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Combining Time Series Analysis and Multi Criteria Decision Making Techniques for Forecasting Financial Performance of Banks in Turkey

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Abstract − **Forecasting plays a major role in financial planning and it is an essential analytical tool in banks' strategies. In recent years, researchers are developing new techniques for estimation. Financial performance evaluation of banks is a kind of multi-criteria decision making (MCDM) problem which has developed rapidly. It is very important for a firm to monitor a wide range of performance indicators in order to ensure that appropriate and timely decisions and plans can be made. Suitable performance measures can ensure that managers adopt a long-term perspective and allocate the company's resources to the most effective activities. The aim of this study is to evaluate the financial performance model of Turkish Banks during 2012-2015 using forecasting (based on 2002-2011 data) methods and multi criteria decision techniques. As forecasting analysis tools, classical time series methods such as moving averages, exponential smoothing, Brown's single parameter linear exponential smoothing, Brown's second-order exponential smoothing, Holt's two parameter linear exponential smoothing and decomposition methods applied to financial ratios data. After forecasting techniques Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methodologies are used for the outranking of banks. This model is applied to a case study for the financial performance evaluation of 3 state banks (Ziraat Bank, Halk Bank and Vakıflar Bank); 9 private banks (Akbank; Anadolubank; Sekerbank; Tekstil Bank; Turkish Bank; Turk Ekonomi Bank; Garanti Bank; Is Bank and Yapı Kredi Bank) and 5 foreign banks (Denizbank; Eurobank Tekfen; Finans Bank; HSBC Bank and ING Bank) in Turkey. Financial performances of a bank is divided into ten groups including Capital Ratios, Balance Sheet Ratios, Assets Quality, Liquidity, Profitability, Income-Expenditure Structure, Share in Sector, Share in Group, Branch Ratios and Activity Ratios as described by the Banks Association of Turkey.**

Keywords - *Financial Performance Evaluation, Analytical Hierarchy Process (AHP), TOPSIS Method, Turkish Banking Sector, Multi Criteria Decision Making, Forecasting, Time Series Analysis*

1.   Introduction

The nature of forecasting revolves around future expectations. In the banking industry forecasts are inputs into the financial planning process, so that current resources can be utilized efficiently to achieve corporate objectives. Financial decisions within the banking industry have become increasingly complex, with a wide range of alternative sources and uses of funds, and a shifting emphasis away from safety toward high profit performance and growth. Accurate financial forecasting, focusing on both the economic environment and internal financial variables, has become a critical input into the decision-making process. Forecasting of financial process of a bank is a multi-faceted function that analyzes potential portfolio decisions over some planning horizon. This function would normally require the prediction of the future external economic environment facing the individual bank and internal financial variables. A bank's current financial position is the result of past decisions for acquiring deposits and funds from other sources and investing these funds in alternative investment opportunities, such as loans and bonds. A bank's current decisions on acquiring and investing funds

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will affect the bank's future financial position. These decisions should be the result of financial planning based on the bank's existing financial position and the expected external environment, with the expectation of meeting financial performance standards within the framework of management objectives. Initially, the forecasting function should be concerned with the economic variables relevant to the future external environment of the bank; i.e., the both the national and regional levels. Of primary concern are such factors as potential deposit levels, loan demand, and interest rates. Once a bank has a forecast of these variables for the planning horizon, the impact of the variables on the future financial position of the bank can be analyzed. For example, a forecast of strong economic growth may lead to expectations of rising deposit levels at financial institutions, increased loan demand, and an upward trend of most interest rates. Accurate forecasts of the specific variables impacting on the bank's portfolio then become crucial to the planning function and, ultimately, to management decisions. In the context of a banking framework, financial forecasting is most relevant to the interrelated concepts of: (1) assets and liability (balance sheet) management; and (2) profit planning. Balance sheet management is concerned with the simultaneous management of the asset, liability, and capital accounts of a bank as a portfolio for financial planning. Balance sheet management techniques typically have a time horizon of several years, but require review and revision on a regular basis. Profit planning (and control) is defined as a managerial process that produces formal plans to achieve desired goals and then measure the results achieved against them. From these points of view, the purpose of this study is to evaluate the financial performances of Turkish Banks during 2012-2015 by using forecasting methods and multi criteria decision techniques based on 2002-2011 data.

2.   Literature Review

In the literature, there are a large number of performance evaluation methods and researches. Stankeviciene and Mencaite (2012) used a multi-criteria decision making approach, particularly the AHP model to evaluate the performance of Lithuanian commercial banks. They created and described a system of indicators and assigned each indicator a different degree of significance taking into account the needs and priorities of both internal and external evaluators. They have concluded that the AHP model is appropriate for using it in the process valuating bank performance.

Ayadi et al. (1998) applied data envelopment analysis to 1991-1994 data on ten Nigerian banks to assess their relative efficiency. They discussed the consistency of the findings with other research and concluded on the root causes of Nigeria's banking problem like government interface, poor management, unprofessional practices etc.

Al-Nimer et al. (2012) provided a view of the present role of performance evaluation measures to identify the extent of usage of performance evaluation measures and examined the contingent variables in order to find out their effect upon the extent of usage in the Jordanian banks. Their results revealed that there is a lack of use of non-financial measures that are considered as contemporary management accounting practices and financial measures were considered as the highest practice being utilized.

Sayed and Sayed (2013) chose CAMELS (C - Capital Adequacy, A - Assets Quality, M - Management Efficiency, E - Earning Quality, L - Liquidity and S - Sensitivity to Market Risk) model which rates the performance of banks on five points scale for evaluating the performance and quality of Indian banks. Their analysis result shows that on an average Kotak Mahindra Bank stands at the top position.

Mamo Bekana and Abitie (2012) evaluated the financial performance of Construction and Business Bank (CBB) of Ethiopia. Their study emphasized on financial performance measurement ratios to evaluate the bank's financial performance. They concluded that some important financial ratios computed for analysis of the financial performance of the company are in a going up pattern excluding loan deposit ratio, assets turnover ratio and the long term debt to equity ratios.

Abbott et al. (2013) presented some measures of the performance of banks operating in Australia since the deregulation of the Australian financial system in early 1980s including the periods of financial market instability. They used standard financial indicators and applied Data Envelopment Analysis (DEA) to determine Malmquist indices of the levels of the changes in the efficiency and productivity of Australian banks. Obtained empirical results demonstrate the effect of deregulation and periodic financial crisis's on the

performance of individual banks, and the major part of the Australian banking sector.

Almazari (2011) measured the financial performance of seven selected Jordanian commercial banks for the period 2005-2009. The financial performance of banks was studied on the basis of financial variables and ratios. The research shown that banks with higher total deposits, credits, assets, and shareholders' equity do not always mean that has better profitability performance. It was also found that there exists a positive correlation between financial performance and asset size, asset utilization and operational efficiency.

Minh et al. (2013) estimated and compared efficiency performance of 32 commercial banks in Vietnam during 2001-2005 and identified possible factors determining such efficiency performance. Efficiency was measured by a DEA model and super-efficiency measure through a slacks-based model (SBM) under the assumption of variable returns to scale (VRS). They found that there were a small number of efficient banks and large banks do not guarantee high super efficiency scores in comparison with small banks.

Grigoroudis et al. (2013) presented a real-world study for measuring the relative efficiency of a set of bank branches using a DEA approach. They proposed a multistage DEA network model using a set of performance indicators that combine customer satisfaction, employee evaluation, and business performance indices. The found results estimate the contribution of the assessed performance indicators to the branch's overall efficiency, and determine potential improvement actions.

Bao et al. (2012) studied an improved hierarchical fuzzy TOPSIS model to combine the multilayer safety performance indicators into one overall index by incorporating experts' knowledge for a case study of a given set of European countries.

Pinter and Psunter (2013) discussed the overall success of a construction project as a multi-criterion problem and presented a new approach to it based on the multi-criteria decision method M-TOPSIS.

Sooreh et al. (2011) did a measurement and investigation using Importance-Performance Analysis (IPA) and TOPSIS methods to define and measure entrepreneurial universities in Iranian context. The result of the study is a set of building blocks of entrepreneurial universities, which include a number of prioritized variables.

Zavadskas et al. (2010) proposed an assessment model which covers method of TOPSIS, method with attributes values determined at intervals (TOPSIS-grey) and a new method of Simple Additive Weighting with Grey relations (SAW-G). A case study of the assessment of contractors' competitive ability was used to demonstrate the applicability and the effectiveness of the proposed approach. The results show that the methods of grey relations methodology can be implemented as an effective decision aid for tasks with uncertain data.

Yu and Hu (2010) developed an integrated multi criteria decision making approach that combines the voting method and the fuzzy TOPSIS method to evaluate the performance of multiple manufacturing plants in a fuzzy environment. They used voting to determine the appropriate criteria weights and used proposed approach to evaluate the performance of five chosen manufacturing plants.

Jajimoggala et al. (2011) considered supplier selection as a multi criteria decision problem and suggested a comprehensive decision method for identifying top suppliers. They proposed a hybrid model which incorporates the technique of Analytic Network Process (ANP) and TOPSIS. They illustrated the effectiveness and feasibility of the suggested model and identified the most potential supplier.

Nili et al. (2012) offered a new method for evaluating performance in production industries. Five large plants were selected as a sample and a method based on the Balance Score Card (BSC) system and TOPSIS technique was implemented in them. They found which indexes should be considered when evaluating performance in the chosen plants.

Pal and Choudhury (2009) suggested that customers distinguish four dimensions of service quality in the case of the retail banking industry in India, namely, customer-orientedness, competence, tangibles and convenience. They used TOPSIS to evaluate and ranking the relative performance of the banks across the service quality dimensions.

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Manian et al. (2011) constructed an approach based on the modified fuzzy TOPSIS and balanced scorecard (BSC) for evaluating an IT department in Tehran Province Gas Company. The BSC concept is applied to define the hierarchy with financial, customer, internal business process, and learning and growth perspectives and for each perspective, performance indicators are selected. By using a fuzzy TOPSIS approach, obtained results provided guidance to IT departments regarding strategies for improving department performance.

Marie et al. (2013) applied a parallel DEA model of operational-profitability and operational-quality indicators to the banking sector in Dubai. They made comparisons between the Islamic and the commercial banks within both models. They found that there are no statistical differences between the Islamic and the commercial banks in the operational-profitability model.

Forecasting techniques are important tools in operational management for creating realistic expectations. In literature many different techniques in the area of statistics and artificial intelligence were proposed for achieving close estimations.

Clements et al. (2004) study was about estimating, evaluating, and selecting among non-linear forecasting models for economic and financial time series. They suggested that careful application of existing techniques, and new models and tests, can result in significant advances in understanding.

3. Overview of Data

Annual time series data are used for the period 2002 to 2011. The sample period is dependent on annual data availability. The data was gathered from the publications of the Banks Association of Turkey. The sample includes 3 state banks (Ziraat Bank, Halk Bank and Vakıflar Bank); 9 private banks (Akbank; Anadolubank; Sekerbank; Tekstil Bank; Turkish Bank; Turk Ekonomi Bank; Garanti Bank; Is Bank and Yapı Kredi Bank) and 5 foreign banks (Denizbank; Eurobank Tekfen; Finans Bank; HSBC Bank and ING Bank). Financial ratios have been grouped as Capital Ratios, Balance Sheet Ratios, Assets Quality, Liquidity, Profitability, Income-Expenditure Structure, Share in Sector, Share in Group, Branch Ratios and Activity Ratios as described by the Banks Association of Turkey. Table 1 shows the hierarchical structure of model for financial performance:

Table 1: Hierarchical Structure of Model for Financial Performance

GOAL	CRITERIA	SUB CRITERIA
Performance Evaluation of Turkish Banks	CAPITAL RATIOS, %	Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)
		Shareholders' Equity / Total Assets
		(Shareholders' Equity-Permanent Assets) / Total Assets
		Shareholders' Equity / (Deposits + Non-Deposit Funds)
		On Balance-sheet FC Position / Shareholders' Equity
		Net on Balance-sheet Position / Total Shareholders' Equity
		N(on+off) Balance-sheet Position / Total Shareholders' Equity
	BALANCE SHEET RATIOS, %	TC Assets / Total Assets
		FC Assets / Total Assets
		TC Liabilities / Total Liabilities
		FC Liabilities / Total Liabilities
		FC Assets / FC Liabilities
		TC Deposits / Total Deposits
		TC Loans and Receivables / Total Loans and Receivables
		Total Deposits / Total Assets
		Funds Borrowed / Total Assets

Table 1: Hierarchical Structure of Model for Financial Performance (Continued)

GOAL	CRITERIA	SUB CRITERIA
Performance Evaluation of Turkis	ASSETS QUALITY, %	Financial Assets (Net) / Total Assets
		Total Loans and Receivables / Total Assets

		Total Loans and Receivables / Total Deposits
		Consumer Loans / Total Loans and Receivables
	LIQUIDITY, %	Liquid Assets / Total Assets
		Liquid Assets / Short-term Liabilities
		TC Liquid Assets / Total Assets
		Liquid Assets / (Deposits + Non-Deposit Funds)
		FC Liquid Assets / FC Liabilities
	PROFITABILITY, %	Net Profit (Losses) / Total Assets
		Net Profit (Losses) / Total Shareholders' Equity
		Income Before Taxes / Total Assets
		Net Profit (Losses) / Paid-in Capital
	INCOME-EXPENDITURE STRUCTURE, %	Net Interest Income After Specific Provisions / Total Assets
		Net Interest Income After Specific Provisions / Total Operating Income
		Non-Interest Income (Net) / Total Assets
		Non-Interest Income (Net) / Other Operating Expenses
		Interest Income / Interest Expense
		Total Income / Total Expense
		Interest Income / Total Assets
		Interest Income / Total Expenses
		Interest Expense / Total Expenses
	SHARE IN SECTOR, %	Total Assets
		Total Loans and Receivables
		Total Deposits
	SHARE IN GROUP, %	Total Assets
		Total Loans and Receivables
		Total Deposits
	BRANCH RATIOS, TRY MILLION	Total Assets / No. of Branches
		Total Deposits / No. of Branches
		TRY Deposits / No. of Branches
		FX Deposits / No. of Branches
		Total Loans and Receivables / No. of Branches
		Total Employees / No. of Branches (person)
		Net Income / No. of Branches
	ACTIVITY RATIOS	(Personnel Expenses + Reserve for Employee Termination Benefit) / Total Assets
		(Personnel Expenses + Reserve for Employee Termination Benefit) / Number of Personnel (Thousand TRY)
		Reserve for Employee Termination Benefit / Number of Personnel (Thousand TRY)
		Personnel Expenses / Other Operating Expenses
		Other Operating Expenses / Total Asset
		Total Operating Income / Total Assets

4. Multi Criteria Decision Making Techniques

AHP is an effective decision making method especially when subjectivity exists and it is very suitable to solve problems where the decision criteria can be organized in a hierarchical way into sub-criteria. The findings of previous studies about factors influencing performance of banks were first identified by literature review. Experts expressed or defined a ranking for the attributes in terms of importance/weights. Each experts is asked to fill

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''checked mark'' in the 9-point scale evaluation table. The AHP allows group decision making. One of the main advantages of the AHP method is the simple structure. The questionnaire is answered by financial expert. Financial expert is asked to compare the criteria at a given level on a pair-wise basis to identify their relative precedence.

4.1. Analytical Hierarchy Process

AHP was developed in the 1970s by Thomas Saaty is a multi-criteria decision making (MCDM) methodology. It has been used extensively for analyzing complex decisions. The approach can be used to help decision-makers for prioritizing alternatives and determining the optimal alternative using pair-wise comparison judgments (Liberatore and, Nydick, 1997, s. 595 ; Yoo and Choi s. 137, 2006). Weighting the criteria by multiple experts

avoids the bias decision making and provides impartiality (Dagdeviren, 2009).

The AHP is a selection process that consists of following steps (Saaty, 1990, 2008; Saaty and Vargas, 2001):

    1. Define the problem and determine the criteria. Factors and related sub factors must be correlated (Lee, 2012).
    2. Structure the decision hierarchy taking into account the goal of the decision.
    3. Construct a set of all judgments in a square comparison matrix in which the set of elements is compared with itself (size nxn) by using the fundamental scale of pair-wise comparison shown in Table 4. Assign the reciprocal value in the corresponding position in the matrix. Total number of comparison is n.(n-1)/2 (Lee, 2012).

Table 4. The fundamental scale of pair-wise comparison for AHP

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities have equal contribute to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another.
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong on demonstrated importance	An activity is favored very strongly over another
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	For compromise between the above values	Sometimes one needs to interpolate a compromise judgment numerically

    4. Use overall or global priorities obtained from weighted values for weighting process. For synthesis of priorities obtain the principal right eigenvector and largest eigenvalue.

$$Aw = \begin{bmatrix} 1 & w_1/w_2 & . & w_1/w_n \\ w_2/w_1 & 1 & . & w_2/w_n \\ . & . & . & . \\ w_n/w_1 & w_n/w_2 & . & 1 \end{bmatrix} \begin{bmatrix} w_1 \\ . \\ . \\ w_n \end{bmatrix} = nw \qquad (1)$$

$$a_{ij} = w_i / w_j, \qquad i,j = 1,2,....n \qquad (2)$$

$$Aw = \lambda_{max} w \qquad (3)$$

For measure consistency index (CI) adopt the value:

$$CI = (\lambda_{max} - n)/(n-1) \qquad (4)$$

Matrix $A=(a_{ij})$ is said to be consistent if $a_{ij}.a_{jk}=a_{ik}$ and its principal eigenvalue (λ_{max}) is equal to n.

The general eigenvalue formulation is:

Accept the estimate of w if the consistency ratio (CR) of CI that random matrix is significant small. If CR value is too high, then it means that experts' answers are not consistent (Lee, 2012; Saaty, 1980) . When CR value is less than 0.10 consistency of the comparisons is appropriate (Millet and Saaty, 2000; Lee, 2012). The CR is obtained by comparing the CI with an average random consistency index (RI).

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$$CR = \frac{CI}{RI} \qquad (5)$$

The following gives the average RI:

Table 5. Average RI values

n	3	4	5	6	7	8	9	10
RI	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1,49

4.2. Using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to rank the alternatives

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was first presented by Yoon (1980) and Hwang and Yoon (1981), for solving multiple criteria decision making (MCDM) problems based upon the concept that the chosen alternative should have the shortest Euclidian distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS). For instance, PIS maximizes the benefit and minimizes the cost, whereas the NIS maximizes the cost and minimizes the benefit. It assumes that each criterion require to be maximized or minimized. TOPSIS is a simple and useful technique for ranking a number of possible alternatives according to closeness to the ideal solution. Expanded developments of TOPSIS were done by Chen and Hwang in 1992, Lai, Liu and Hwang (1994). This MCDM technique is widely used in many fields, including financial performance evaluation, supplier selection, tourism destination evaluation, location selection, company evaluation, selecting the most suitable machine, ranking the carrier alternatives (Behzadian, 2012). One of the advantages of TOPSIS is that pair-wise comparisons are avoided. TOPSIS is conducted as follows (Tsaur, 2011).

Step 1. Establish a decision matrix for the ranking. TOPSIS uses all outcomes (x_{ij}) in a decision matrix to develop a compromise rank. The viable alternatives of the decision process are A_1, A_2,..., A_n. The structure of the decision matrix denoted by $X = (x_{ij})_{n \times m}$ can be expressed as follows:

$$
\begin{array}{c}
\quad m \quad Criteria \\
\begin{array}{cccccc}
C_1 & C_2 & \cdots & C_j & \cdots & C_m
\end{array} \\
X = \begin{bmatrix}
x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1m} \\
x_{21} & x_{22} & \cdots & x_{2j} & \cdots & x_{2m} \\
\vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\
x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{im} \\
\vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\
x_{n1} & x_{n2} & \cdots & x_{nj} & \cdots & x_{nm}
\end{bmatrix}
\begin{array}{l}
A_1 \\ A_2 \\ \vdots \\ A_i \\ \vdots \\ A_n
\end{array}
\end{array} \quad n \; Alternatives \qquad (6)
$$

x_{ij} is the outcome of ith alternative with respect to jth criteria. $W = (w_1, w_2, \ldots, w_j, \ldots, w_m)$ is the relative weight vector about the criteria, and w_j represents the weight of the jth attribute and $\sum_{j=1}^{m} w_j = 1$.

Step 2. Normalize the decision matrix using the following equation:

$$r_{ij} = \frac{w_{ij}}{\sqrt{\sum_{k=1}^{n} w_{ij}^2}} \quad \text{i=1,2,3,...,n} \quad \text{j=1,2,3,...,m} \qquad (7)$$

Step 3. Weighted normalized decision matrix is calculated by multiplying the normalized decision matrix by its associated weights as:

$$v_{ij} = w_j r_{ij} \qquad \text{i=1,2,3,...,n} \quad \text{j=1,2,3,...,m} \qquad (8)$$

Step 4. Identify the positive ideal solution (PIS) and negative ideal solution (NIS), respectively, as follows:

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$$PIS = A^* = \left\{ v_1^*, v_2^*, ..., v_m^* \right\}$$

$$= \left\{ \left(\max_i v_{ij} \mid j \in \Omega_b \right), \left(\min_i v_{ij} \mid j \in \Omega_c \right) \right\} \qquad (9)$$

$$NIS = A^- = \left\{ v_1^-, v_2^-, ..., v_m^- \right\}$$

$$= \left\{ \left(\min_i v_{ij} \mid j \in \Omega_b \right), \left(\max_i v_{ij} \mid j \in \Omega_c \right) \right\} \qquad (10)$$

Ω_b is associated with benefit criteria, and Ω_c is associated with cost criteria.

Step 5. Determine the Euclidean distance (separation measures) of each alternative from the ideal and negative-ideal solution as below respectively:

$$d_i^* = \sqrt{\sum_{j=1}^m \left(v_{ij} - v_j^* \right)^2} \ , \ \text{i=1,2,3,...,n} \qquad (11)$$

$$d_i^- = \sqrt{\sum_{j=1}^m \left(v_{ij} - v_j^- \right)^2} \ , \ \text{i=1,2,3,...,n} \qquad (12)$$

Step 6 Calculate the relative closeness of the ith alternative to ideal solution using the following equation:

$$RC_i = \frac{d_i^-}{d_i^* + d_i^-} \ \text{i=1,2,3,...,n} \ \ RC_i \in [0,1] \qquad (13)$$

Step 7. By comparing RC$_i$ values, the ranking of alternatives are determined. The higher the closeness means the better the rank. Ranked the alternatives starting from the value that closest to 1 and in decreasing order.

5.   Forecasting

In this study two different traditional time series methods including decomposition methods and smoothing methods were applied to the macro economic data for forecasting. The methods and regarding formulas are shown in this section. The notation of Orhunbilge (1999) is used to explain the time series methods.

5.1. Decomposition Methods

Decomposition methods are using for determining secular trend, seasonal variation, conjuncture (cyclical variation) and random fluctuation (irregular variation)

components in time series. It this study annual data was used. Therefore 3 important trend function including linear, quadratic and growth were mentioned in this part of this study.

5.1.1. Least Squares Method for Determining Trend

Least square method is one of the popular methods for determining trend. X is the time variable (year, month, etc.) in $y_t = f(x)$ function. If the the sum of the time series variable (X) is identified as zero the estimation values of model parameters can be shown as the following formulas. The trend of y_t can be determined by least squares method. It is not very easy to decide which function we should use as a trend. By trying several functions and finding minimum sum of squares of residuals, the suitable trend functions can be found.

$$\sum_{t=1}^n e_t^2 = \sum_{t=1}^n \left(y_t - y_t' \right)^2 \Rightarrow \min \qquad (14)$$

5.1.2. Linear Trend Function

The linear trend function is shown as below:

$$y = a + bx + e_t \qquad (15)$$

When the least squares method is applied the linear trend function, the equations below are obtained.

$$\sum_{t=1}^n e_t^2 = \sum_{t=1}^n \left(y_t - y_t' \right)^2 = \sum_{t=1}^n \left(y_t - a - bx \right)^2 \qquad (16)$$

For determining the minimum of this function the first level derivatives should be done regarding to a and b parameters.

$$\sum y_t = na + b \sum x \qquad (17)$$

$$\sum xy_t = a \sum x + b \sum x^2 \qquad (18)$$

By solving these equations the parameters a and b can be found as follows:

$$a = \frac{\sum y_t}{n} \qquad (19)$$

$$b = \frac{\sum xy_t}{\sum x^2} \qquad (20)$$

5.1.3. Quadratic Trend Function

If the observed data has a curved figure (in quadratic trend function the mean of the data is increasing first

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than start decreasing or reverse) than quadratic trend function can be used.

$$y = a + bx + cx^2 + e_t$$

$$\sum_{t=1}^{n} e_t^2 = \sum_{t=1}^{n} (y_t - y_t')^2 \qquad (21)$$
$$= \sum_{t=1}^{n} (y_t - a - bx - cx^2)^2 = 0$$

First order derivatives of the equation according to a, b and c parameters should be solved for writing the quadratic trend function with using least squares method. The equations below are the normal equations. Three unknown can be found by solving these three equations.

$$\sum y_t = na + b\sum x + c\sum x^2 \qquad (22)$$

$$\sum xy_t = a\sum x + b\sum x^2 + c\sum x^3 \qquad (23)$$

$$\sum x^2 y_t = a\sum x^2 + b\sum x^3 + c\sum x^4 \qquad (24)$$

$$b = \frac{\sum xy_t}{\sum x^2} \qquad (25)$$

5.1.4. Growth Trend Function

If the change of the y variable is nearly constant in time, growth trend function can be used for this kind of data. The growth trend function is shown below.

$$y_t = ab^x + e_t \qquad (26)$$

$$\sum_{t=1}^{n} e_t^2 = \sum_{t=1}^{n} (\log y_t - \log y_t')^2$$
$$\qquad (27)$$
$$= \sum_{t=1}^{n} (\log y_t - \log a - x\log b)^2 = 0$$

$$\sum \log y_t = n\log a + \log b \sum x \qquad (28)$$

$$\sum x \log y_t = \log a \sum x + \log b \sum x^2 \qquad (29)$$

$$\log a = \frac{\sum \log y_t}{n} \qquad (30)$$

$$\log b = \frac{\sum x \log y_t}{\sum x^2} \qquad (31)$$

$$\log y_t = \log a + x\log b \qquad (32)$$

5.2. Smoothing Methods

Random or/and coincidental fluctuations in weekly, monthly, seasonal or annual time series data can be removed or softened by smoothing methods. Six smoothing methods including single moving averages, Brown's simple exponential smoothing method, linear moving averages, Brown's linear exponential smoothing methods with single parameter, Holt's linear exponential smoothing with two parameters and Brown's quadratic exponential smoothing methods are mentioned in this part of the study (Orhunbilge, 1999).

5.2.1. Single Moving Averages

Estimation can be done by using arithmetic mean of number of certain (k) prior period of data. Single moving average method gives the same importance level to the past data for estimating future values.

$$y_{t+1}' = \frac{(y_t + y_{t-1} + \ldots + y_{t-k+1})}{k} \qquad (33)$$

$$y_{t+1}' = \frac{1}{k} \sum_{i=t-k+1}^{t} y_i \qquad (34)$$

$$y_{t+1}' = \frac{y_t}{k} - \frac{y_{t-k}}{k} + y_t' \qquad (35)$$

5.2.2. Brown's Simple Exponential Smoothing Method

It is a suitable method for time series that $y_1, y_2, \ldots, y_n$ has no significant trend or seasonal fluctuations. y_t' is the estimation value for the time t. y_{t-1} is the observation data for the time t-1. α is a smoothing constant. The constant α has the value between 0 and 1.

$$y_t' = \alpha y_{t-1} + (1-\alpha) y_{t-1}' \qquad (36)$$

$$y_t' = y_{t-1} + \alpha (y_{t-1} - y_{t-1}') \qquad (37)$$

$$y_t' = y_{t-1}' + \alpha e_t \qquad (38)$$

5.2.3. Brown's Simple Exponential Smoothing Method

When moving averages method is applied the data which has a significant trend, estimations are always remains lower than actual values. To deal with this situation "Linear Moving Averages" method was

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developed. The main idea of this method is the calculation of second moving average.

$$y_t' = \frac{y_t + y_{t-1} + y_{t-2} + \ldots + y_{t-k+1}}{k} \qquad (39)$$

$$y_t'' = \frac{y_t' + y_{t-1}' + y_{t-2}' + \ldots + y_{t-k+1}'}{k} \qquad (40)$$

$$a_t = y_t' + (y' - y_t'') = 2y_t' - y_t'' \qquad (41)$$

$$b_t = \frac{2}{k-1}(y_t' - y_t'') \qquad (42)$$

$$\hat{y}_{t+m} = a_t + b_t m \qquad (43)$$

The coefficient "m" is the forecast period to be estimated.

5.2.4. Brown's Linear Exponential Smoothing Method with Single Parameter

Brown's Linear Exponential Smoothing Method with single parameter has some similarities with linear moving averages method. But the difference between first and second smoothing values is added into the first smoothing value.

$$y_t' = \alpha y_t + (1-\alpha) y_{t-1}' \qquad (44)$$

$$y_t'' = \alpha y_t' + (1-\alpha) y_{t-1}'' \qquad (45)$$

$$a_t = y_t' + (y_t' - y_t'') = 2y_t' - y_t'' \qquad (46)$$

$$b_t = \frac{\alpha}{1-\alpha}(y_t' - y_t'') \qquad (47)$$

$$\hat{y}_{t+m} = a_t + b_t m \qquad (48)$$

5.2.5. Holt's Linear Exponential Smoothing Method with Two Parameter

It seems similar to previous method (Brown's Linear Exponential Smoothing Method with Single Parameter). But in Holt's Linear Exponential Smoothing Method second smoothing is not used. Trend values are smoothed directly. This adds flexibility into the method. The parameters α and γ have the values between 0 and 1.

$$y_t' = \alpha y_t + (1-\alpha)(y_{t-1}' + b_{t-1}) \qquad (49)$$

$$b_t = \gamma(y_t' - y_{t-1}') + (1-\gamma)b_{t-1} \qquad (50)$$

$$\hat{y}_{t+m} = y_t' - b_t m \qquad (51)$$

The parameters α and γ are the smoothing constants. These parameters should be optimized for minimizing the sum of error squares.

5.2.6. Brown's Quadratic Exponential Smoothing Method

When the time series are curved shape (quadratic, third order or more) Brown's quadratic exponential smoothing technique is suitable for estimation. Third parameter is added to the model. The equations for quadratic exponential smoothing are below:

$$y_t' = \alpha y_t + (1-\alpha) y_{t-1}' \qquad (52)$$

$$y_t'' = \alpha y_t' + (1-\alpha) y_{t-1}'' \qquad (53)$$

$$y_t''' = \alpha y_t'' + (1-\alpha) y_{t-1}''' \qquad (54)$$

$$a_t = 3y_t' - 3y_t'' + y_t''' \qquad (55)$$

$$b_t = \frac{\alpha}{2(1-\alpha)^2} \qquad (56)$$
$$[(6-5\alpha)y_t' - (10-8\alpha)y_t'' + (4-3\alpha)y_t''']$$

$$c_t = \frac{\alpha^2}{(1-\alpha)^2}(y_t' - 2y_t'' + y_t''') \qquad (57)$$

Estimation equation can be shown as below:

$$\hat{y}_{t+m} = a_t + b_t m + \frac{1}{2}c_t m^2 \qquad (58)$$

The selection of the α coefficient can be done as the selection in previous methods.

6. Combining Forecasting and Multi Criteria Decision Making Techniques to Determine the Rank of Alternatives

In analyzing the data, Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methodologies

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are used for the outranking of Bank alternatives. Fig. 2 shows the steps of the proposed method. To apply proposed method financial performance evaluation problem was solved. In this financial performance evaluation there are 10 main criteria, 57 sub-criteria and 17 alternatives. The hierarchical structure to select the best performing bank is shown in Table 3. An interview was performed with the financial expert in order to identify weight coefficients. Past experience and the back-ground of the financial expert are utilized in the determination of the criteria and 10 main, 57 sub-criteria to be used for bank evaluation are established. The outputs of the AHP are determined as the input of TOPSIS method. Performance evaluation plays a major role in planning and it is an essential analytical tool in banks' financial strategies. In this content, the primary purpose of this

research is to evaluate the financial performances of Turkish Banks. Annual time series data are used for the period 2002 to 2011. The sample period is dependent on annual data availability. The data was gathered from the publications of the Banks Association of Turkey. The sample includes 3 state banks (Ziraat Bank, Halk Bank and Vakıflar Bank); 9 private banks (Akbank; Anadolubank; Sekerbank; Tekstil Bank; Turkish Bank; Turk Ekonomi Bank; Garanti Bank; Is Bank and Yapı Kredi Bank) and 5 foreign banks (Denizbank; Eurobank Tekfen; Finans Bank; HSBC Bank and ING Bank). Financial ratios have been grouped as Capital Ratios, Balance Sheet Ratios, Assets Quality, Liquidity, Profitability, Income-Expenditure Structure, Share in Sector, Share in Group, Branch Ratios and Activity Ratios as described by the Banks Association of Turkey.

Figure 1. Steps of proposed method

As a result, 10 main criteria were used in evaluation and decision hierarchy is established accordingly. Decision hierarchy structured with the determined

banks and criteria is provided in Table 3. There are four levels in the decision hierarchy structured for bank performance evaluation problem. The overall

goal of the decision process is ''performance evaluation of selected banks in Turkey'' in the first level of the hierarchy. The main financial ratios are on the second level, sub-ratios are on the third level and alternative banks are on the fourth level of the hierarchy. After forming the decision hierarchy for the problem, the weights of the criteria to be used in evaluation process are calculated by using AHP method. In this phase, the financial expert is given the task of forming individual pairwise comparison matrix by using the Saaty's 1-9 scale.

Table 6. The pairwise comparison matrix main financial ratios

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	**1.00**	6.00	3.00	4.00	2.00	5.00	8.00	9.00	7.00	6.00
C2	0.17	**1.00**	0.25	0.33	0.20	0.50	4.00	5.00	3.00	2.00
C3	0.33	4.00	**1.00**	2.00	0.50	3.00	6.00	7.00	5.00	4.00
C4	0.25	3.00	0.50	**1.00**	0.50	2.00	6.00	7.00	5.00	4.00
C5	0.50	5.00	2.00	2.00	**1.00**	4.00	7.00	9.00	7.00	6.00
C6	0.20	2.00	0.33	0.50	0.25	**1.00**	5.00	6.00	4.00	3.00
C7	0.13	0.25	0.17	0.17	0.14	0.20	**1.00**	2.00	0.50	0.33
C8	0.11	0.20	0.14	0.14	0.11	0.17	0.50	**1.00**	0.33	0.25
C9	0.14	0.33	0.20	0.20	0.14	0.25	2.00	3.00	**1.00**	0.50
C10	0.17	0.50	0.25	0.25	0.17	0.33	3.00	4.00	2.00	**1.00**

Financial expert's choice values (Table 6) are calculated to form the pairwise comparison matrix (Table 7). The results obtained from the calculations based on the pairwise comparison matrix provided in Table 6, are presented in Table 7.
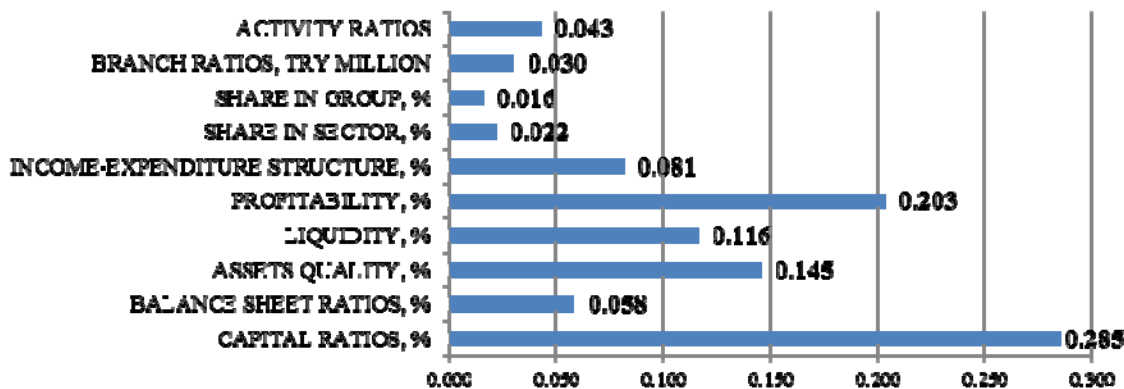
Figure 2. Resulting weights of main financial ratios obtained with AHP

Net Profit (Losses) / Total Assets (PROFITABILITY) (0,1057), Shareholders' Equity / Total Assets (CAPITAL RATIOS) (0,1020), Consumer Loans / Total Loans and Receivables (ASSETS QUALITY) (0,0763), Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk) (CAPITAL RATIOS) (0,0736) and Net Profit (Losses) / Total Shareholders' Equity (PROFITABILITY) (0,0583) are determined as the five most important financial ratios for the performance of the banks by AHP.

FX Deposits / No. of Branches (BRANCH RATIOS) (0,0010), FC Assets / FC Liabilities (BALANCE SHEET RATIOS) (0,0011), TRY Deposits / No. of Branches (BRANCH RATIOS) (0,0014), FC Liabilities / Total Liabilities (BALANCE SHEET RATIOS) (0,0014) and Non-Interest Income (Net) / Other Operating Expenses (INCOME-EXPENDITURE STRUCTURE) (0,0016) are determined as the five least important financial ratios for the performance of the banks by AHP.

Table7. Results of main criteria obtained by AHP

Criteria	Weights	λmax, CI, RI	CR

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CAPITAL RATIOS, %	0.285		
BALANCE SHEET RATIOS, %	0.058		
ASSETS QUALITY, %	0.145		
LIQUIDITY, %	0.116	λmax = 10.59	
PROFITABILITY, %	0.203	CI = 0.0652	0.044
INCOME-EXPENDITURE STRUCTURE, %	0.081	RI = 1.49	
SHARE IN SECTOR, %	0.022		
SHARE IN GROUP, %	0.016		
BRANCH RATIOS, TRY MILLION	0.030		
ACTIVITY RATIOS	0.043		

Consistency ratios of the expert's pairwise comparison matrixes are calculated as 0,044 (Main Financial Ratios), 0,027 (CAPITAL RATIOS), 0,038 (BALANCE SHEET RATIOS), 0,045 (ASSETS QUALITY), 0,042 (LIQUIDITY), 0,064 (PROFITABILITY), 0,037 (INCOME-EXPENDITURE STRUCTURE), 0,008 (SHARE IN SECTOR), 0,008 (SHARE IN GROUP), 0,025 (BRANCH RATIOS) and 0,020 (ACTIVITY RATIOS). They all are less than 0.1. So the weights are shown to be consistent and they are used in the financial performance evaluation. The most important criterion is "Net Profit (Losses) / Total Assets" (0.1057) and the least important criterion is "FX Deposits / No. of Branches" (0.0010).

Table 8. Global weights obtained by AHP

Rank	FINANCIAL RATIOS	SUB RATIOS	Global Weights
1	PROFITABILITY, %	Net Profit (Losses) / Total Assets	0.1057
2	CAPITAL RATIOS, %	Shareholders' Equity / Total Assets	0.1020
3	ASSETS QUALITY, %	Consumer Loans / Total Loans and Reciv.	0.0763
4	CAPITAL RATIOS, %	Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)	0.0736
5	PROFITABILITY, %	Net Profit (Losses) / Total Shareholders' Equity	0.0583
6	LIQUIDITY, %	Liquid Assets / Total Assets	0.0494
7	CAPITAL RATIOS, %	(Shareholders' Equity-Permanent Assets) / Total Assets	0.0449
8	ASSETS QUALITY, %	Total Loans and Receivables / Total Deposits	0.0448
9	PROFITABILITY, %	Net Profit (Losses) / Paid-in Capital	0.0293
10	CAPITAL RATIOS, %	Net on Balance-sheet Position / Total Shareholders' Equity	0.0289
11	LIQUIDITY, %	Liquid Assets / Short-term Liabilities	0.0286
12	INCOME-EXPENDITURE STRUCTURE, %	Interest Income / Total Assets	0.0248
13	LIQUIDITY, %	Liquid Assets / (Deposits + Non-Deposit Funds)	0.0217
14	CAPITAL RATIOS, %	Shareholders' Equity / (Deposits + Non-Deposit Funds)	0.0180
15	BALANCE SHEET RATIOS, %	TC Assets / Total Assets	0.0176
16	INCOME-EXPENDITURE STRUCTURE, %	Interest Income / Total Expenses	0.0176
17	ACTIVITY RATIOS	Total Operating Income / Total Assets	0.0162
18	ASSETS QUALITY, %	Financial Assets (Net) / Total Assets	0.0160
19	BALANCE SHEET RATIOS, %	Total Deposits / Total Assets	0.0128
20	INCOME-EXPENDITURE STRUCTURE, %	Total Income / Total Expense	0.0123
21	SHARE IN SECTOR, %	Total Deposits (SHARE IN SECTOR, %)	0.0118
22	LIQUIDITY, %	TC Liquid Assets / Total Assets	0.0107
23	ACTIVITY RATIOS	Personnel Expenses / Other Operating Expenses	0.0106
24	BRANCH RATIOS, TRY MILLION	Net Income / No. of Branches	0.0106
25	CAPITAL RATIOS, %	On Balance-sheet FC Position / Shareholders' Equity	0.0103
26	PROFITABILITY, %	Income Before Taxes / Total Assets	0.0101
27	BALANCE SHEET RATIOS, %	TC Deposits / Total Deposits	0.0095
28	INCOME-EXPENDITURE STRUCTURE, %	Interest Expense / Total Expenses	0.0090
29	SHARE IN GROUP, %	Total Deposits (SHARE IN GROUP, %)	0.0086
30	ASSETS QUALITY, %	Total Loans and Receivables / Total Assets	0.0083

Table 8. Global weights obtained by AHP (Continued)

Rank	FINANCIAL RATIOS	SUB RATIOS	Global Weights
31	BRANCH RATIOS, TRY MILLION	Total Deposits / No. of Branches	0.0072
32	CAPITAL RATIOS, %	N(on+off) Balance-sheet Position / Total Shareholders' Equity	0.0070
33	ACTIVITY RATIOS	(Personnel Expenses + Reserve for Employee Termination Benefit) / Total Assets	0.0069
34	SHARE IN SECTOR, %	Total Assets (SHARE IN SECTOR, %)	0.0065
35	BALANCE SHEET RATIOS, %	TC Liabilities / Total Liabilities	0.0065
36	INCOME-EXPENDITURE STRUCTURE, %	Interest Income / Interest Expense	0.0063
37	LIQUIDITY, %	FC Liquid Assets / FC Liabilities	0.0057
38	BRANCH RATIOS, TRY MILLION	Total Assets / No. of Branches	0.0048
39	SHARE IN GROUP, %	Total Assets (SHARE IN GROUP, %)	0.0047
40	INCOME-EXPENDITURE STRUCTURE, %	Net Interest Income After Specific Provisions / Total Assets	0.0044
41	ACTIVITY RATIOS	(Personnel Expenses + Reserve for Employee Termination Benefit) / Number of Personnel (Thousand TRY)	0.0044
42	BALANCE SHEET RATIOS, %	TC Loans and Receivables / Total Loans and Receivables	0.0043
43	SHARE IN SECTOR, %	Total Loans and Receivables (SHARE IN SECTOR, %)	0.0036
44	INCOME-EXPENDITURE STRUCTURE, %	Non-Interest Income (Net) / Total Assets	0.0032
45	BRANCH RATIOS, TRY MILLION	Total Loans and Receivables / No. of Branches	0.0032
46	BALANCE SHEET RATIOS, %	Funds Borrowed / Total Assets	0.0030
47	ACTIVITY RATIOS	Other Operating Expenses / Total Asset	0.0028
48	SHARE IN GROUP, %	Total Loans and Receivables (SHARE IN GROUP, %)	0.0026
49	INCOME-EXPENDITURE STRUCTURE, %	Net Interest Income After Specific Provisions / Total Operating Income	0.0022
50	BRANCH RATIOS, TRY MILLION	Total Employees / No. of Branches (person)	0.0021
51	BALANCE SHEET RATIOS, %	FC Assets / Total Assets	0.0020
52	ACTIVITY RATIOS	Reserve for Employee Termination Benefit / Number of Personnel (Thousand TRY)	0.0019
53	INCOME-EXPENDITURE STRUCTURE, %	Non-Interest Income (Net) / Other Operating Expenses	0.0016
54	BALANCE SHEET RATIOS, %	FC Liabilities / Total Liabilities	0.0014
55	BRANCH RATIOS, TRY MILLION	TRY Deposits / No. of Branches	0.0014
56	BALANCE SHEET RATIOS, %	FC Assets / FC Liabilities	0.0011
57	BRANCH RATIOS, TRY MILLION	FX Deposits / No. of Branches	0.0010

Table 9. Input values sample of the TOPSIS analysis for the year 2011

Weights	0.0736	0.1020	...	0.0106	0.0028	0.0162
RATIOS BANKS	Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)	Shareholders' Equity / Total Assets	…	Personnel Expenses / Other Operating Expenses	Other Operating Expenses / Total Asset	Total Operating Income / Total Assets
Ziraat Bank	15.61	8.20	…	50.06	1.63	3.86
Halk Bank	14.30	9.48	…	42.42	1.89	5.54
Vakıflar Bank	13.38	10.43	…	42.96	2.18	4.96
Akbank	16.98	13.14	…	39.45	1.82	4.56
Anadolubank	16.96	14.54	…	66.78	3.23	5.81
Sekerbank	13.24	10.15	…	41.73	3.80	6.09
Tekstil Bank	15.86	14.75	…	60.07	2.78	4.22
Turkish Bank	32.09	17.10	…	53.24	3.38	3.73
Turk Ekonomi	14.23	11.06	…	41.99	3.62	4.71
Garanti Bank	16.89	11.99	…	38.93	2.19	5.41
Is Bank	14.07	11.09	…	52.26	2.15	5.05
Yapı Kredi Bank	14.69	10.82	…	42.31	2.49	5.39
Denizbank	15.65	10.98	…	48.92	3.40	6.37
Eurobank Tekfen	16.94	12.77	…	50.41	2.98	4.26
Finans Bank	17.18	12.33	…	43.43	3.41	6.49
HSBC Bank	16.14	11.58	…	42.32	4.36	6.36
ING Bank	14.19	11.21	…	46.34	3.99	5.22

Finally, TOPSIS method is applied to rank the banks. The priority weights of banks with respect to criteria, calculated by AHP and shown in Table 8, can be used as input of TOPSIS (Table 9). The weighted normalized decision matrix can be seen from Table 10.

Table 10. Weighted evaluation for the bank evaluation for the year 2011

BANKS	RATIOS	Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)	Shareholders' Equity / Total Assets	…	Personnel Expenses / Other Operating Expenses	Other Operating Expenses / Total Asset	Total Operating Income / Total Assets
Ziraat Bank		0.01650	0.01685	…	0.00270	0.00037	0.00290
Halk Bank		0.01511	0.01948	…	0.00229	0.00043	0.00416
Vakıflar Bank		0.01414	0.02142	…	0.00232	0.00049	0.00372
Akbank		0.01795	0.02700	…	0.00213	0.00041	0.00341
Anadolubank		0.01793	0.02987	…	0.00360	0.00073	0.00435
Sekerbank		0.01399	0.02086	…	0.00225	0.00086	0.00456
Tekstil Bank		0.01676	0.03031	…	0.00324	0.00063	0.00316
Turkish Bank		0.03391	0.03513	…	0.00287	0.00076	0.00279
Turk Ekonomi Bank		0.01504	0.02272	…	0.00226	0.00082	0.00353
Garanti Bank		0.01785	0.02462	…	0.00210	0.00049	0.00406
Is Bank		0.01487	0.02277	…	0.00282	0.00049	0.00378
Yapı Kredi Bank		0.01553	0.02224	…	0.00228	0.00056	0.00404
Denizbank		0.01654	0.02256	…	0.00264	0.00077	0.00477
Eurobank Tekfen		0.01791	0.02624	…	0.00272	0.00067	0.00319
Finans Bank		0.01816	0.02533	…	0.00234	0.00077	0.00487
HSBC Bank		0.01706	0.02380	…	0.00228	0.00098	0.00477
ING Bank		0.01500	0.02302	…	0.00250	0.00090	0.00391
Min or Max		+	+	…	-	-	+
A^*		0.03391	0.03513	…	0.00210	0.00037	0.00487
A^-		0.01399	0.01685	…	0.00360	0.00098	0.00279

By using TOPSIS method, the ranking of banks are calculated. Table 11 shows the evaluation results and final ranking of banks.

Table 11. TOPSIS results for the year 2011

Banks	d_i^*	d_i^-	RC_i
Ziraat Bank	0.041	0.041	**0.500**
Halk Bank	0.040	0.053	**0.568**
Vakıflar Bank	0.043	0.039	**0.477**
Akbank	0.036	0.044	**0.551**
Anadolubank	0.047	0.035	**0.430**
Sekerbank	0.055	0.026	**0.315**
Tekstil Bank	0.058	0.025	**0.297**
Turkish Bank	0.064	0.036	**0.361**
Turk Ekonomi Bank	0.056	0.025	**0.309**
Garanti Bank	0.033	0.050	**0.601**
Is Bank	0.041	0.041	**0.496**
Yapı Kredi Bank	0.043	0.041	**0.487**
Denizbank	0.037	0.055	**0.600**
Eurobank Tekfen	0.057	0.030	**0.347**
Finans Bank	0.038	0.051	**0.575**
HSBC Bank	0.047	0.036	**0.429**
ING Bank	0.060	0.025	**0.293**

Depends on the RCj values (Table 12), the ranking of the alternatives from top to bottom order are Garanti Bank, Denizbank, Finans Bank, Halk Bank, Akbank, Ziraat Bank, Is Bank, Yapı Kredi Bank, Vakıflar Bank, Anadolubank, HSBC Bank, Turkish Bank, Eurobank Tekfen, Sekerbank, Turk Ekonomi Bank, Tekstil Bank and ING Bank. Proposed model results show that Garanti Bank is the best performing bank for the year 2011 with RC value of 0.601.

Table 12. Performance ranking for the year 2011

RANK	BANK	RCi*
1	Garanti Bank	0.601
2	Denizbank	0.600
3	Finans Bank	0.575
4	Halk Bank	0.568
5	Akbank	0.551
6	Ziraat Bank	0.500
7	Is Bank	0.496
8	Yapı Kredi Bank	0.487
9	Vakıflar Bank	0.477
10	Anadolubank	0.430
11	HSBC Bank	0.429

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12	*Turkish Bank*	*0.361*
13	*Eurobank Tekfen*	*0.347*
14	*Sekerbank*	*0.315*
15	*Turk Ekonomi Bank*	*0.309*
16	*Tekstil Bank*	*0.297*
17	*ING Bank*	*0.293*

Depends on the RCj values (Appendix: Table 12-Table 14), the rankings of the alternatives for the years 2002-2011 are shown on Table 13.

Proposed model results show that Akbank is the best performing bank during the years 2007-2011 and 2009-2011 (Table 14).

Table 13. Performance ranking for the years 2002-2011

BANK	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Akbank	4	**1**	**1**	3	3	2	5	**1**	**1**	5
Anadolubank	13	17	9	13	13	9	**2**	6	8	10
Denizbank	15	9	11	9	6	11	12	8	11	**2**
Eurobank Tekfen	7	15	14	15	17	17	17	17	17	13
Finans Bank	8	6	10	10	**2**	8	11	4	**2**	**3**
Garanti Bank	16	14	12	7	9	**3**	4	**3**	**3**	**1**
Halk Bank	**2**	4	5	8	5	5	8	9	5	4
HSBC Bank	**3**	**2**	4	**2**	4	4	**1**	5	9	11
ING Bank	12	10	7	4	14	14	15	13	15	17
Is Bank	11	7	8	6	10	6	6	7	6	7
Sekerbank	17	11	6	11	11	10	13	12	13	14
Tekstil Bank	5	16	17	16	16	15	16	15	14	16
Turk Ekonomi Bank	14	12	16	14	15	16	14	14	12	15
Turkish Bank	6	5	13	12	8	13	7	16	16	12
Vakıflar Bank	10	8	**3**	5	7	7	10	11	10	9
Yapı Kredi Bank	**1**	13	15	17	12	12	9	10	7	8
Ziraat Bank	9	**3**	**2**	**1**	**1**	**1**	**3**	**2**	4	6

Table 14. Performance ranking for the years 2007-2011 (5 years) and 2009-2011 (3 years)

Top Performing Banks During 2007-2011			Top Performing Banks During 2009-2011		
Rank	Bank	Average	Rank	Bank	Average
1	Akbank	2.8	1	Akbank	2.33
2	Garanti Bank	2.8	2	Garanti Bank	2.33
3	Ziraat Bank	3.2	3	Finans Bank	3
4	Finans Bank	5.6	4	Ziraat Bank	4
5	HSBC Bank	6	5	Halk Bank	6
6	Halk Bank	6.2	6	Is Bank	6.67
7	Is Bank	6.4	7	Denizbank	7
8	Anadolubank	7	8	Anadolubank	8
9	Denizbank	8.8	9	HSBC Bank	8.33
10	Yapı Kredi Bank	9.2	10	Yapı Kredi Bank	8.33
11	Vakıflar Bank	9.4	11	Vakıflar Bank	10
12	Sekerbank	12.4	12	Sekerbank	13
13	Turkish Bank	12.8	13	Turk Ekonomi Bank	13.67
14	Turk Ekonomi Bank	14.2	14	Turkish Bank	14.67
15	ING Bank	14.8	15	ING Bank	15
16	Tekstil Bank	15.2	16	Tekstil Bank	15
17	Eurobank Tekfen	16.2	17	Eurobank Tekfen	15.67

7. Concluding Remarks

The operations of individual banks are roughly similar throughout the world; they acquire, use and manage funds to make a profit. In all countries, banks are financial intermediaries in the business of earning profits and the efficiency of banks can affect the stability of the financial market and thus the effectiveness of the whole monetary system. Turkish Banking Sector has changed drastically after the financial crisis. The impact of 2000 and 2001 crises on financial system especially on the Turkish Banking sector was extensive. As mentioned, social and economic reforms have been introduced in many areas after the crises that includes restructuring of the state banks, restructuring of private banks, enhancement of supervision and audit of banking system and new legal arrangements and resolution of non-performing loans. From the view of these transforming activities, performance evaluation plays a major role in planning and it is an essential analytical tool in banks' financial strategies. In this content, the primary purpose of this research is to evaluate the financial performances of Turkish Banks for the period 2002 to 2011.

This research proposes a financial performance evaluation model for banks that includes the consideration of financial ratios. This model is then applied to a case study for the financial performance evaluation of 3 state banks (Ziraat Bank, Halk Bank and Vakıflar Bank); 9 private banks (Akbank; Anadolubank; Sekerbank; Tekstil Bank; Turkish Bank; Turk Ekonomi Bank; Garanti Bank; Is Bank and Yapı Kredi Bank) and 5 foreign banks (Denizbank; Eurobank Tekfen; Finans Bank; HSBC Bank and ING Bank) in Turkey. Total performance of bank is divided into ten groups including Capital Ratios, Balance Sheet Ratios, Assets Quality, Liquidity, Profitability, Income-Expenditure Structure, Share in Sector, Share in Group, Branch Ratios and Activity Ratios as described by the Banks Association of Turkey. After AHP analysis most important ratios are found. Net Profit (Losses) / Total Assets (Profitability) (0,1057), Shareholders' Equity / Total Assets (Capital Ratios) (0,1020), Consumer Loans / Total Loans and Reciv. (Assets Quality) (0,0763), Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk) (Capital Ratios) (0,0736) and Net Profit (Losses) / Total Shareholders' Equity (Profitability) (0,0583) are determined as the five most important financial ratios

for the performance of the banks by AHP. Finally, TOPSIS method is applied to rank the banks.

Our model shows that Akbank is the best performing bank during the years 2007-2011 and 2009-2011. On the other hand, critical changes happened for Garanti Bank throughout years; it performs better than the others and has the highest rank in 2011, whereas it has the just before last rank (16th) after the 2001 financial crisis.

Forecasting techniques are important tools in operational management for creating realistic expectations. In literature many different techniques in the area of statistics were proposed for achieving close estimations. This paper also shows evaluation of the financial performance of banks combining traditional forecasting techniques and multi criteria decision making methods. Forecasting models are applied the financial data of Turkish Banks during 2012-2015 based on 2002-2011 data. Results indicates that Garanti Bank continue being leader and Ziraat Bank and Denizbank will follow Garanti Bank during years 2012-2015.

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APPENDIX

Table 1. Results of capital ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational	0.259		
Shareholders' Equity / Total Assets	0.358		
(Shareholders' Equity-Permanent Assets) / Total Assets	0.158	λmax = 7.22	
Shareholders' Equity / (Deposits + Non-Deposit Funds)	0.063	CI = 0.0363	0.027
On Balance-sheet FC Position / Shareholders' Equity	0.036	RI = 1.32	
Net on Balance-sheet Position / Total Shareholders' Equity	0.101		
N(on+off) Balance-sheet Position / Total Shareholders' Equity	0.024		

Table 2. Results of balance sheet ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
TC Assets / Total Assets	0,285		
FC Assets / Total Assets	0,058		
TC Liabilities / Total Liabilities	0,145		
FC Liabilities / Total Liabilities	0,116	λmax = 9,44	
FC Assets / FC Liabilities	0,203	CI = 0.055	0,038
TC Deposits / Total Deposits	0,081	RI = 1.45	
TC Loans and Receivables / Total Loans and Receivables	0,022		
Total Deposits / Total Assets	0,016		
Funds Borrowed / Total Assets	0,030		

Table 3. Results of assets quality ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Financial Assets (Net) / Total Assets	0,110		
Total Loans and Receivables / Total Assets	0,057	λmax = 4,12	
Total Loans and Receivables / Total Deposits	0,308	CI = 0.041	0,045
Consumer Loans / Total Loans and Reciv.	0,525	RI = 0,9	

Table 4. Results of liquidity ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Liquid Assets / Total Assets	0,425		
Liquid Assets / Short-term Liabilities	0,246	λmax = 5,19	
TC Liquid Assets / Total Assets	0,093	CI = 0.047	0,042
Liquid Assets / (Deposits + Non-Deposit Funds)	0,187	RI = 1,12	
FC Liquid Assets / FC Liabilities	0,049		

Table 5. Results of profitability ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Net Profit (Losses) / Total Assets	0,520		
Net Profit (Losses) / Total Shareholders' Equity	0,287	λmax = 4,17	0,064
Income Before Taxes / Total Assets	0,050	CI = 0.057	
Net Profit (Losses) / Paid-in Capital	0,144	RI = 0,9	

Table 6. Results of income-expenditure structure ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Net Interest Income After Specific Provisions / Total Assets	0,054		
Net Interest Income After Specific Provisions / Total Operating	0,027		
Non-Interest Income (Net) / Total Assets	0,039		
Non-Interest Income (Net) / Other Operating Expenses	0,019	λmax = 9,44	
Interest Income / Interest Expense	0,078	CI = 0.054	0,037
Total Income / Total Expense	0,151	RI = 1.45	
Interest Income / Total Assets	0,305		
Interest Income / Total Expenses	0,216		
Interest Expense / Total Expenses	0,111		

Table 7. Results of share in sector ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Total Assets	0,297	λmax = 3,01	
Total Loans and Receivables	0,164	CI = 0.005	0,008
Total Deposits	0,539	RI = 0,58	

Table 8. Results of share in group ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Total Assets	0,297	λmax = 3,01	
Total Loans and Receivables	0,164	CI = 0.005	0,008
Total Deposits	0,539	RI = 0,58	

Table 9. Results of branch ratios obtained by AHP

Criteria	Weights	λmax, CI, RI	CR
Total Assets / No. of Branches	0,159		
Total Deposits / No. of Branches	0,237		
TRY Deposits / No. of Branches	0,046	λmax = 7.20	
FX Deposits / No. of Branches	0,032	CI = 0.033	0,025
Total Loans and Receivables / No. of Branches	0,106	RI = 1.32	
Total Employees / No. of Branches (person)	0,070		
Net Income / No. of Branches	0,350		

Table 10. Results of activity ratios obtained by AHP

| Criteria	Weights	λmax, CI, RI	CR
(Personnel Expenses + Reserve for Employee Termination Benefit) / Total Assets	0,160		
(Personnel Expenses + Reserve for Employee Termination Benefit) / Number of Personnel (Thousand TRY)	0,102		
Reserve for Employee Termination Benefit / Number of Personnel (Thousand TRY)	0,043	λmax = 6,12	0,020
Personnel Expenses / Other Operating Expenses	0,249	CI = 0.025	
Other Operating Expenses / Total Asset	0,065	RI = 1,24	
Total Operating Income / Total Assets	0,379		

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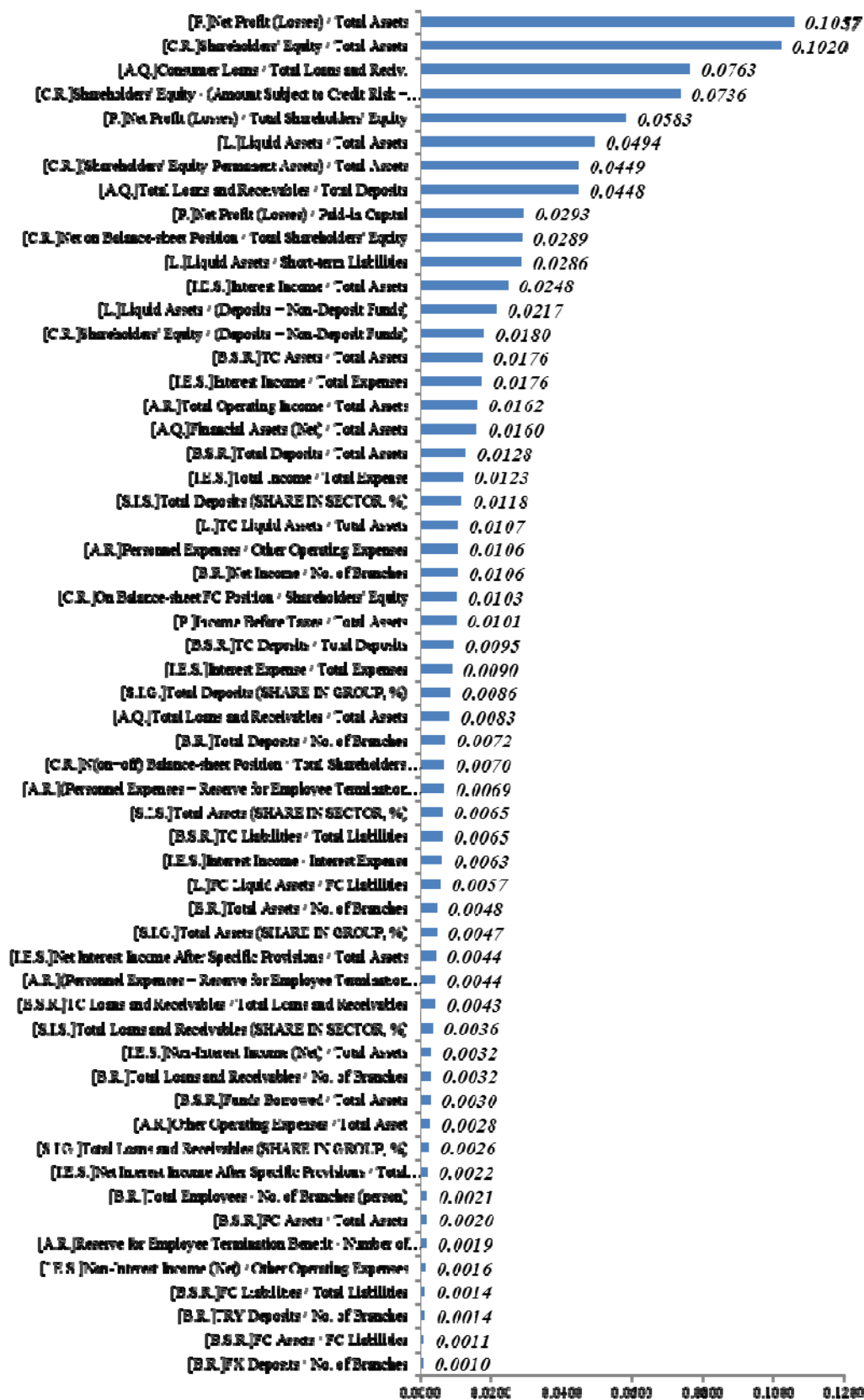
Figure 1. Weights of financial ratios

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Table 11. Local and global weights of all criteria

FINANCIAL RATIOS	Local Weights	SUB RATIOS	Min	Max	Local Weights	Global Weights
CAPITAL RATIOS, %	0.2847	Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)		x	0.2586	**0.0736**
		Shareholders' Equity / Total Assets		x	0.3583	**0.1020**
		(Shareholders' Equity-Permanent Assets) / Total Assets		x	0.1578	**0.0449**
		Shareholders' Equity / (Deposits + Non-Deposit Funds)		x	0.0633	**0.0180**
		On Balance-sheet FC Position / Shareholders' Equity		x	0.0361	**0.0103**
		Net on Balance-sheet Position / Total Shareholders'		x	0.1015	**0.0289**
		N(on+off) Balance-sheet Position / Total Shareholders'		x	0.0244	**0.0070**
BALANCE SHEET RATIOS, %	0.0583	TC Assets / Total Assets		x	0.3023	**0.0176**
		FC Assets / Total Assets		x	0.0351	**0.0020**
		TC Liabilities / Total Liabilities		x	0.1111	**0.0065**
		FC Liabilities / Total Liabilities		x	0.0244	**0.0014**
		FC Assets / FC Liabilities		x	0.0184	**0.0011**
		TC Deposits / Total Deposits		x	0.1634	**0.0095**
		TC Loans and Receivables / Total Loans and Receivables		x	0.0730	**0.0043**
		Total Deposits / Total Assets		x	0.2204	**0.0128**
		Funds Borrowed / Total Assets		x	0.0518	**0.0030**
ASSETS QUALITY, %	0.1454	Financial Assets (Net) / Total Assets		x	0.1101	**0.0160**
		Total Loans and Receivables / Total Assets		x	0.0572	**0.0083**
		Total Loans and Receivables / Total Deposits		x	0.3079	**0.0448**
		Consumer Loans / Total Loans and Reciv.		x	0.5248	**0.0763**
LIQUIDITY, %	0.1162	Liquid Assets / Total Assets		x	0.4249	**0.0494**
		Liquid Assets / Short-term Liabilities		x	0.2464	**0.0286**
		TC Liquid Assets / Total Assets		x	0.0925	**0.0107**
		Liquid Assets / (Deposits + Non-Deposit Funds)		x	0.1867	**0.0217**
		FC Liquid Assets / FC Liabilities		x	0.0495	**0.0057**
PROFITABILITY, %	0.2035	Net Profit (Losses) / Total Assets		x	0.5196	**0.1057**
		Net Profit (Losses) / Total Shareholders' Equity		x	0.2866	**0.0583**
		Income Before Taxes / Total Assets		x	0.0499	**0.0101**
		Net Profit (Losses) / Paid-in Capital		x	0.1439	**0.0293**
INCOME-EXPENDITURE STRUCTURE, %	0.0813	Net Interest Income After Specific Provisions / Total		x	0.0542	**0.0044**
		Net Interest Income After Specific Provisions / Total Operating Income		x	0.0267	**0.0022**
		Non-Interest Income (Net) / Total Assets		x	0.0393	**0.0032**
		Non-Interest Income (Net) / Other Operating Expenses		x	0.0194	**0.0016**
		Interest Income / Interest Expense		x	0.0778	**0.0063**
		Total Income / Total Expense		x	0.1507	**0.0123**
		Interest Income / Total Assets		x	0.3050	**0.0248**
		Interest Income / Total Expenses		x	0.2163	**0.0176**
		Interest Expense / Total Expenses	x		0.1106	**0.0090**
SHARE IN SECTOR, %	0.0219	Total Assets (SHARE IN SECTOR, %)		x	0.2973	**0.0065**
		Total Loans and Receivables (SHARE IN SECTOR, %)		x	0.1638	**0.0036**
		Total Deposits (SHARE IN SECTOR, %)		x	0.5390	**0.0118**
SHARE IN GROUP, %	0.0159	Total Assets (SHARE IN GROUP, %)		x	0.2973	**0.0047**
		Total Loans and Receivables (SHARE IN GROUP, %)		x	0.1638	**0.0026**
		Total Deposits (SHARE IN GROUP, %)		x	0.5390	**0.0086**
BRANCH RATIOS, TRY MILLION	0.0302	Total Assets / No. of Branches		x	0.1590	**0.0048**
		Total Deposits / No. of Branches		x	0.2375	**0.0072**
		TRY Deposits / No. of Branches		x	0.0462	**0.0014**
		FX Deposits / No. of Branches		x	0.0318	**0.0010**
		Total Loans and Receivables / No. of Branches		x	0.1056	**0.0032**
		Total Employees / No. of Branches (person)	x		0.0696	**0.0021**
		Net Income / No. of Branches		x	0.3504	**0.0106**

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ACTIVITY RATIOS	0.0427	(Personnel Expenses + Reserve for Employee Termination Benefit) / Total Assets	x		0.1604	**0.0069**
		(Personnel Expenses + Reserve for Employee Termination Benefit) / Number of Personnel (Thousand TRY)	x		0.1024	**0.0044**
		Reserve for Employee Termination Benefit / Number of Personnel (Thousand TRY)	x		0.0434	**0.0019**
		Personnel Expenses / Other Operating Expenses	x		0.2488	**0.0106**
		Other Operating Expenses / Total Asset	x		0.0655	**0.0028**
		Total Operating Income / Total Assets		x	0.3794	**0.0162**

Table 12. Performance rankings for the years 2002 and 2003

Financial Performance of the banks for the year 2002			*Financial Performance of the banks for the year 2003*		
RANK	*BANK*	*RCi**	*RANK*	*BANK*	*RCi**
1	*Yapı Kredi Bank*	*0.531*	1	*Akbank*	*0.666*
2	*Halk Bank*	*0.510*	2	*HSBC Bank*	*0.578*
3	*HSBC Bank*	*0.505*	3	*Ziraat Bank*	*0.520*
4	*Akbank*	*0.480*	4	*Halk Bank*	*0.500*
5	*Tekstil Bank*	*0.474*	5	*Turkish Bank*	*0.440*
6	*Turkish Bank*	*0.431*	6	*Finans Bank*	*0.434*
7	*Eurobank Tekfen*	*0.424*	7	*Is Bank*	*0.387*
8	*Finans Bank*	*0.419*	8	*Vakıflar Bank*	*0.377*
9	*Ziraat Bank*	*0.383*	9	*Denizbank*	*0.362*
10	*Vakıflar Bank*	*0.372*	10	*ING Bank*	*0.346*
11	*Is Bank*	*0.368*	11	*Sekerbank*	*0.339*
12	*ING Bank*	*0.359*	12	*Turk Ekonomi Bank*	*0.335*
13	*Anadolubank*	*0.315*	13	*Yapı Kredi Bank*	*0.323*
14	*Turk Ekonomi Bank*	*0.313*	14	*Garanti Bank*	*0.314*
15	*Denizbank*	*0.298*	15	*Eurobank Tekfen*	*0.297*
16	*Garanti Bank*	*0.277*	16	*Tekstil Bank*	*0.247*
17	*Sekerbank*	*0.233*	17	*Anadolubank*	*0.240*

Table 13. Performance rankings for the years 2004 and 2005

Financial Performance of the banks for the year 2004			*Financial Performance of the banks for the year 2005*		
RANK	*BANK*	*RCi**	*RANK*	*BANK*	*RCi**
1	*Akbank*	*0.672*	1	*Ziraat Bank*	*0.801*
2	*Ziraat Bank*	*0.620*	2	*Akbank*	*0.787*
3	*Vakıflar Bank*	*0.608*	3	*HSBC Bank*	*0.786*
4	*HSBC Bank*	*0.565*	4	*ING Bank*	*0.783*
5	*Halk Bank*	*0.523*	5	*Vakıflar Bank*	*0.769*
6	*Sekerbank*	*0.495*	6	*Is Bank*	*0.762*
7	*ING Bank*	*0.482*	7	*Garanti Bank*	*0.748*
8	*Is Bank*	*0.481*	8	*Halk Bank*	*0.745*
9	*Anadolubank*	*0.471*	9	*Denizbank*	*0.742*
10	*Finans Bank*	*0.453*	10	*Finans Bank*	*0.731*
11	*Denizbank*	*0.444*	11	*Sekerbank*	*0.716*
12	*Garanti Bank*	*0.426*	12	*Turkish Bank*	*0.706*
13	*Turkish Bank*	*0.394*	13	*Anadolubank*	*0.705*
14	*Eurobank Tekfen*	*0.354*	14	*Turk Ekonomi Bank*	*0.685*
15	*Yapı Kredi Bank*	*0.338*	15	*Eurobank Tekfen*	*0.670*
16	*Turk Ekonomi Bank*	*0.318*	16	*Tekstil Bank*	*0.648*
17	*Tekstil Bank*	*0.268*	17	*Yapı Kredi Bank*	*0.196*

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Table 14. Performance rankings for the years 2006 and 2007

Financial Performance of the banks for the year 2006			*Financial Performance of the banks for the year 2007*		
RANK	*BANK*	*RCi**	*RANK*	*BANK*	*RCi**
1	*Ziraat Bank*	*0.648*	1	*Ziraat Bank*	*0.691*
2	*Finans Bank*	*0.604*	2	*Akbank*	*0.654*
3	*Akbank*	*0.561*	3	*Garanti Bank*	*0.645*
4	*HSBC Bank*	*0.544*	4	*HSBC Bank*	*0.614*
5	*Halk Bank*	*0.487*	5	*Halk Bank*	*0.570*
6	*Denizbank*	*0.477*	6	*Is Bank*	*0.564*
7	*Vakıflar Bank*	*0.461*	7	*Vakıflar Bank*	*0.553*
8	*Turkish Bank*	*0.442*	8	*Finans Bank*	*0.533*
9	*Garanti Bank*	*0.433*	9	*Anadolubank*	*0.459*
10	*Is Bank*	*0.417*	10	*Sekerbank*	*0.442*
11	*Sekerbank*	*0.318*	11	*Denizbank*	*0.399*
12	*Yapı Kredi Bank*	*0.317*	12	*Yapı Kredi Bank*	*0.399*
13	*Anadolubank*	*0.315*	13	*Turkish Bank*	*0.396*
14	*ING Bank*	*0.311*	14	*ING Bank*	*0.381*
15	*Turk Ekonomi Bank*	*0.297*	15	*Tekstil Bank*	*0.351*
16	*Tekstil Bank*	*0.281*	16	*Turk Ekonomi Bank*	*0.321*
17	*Eurobank Tekfen*	*0.265*	17	*Eurobank Tekfen*	*0.300*

Table 15. Performance rankings for the years 2008 and 2009

Financial Performance of the banks for the year 2008			*Financial Performance of the banks for the year 2009*		
RANK	*BANK*	*RCi**	*RANK*	*BANK*	*RCi**
1	*HSBC Bank*	*0.566*	1	*Akbank*	*0.627*
2	*Anadolubank*	*0.565*	2	*Ziraat Bank*	*0.606*
3	*Ziraat Bank*	*0.562*	3	*Garanti Bank*	*0.600*
4	*Garanti Bank*	*0.544*	4	*Finans Bank*	*0.558*
5	*Akbank*	*0.541*	5	*HSBC Bank*	*0.539*
6	*Is Bank*	*0.503*	6	*Anadolubank*	*0.528*
7	*Turkish Bank*	*0.498*	7	*Is Bank*	*0.503*
8	*Halk Bank*	*0.466*	8	*Denizbank*	*0.499*
9	*Yapı Kredi Bank*	*0.461*	9	*Halk Bank*	*0.499*
10	*Vakıflar Bank*	*0.450*	10	*Yapı Kredi Bank*	*0.478*
11	*Finans Bank*	*0.428*	11	*Vakıflar Bank*	*0.477*
12	*Denizbank*	*0.416*	12	*Sekerbank*	*0.381*
13	*Sekerbank*	*0.402*	13	*ING Bank*	*0.380*
14	*Turk Ekonomi Bank*	*0.398*	14	*Turk Ekonomi Bank*	*0.368*
15	*ING Bank*	*0.343*	15	*Tekstil Bank*	*0.368*
16	*Tekstil Bank*	*0.334*	16	*Turkish Bank*	*0.357*
17	*Eurobank Tekfen*	*0.283*	17	*Eurobank Tekfen*	*0.277*

Table 16. Performance rankings for the years 2010 and 2011

Financial Performance of the banks for the year 2010			*Financial Performance of the banks for the year 2011*		
RANK	*BANK*	*RCi**	*RANK*	*BANK*	*RCi**
1	*Akbank*	*0.655*	1	*Garanti Bank*	*0.605*
2	*Finans Bank*	*0.630*	2	*Denizbank*	*0.599*
3	*Garanti Bank*	*0.630*	3	*Finans Bank*	*0.575*
4	*Ziraat Bank*	*0.626*	4	*Halk Bank*	*0.570*
5	*Halk Bank*	*0.568*	5	*Akbank*	*0.554*
6	*Is Bank*	*0.559*	6	*Ziraat Bank*	*0.499*
7	*Yapı Kredi Bank*	*0.544*	7	*Is Bank*	*0.497*

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8	Anadolubank	0.526	8	Yapı Kredi Bank	0.488
9	HSBC Bank	0.502	9	Vakıflar Bank	0.478
10	Vakıflar Bank	0.470	10	Anadolubank	0.428
11	Denizbank	0.441	11	HSBC Bank	0.427
12	Turk Ekonomi Bank	0.428	12	Turkish Bank	0.358
13	Sekerbank	0.373	13	Eurobank Tekfen	0.345
14	Tekstil Bank	0.368	14	Sekerbank	0.311
15	ING Bank	0.344	15	Turk Ekonomi Bank	0.305
16	Turkish Bank	0.317	16	Tekstil Bank	0.293
17	Eurobank Tekfen	0.263	17	ING Bank	0.288

Table 17. Estimated financial performance rankings for the years 2012 and 2013

Estimated Performance of the banks for the year 2012			Estimated Performance of the banks for the year 2013		
RANK	BANK	RCi*	RANK	BANK	RCi*
1	Garanti Bank	0.680	1	Garanti Bank	0.685
2	Ziraat Bank	0.637	2	Ziraat Bank	0.626
3	Akbank	0.574	3	Denizbank	0.580
4	Halk Bank	0.573	4	Is Bank	0.577
5	Is Bank	0.569	5	Halk Bank	0.574
6	Denizbank	0.568	6	Akbank	0.551
7	Finans Bank	0.558	7	Anadolubank	0.545
8	Anadolubank	0.538	8	Finans Bank	0.543
9	HSBC Bank	0.491	9	Yapı Kredi Bank	0.492
10	Yapı Kredi Bank	0.469	10	HSBC Bank	0.472
11	Vakıflar Bank	0.461	11	Vakıflar Bank	0.447
12	Sekerbank	0.428	12	Sekerbank	0.434
13	Turk Ekonomi Bank	0.385	13	Turk Ekonomi Bank	0.391
14	Turkish Bank	0.342	14	Turkish Bank	0.333
15	ING Bank	0.320	15	ING Bank	0.311
16	Tekstil Bank	0.309	16	Tekstil Bank	0.308
17	Eurobank Tekfen	0.278	17	Eurobank Tekfen	0.278

Table 18. Estimated financial performance rankings for the years 2014 and 2015

Financial Performance of the banks for the year 2014			Financial Performance of the banks for the year 2015		
RANK	BANK	RCi*	RANK	BANK	RCi*
1	Garanti Bank	0.685	1	Garanti Bank	0.684
2	Ziraat Bank	0.611	2	Denizbank	0.598
3	Denizbank	0.589	3	Ziraat Bank	0.598
4	Is Bank	0.583	4	Is Bank	0.593
5	Halk Bank	0.571	5	Halk Bank	0.570
6	Anadolubank	0.548	6	Anadolubank	0.551
7	Akbank	0.530	7	Yapı Kredi Bank	0.532
8	Finans Bank	0.528	8	Akbank	0.516
9	Yapı Kredi Bank	0.511	9	Finans Bank	0.515
10	HSBC Bank	0.456	10	Sekerbank	0.446
11	Sekerbank	0.439	11	HSBC Bank	0.445
12	Vakıflar Bank	0.436	12	Vakıflar Bank	0.432
13	Turk Ekonomi Bank	0.397	13	Turk Ekonomi Bank	0.405
14	Turkish Bank	0.326	14	Turkish Bank	0.322
15	Tekstil Bank	0.309	15	Tekstil Bank	0.313
16	ING Bank	0.304	16	ING Bank	0.302
17	Eurobank Tekfen	0.280	17	Eurobank Tekfen	0.288

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Table 19. Forecasting example for the "Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)" parameter

	Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Forecasting Method
Shareholders' Equity / (Amount Subject to Credit Risk + Market Risk + Operational Risk)	Ziraat Bank	72.0	95.1	50.6	47.7	39.5	25.4	20.1	23.2	19.2	15.6	15.97	14.29	12.60	10.92	Linear Moving Averages
	Halk Bank	102.0	99.3	58.9	49.6	32.0	20.0	14.5	16.0	15.9	14.3	12.71	11.62	10.70	9.92	Power Trend Function
	Vakıflar Bank	14.9	14.9	17.3	25.4	19.7	15.4	14.3	15.4	14.4	13.4	14.37	13.98	13.60	13.21	Linear Trend Function
	Akbank	39.1	44.5	36.2	21.4	20.7	18.9	18.2	22.5	20.6	17.0	15.40	14.37	13.42	12.54	Logarithmic Trend Function
	Anadolubank	13.9	14.3	15.0	14.1	15.2	14.3	18.5	20.0	18.8	17.0	16.94	16.98	17.01	17.04	S Trend Function
	Şekerbank	10.4	16.5	15.8	20.2	16.7	16.8	14.7	16.3	14.0	13.2	15.35	15.37	15.39	15.41	Growth Trend Function
	Tekstil Bank	13.3	12.2	12.7	12.0	14.2	13.2	17.9	20.8	19.4	15.9	19.51	20.30	21.09	21.88	Linear Trend Function
	Turkish Bank	61.3	67.4	40.9	30.9	50.2	31.9	34.5	28.8	24.7	32.1	25.89	24.56	23.23	21.90	Linear Moving Averages
	Türk Ekonomi Bank	15.4	14.9	14.3	12.3	14.3	14.9	17.7	17.7	14.4	14.2	15.66	15.78	15.90	16.01	Linear Trend Function
	Garanti Bank	12.7	16.6	16.8	15.1	14.1	15.4	16.1	21.2	19.6	16.9	19.29	19.80	20.32	20.83	Linear Trend Function
	İş Bankası	25.3	28.4	29.0	25.0	23.9	20.5	15.2	18.3	17.5	14.1	13.87	12.85	11.90	11.03	Compound Trend Function
	Yapı ve Kredi Bank	15.1	18.6	18.3	7.2	12.3	13.7	15.7	17.8	16.1	14.7	15.12	14.86	14.12	14.05	Single Moving Averages
	Denizbank	19.0	18.2	18.9	14.1	15.5	13.2	17.2	19.0	16.4	15.6	15.50	15.31	15.12	14.93	Exponential Trend Function
	Eurobank Tekfen	30.5	26.7	26.6	22.6	16.9	21.8	17.9	26.0	20.3	16.9	17.11	16.32	15.56	14.85	Compound Trend Function
	Finans Bank	8.6	12.7	14.1	13.5	16.8	13.0	16.0	18.0	16.7	17.2	16.76	16.35	15.74	14.93	Quadratic Trend Function
	HSBC Bank	31.7	32.6	19.9	13.2	11.8	13.7	15.4	17.3	16.5	16.1	14.55	14.44	14.35	14.27	S Trend Function
	ING Bank	22.6	16.3	16.7	17.2	12.7	12.8	13.8	15.6	14.6	14.2	13.12	12.91	12.73	12.55	Power Trend Function