank A.Ş.	3,56
9	Tekstil Bankası A.Ş.	2,163	21	Finans Bank A.Ş.	2,97
10	Turkish Bank A.Ş.	2,877	22	HSBC Bank A.Ş.	2,48
11	Türk Ekonomi Bankası A.Ş.	2,479	23	ING Bank A.Ş.	2,56
12	Türkiye Garanti Bankası A.Ş.	3,772	24	Turkland Bank A.Ş.	2,31

Table 3. (Continue)

Panel-B

	Banks	2010		Banks	2010
1	T.C. Ziraat Bankası A.Ş.	4,309	13	Turkish Bank A.Ş.	2,28
2	Türkiye Garanti Bankası A.Ş.	3,757	14	Denizbank A.Ş.	2,25
3	Akbank T.A.Ş.	3,721	15	ING Bank A.Ş.	2,25
4	Türkiye İş Bankası A.Ş.	3,646	16	Türk Ekonomi Bankası A.Ş.	2,21
5	Türkiye Halk Bankası A.Ş.	2,986	17	Anadolubank A.Ş.	1,96
6	Deutsche Bank A.Ş.	2,907	18	Şekerbank T.A.Ş.	1,89
7	Türkiye Vakıflar Bankası T.A.O.	2,773	19	Fibabanka A.Ş.	1,81
8	Yapı ve Kredi Bankası A.Ş.	2,756	20	Tekstil Bankası A.Ş.	1,78
9	Finans Bank A.Ş.	2,719	21	Burgan Bank A.Ş.	1,78
10	Citibank A.Ş.	2,524	22	Turkland Bank A.Ş.	1,58
11	HSBC Bank A.Ş.	2,395	23	Adabank A.Ş.	1,47
12	Arap Türk Bankası A.Ş.	2,326	24	Alternatifbank A.Ş.	1,42

Panel-C

	Banks	2011		Banks	2011
1	T.C. Ziraat Bankası A.Ş.	3,885	13	Arap Türk Bankası A.Ş.	2,54
2	Türkiye Garanti Bankası A.Ş.	3,833	14	Citibank A.Ş.	2,29
3	Akbank T.A.Ş.	3,693	15	Türk Ekonomi Bankası A.Ş.	2,10
4	Türkiye İş Bankası A.Ş.	3,582	16	Burgan Bank A.Ş.	1,93
5	Deutsche Bank A.Ş.	3,551	17	Anadolubank A.Ş.	1,90
6	Türkiye Halk Bankası A.Ş.	3,083	18	ING Bank A.Ş.	1,81
7	Yapı ve Kredi Bankası A.Ş.	2,898	19	Turkland Bank A.Ş.	1,71
8	Türkiye Vakıflar Bankası T.A.O.	2,761	20	Şekerbank T.A.Ş.	1,71
9	Finans Bank A.Ş.	2,731	21	Tekstil Bankası A.Ş.	1,54
10	Turkish Bank A.Ş.	2,714	22	Adabank A.Ş.	1,49
11	Denizbank A.Ş.	2,671	23	Fibabanka A.Ş.	1,36
12	HSBC Bank A.Ş.	2,558	24	Alternatifbank A.Ş.	1,25

Panel-D

	Banks	2012		Banks	2012
1	T.C. Ziraat Bankası A.Ş.	3,614	13	Citibank A.Ş.	2,07
2	Türkiye İş Bankası A.Ş.	3,489	14	HSBC Bank A.Ş.	1,98
3	Türkiye Garanti Bankası A.Ş.	3,448	15	Turkish Bank A.Ş.	1,91
4	Akbank T.A.Ş.	3,436	16	Anadolubank A.Ş.	1,89
5	Türkiye Halk Bankası A.Ş.	3,027	17	ING Bank A.Ş.	1,76
6	Deutsche Bank A.Ş.	3,025	18	Şekerbank T.A.Ş.	1,52
7	Yapı ve Kredi Bankası A.Ş.	2,789	19	Fibabanka A.Ş.	1,48
8	Türkiye Vakıflar Bankası T.A.O.	2,731	20	Turkland Bank A.Ş.	1,39
9	Arap Türk Bankası A.Ş.	2,458	21	Tekstil Bankası A.Ş.	1,37
10	Finans Bank A.Ş.	2,249	22	Adabank A.Ş.	1,34
11	Denizbank A.Ş.	2,155	23	Burgan Bank A.Ş.	1,30
12	Türk Ekonomi Bankası A.Ş.	2,136	24	Alternatifbank A.Ş.	1,22

Table 3. (Continue)

Panel-E

	Banks	2013		Banks	2013
1	T.C. Ziraat Bankası A.Ş.	4,144	13	Türk Ekonomi Bankası A.Ş.	2,34
2	Türkiye İş Bankası A.Ş.	3,841	14	HSBC Bank A.Ş.	2,20
3	Citibank A.Ş.	3,838	15	Denizbank A.Ş.	2,18
4	Akbank T.A.Ş.	3,816	16	Anadolubank A.Ş.	2,06
5	Türkiye Garanti Bankası A.Ş.	3,772	17	Adabank A.Ş.	2,06
6	Yapı ve Kredi Bankası A.Ş.	3,550	18	ING Bank A.Ş.	2,02
7	Türkiye Halk Bankası A.Ş.	3,426	19	Turkland Bank A.Ş.	1,91
8	Deutsche Bank A.Ş.	3,328	20	Tekstil Bankası A.Ş.	1,88
9	Türkiye Vakıflar Bankası T.A.O.	3,114	21	Şekerbank T.A.Ş.	1,75
10	Arap Türk Bankası A.Ş.	2,711	22	Fibabanka A.Ş.	1,73
11	Turkish Bank A.Ş.	2,700	23	Alternatifbank A.Ş.	1,73
12	Finans Bank A.Ş.	2,569	24	Burgan Bank A.Ş.	1,34

5. Conclusions

Measurement of banking sector simultaneously contribute to being in competition as an early warning indicator. Banks could not to replicate the failures revealed in the past and make foresight and strategies by analyzing their performance.

Financial ratios evaluated by AHP and performance ranks of the banks have been determined via the TOPSIS model and the performances of Turkish Commercial commercial system have been analyzed within the scope of the model. In this study, AHP method was utilized to determine the sub-criteria of the performance evaluation hierarchy and weighted ratios used by TOPSIS method combining to rank Commercial commercial banks in Turkey.

In this research, both AHP, main criteria and sub-criteria weights prioritizing and TOPSIS priority of banks directly engagament with the performance based on their raw data. Study show that the higher

the over all adequacy ratio, the higher the level of protection available to depositors. Basically, a large bank needs a larger amount of capital than a small bank. This research also provides very valuable information to the supervisor, decision makers and global and local investors who are responsible from prevention of bank failures.

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