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Performance Assessment of Real Estate Investment Trusts (REIT) Listed in BIST Via Different Multi Criteria Decision Making Methods

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Abstract

Firms' performance assessment which gained crucial importance in last decades is essential issue for decision makers in financial sector. They can acquire competitive power by this way. In this study financial performance of twelve real estate investment trusts (REITs) listed in BIST is analyzed by using four financial indicators within the period of 2011-2015. Therefore firstly weights of criteria related to financial ratios are obtained by using Chang's Extent Analysis Method on Fuzzy Analytic Hierarchy Process (FAHP). Following to this firms' final rankings are determined by means of TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) methods respectively. Also ranking performance of these two methods is interpreted.

Keywords: performance analysis, multi criteria decision making, analytic hierarchy process, TOPSIS, VIKOR, real estate investment trust, BIST

1. Introduction

Real Estate Investment Trusts (REITs) are established with aim for investing high return potential real estates and real estate based projects also making profit from real estate leasing and commerce. Portfolio earnings of REITs are distributed to shareholders as dividends within the frame of capital markets board regulations in the year-end (https://www.sec.gov).

REITs are only operated within the concept of real estate based portfolio management and hence machine and equipment are not contained in their assets. Furthermore they do not undertake the responsibility of civil works and conduct a project but finance civil projects under the responsibility of other companies.

Real estates and real estate based investments develop psychological trust for investors. Earnings of REITs are exempt from corporation tax. While nine REITs are listed in IMKB in 2009, thirty two REITs are listed in BIST nowadays (http://www.spk.gov.tr).

Studies about real estate investment trusts (REITs) are introduced in USA since 1970s. First studies are aimed to evaluate the performance of REITs. There are no more studies about REITs, developed in 1990s and 2005, in other countries. Studies in Turkey which is introduced from 2000s depend on process and legal infrastructure of REITs. According to the literature this study is one of the rare ones based on analyzing the performance of REITs traded in Turkey via multi criteria decision making methods.

2. Financial Performance Indicators

While financial indicators are used for specifying the firms' value by investors and shareholders; they are utilized by creditors for determining solvency capacity and financing costs. Valuation models determining firms' market value can be classified into accounting and financial models. According to the accounting ones firm value is considered as a function of a number of variables such as profit margin, earnings per share, profitability growth ratio, cash flows, book value and dividends.

With respect to financial models firm value is handled as a function of yield capacity from available assets and potential investments, return level and cost of capital. It is pointed out the superiority of economic value added (EVA) over other indicators in revealing the firms' real value. Financial indicator namely EVA was used for detecting financial performance and purpose of firms, projects planned to invest and intellectual capital (Baybordi, Barvari, Bahramihajlabad, & Sheykhlov, 2013, p.1307).

A number of studies measuring firms' financial performance are based on comparing the effect of value based performance indicators and traditional ones. Lehn and Makhija (1997) found out the outstanding performance of EVA over traditional based indicators. As opposed to that Biddle, Bowen and Wallace (1997) revealed the superiority of accounting based indicators. Chen and Dodd (1998) analyzed the efficiency of operating profit, residual income and EVA in firm valuation and did not find the EVA as the most effective one. Acheampong and Wetzstein (2001) stressed the indifference between value based indicators and traditional ones and asserted the joint consideration. Worthington and West (2004) concluded that the effectiveness of EVA usage in determining stock yield than traditional performance indicators such as net cash flows and residual income.

Superiority of performance indicators change according to the application field. Therefore REITs, inadequate interest shown by researchers, are considered in this study. Both traditional performance indicators (return on assets, residual income and return on sales) and value based ones (EVA) are used for measuring the performance of REITs. In addition to this firms are compared with regard to multi criteria decision making (MCDM) methods.

2.1 Return on Assets

Return on assets degrades profit/cost and investments into a ratio by dealing the concept of profitability. Furthermore it is one of the commonly used performance ratios for comparing the return of assets in terms of firms' investments which are made or planned.

The ratio of return of assets (ROA) shows how firms efficiently used their total assets and calculated by various ways:

$$\textit{Return of Assets} = \textit{Profit/Total Assets} \tag{1}$$

$$\textit{Return of Assets} = \textit{Return on Sales x Investment Turnover} \tag{2}$$

According to the different viewpoints profit, shown in Eq. (1), can be treated as operating profit or net profit. Similarly total assets, depicted in Eq. (1), can be considered as firms' assets held or computed as total assets – short term debts according to different applications (Yükçü & Atağan, 2009, p. 9).

2.2 Residual Income

Investors desire firms being appreciate and want to see the result of their investments. Ratios namely net return on investments (ROI) and residual income are used for this purpose. In addition to the similarity between ratios; while ROI is depicted as percentage residual income is shown as amount. This is the reason for preferring residual income by managers.

Although item namely cost of financial sources are available in the income statement, it is not true for owner's equity. Therefore added value is calculated as subtracting cost of equity from net income in case of determining cost for owner's equity. According to the Öztürk (2010), who made a study aimed at examining the manufacturing firms listed in BIST, firms should focus on residual income that will create value for shareholders and increasing their market value.

According to the method of residual income expected return on capital is generally assumed as constant and equity expenditures in the ith year are calculated as multiplying return on equity by the book value of equity at the beginning of year (Yavuzarslan, 2007, pp. 11-17).

$$\textit{Equity Expenditures} = \textit{Book value of equity x expected return on capital} \tag{3}$$

$$\textit{Residual income} = \textit{Net income} - \textit{Capital expenditures} \tag{4}$$

Different approaches and formulations are used for defining the residual income. According to Yükçü (2007) residual income is formulated as:

$$\textit{Residual income} = \textit{Operating profit} - (\textit{Expected income x Total assets}) \tag{5}$$

If residual income is positive added value is created otherwise it is lost.

2.3 Economic Value Added (EVA)

The ratio of economic value added (EVA) is introduced in the early period of 1980s. EVA, which ignores the cost of capital, is mostly used method to avoid the misleading effect of accounting based traditional performance indicators. A number of big businesses like Coca-Cola, IBM, Whirlpool use this method in planning and performance auditing.

EVA aims to calculate the value that is created via firms' sources in a period. Variables which is unavailable in accounting records are used for this purpose and so developments in the sector can be measured. EVA, in which economic value is used as basic one, provides analyzing the effects of growth in terms of whole business and its' parts. EVA , which considers the cost of equity and resource, is an indicator of earnings exceeding the cost of capital and differs from the performance indicators like earnings per share, ROA and return on equity. EVA can be formulated as below:

$$EVA = \text{Net Operating Profit Less Adjusted Taxes} - (\text{Invested Capital} \times \text{Weighted Average Cost of Capital}) \quad (6)$$

$$EVA = (\text{Return on Invested Capital} - \text{Weighted Average Cost of Capital}) \times \text{Invested Capital} \quad (7)$$

According to Eq. (6) firm creates added value if the value of EVA being positive in other words the value of net operating profit less adjusted taxes exceeds the capital expenditures. Value of EVA can be increased by decreasing the capital expenditures or raising the net operating profit less adjusted taxes (Yavuzarslan, 2007, p. 39)

There are some difficulties in calculating the value of EVA such as the weighted average cost of capital. Weighted average cost of capital can be computed as below:

$$\text{Weighted Average Cost of Capital} = (\text{Debt Ratio} \times \text{Cost of Debt After Taxes}) + (\text{Ratio of Owner's Equity} \times \text{Cost of Equity}) \quad (8)$$

2.4 Return on Sales

Return on sales which is one of the commonly used performance indicator is easily computed and formulated as below:

$$\text{Return on Sales} = \text{Operating Profit}/\text{Sales} \quad (9)$$

3. Literature Review

Smith and Shulman (1976) compared the performances of REITs operated in USA with S&P index, savings accounts and 15 investment funds in the period of 1963-1974. With this aim capital assets pricing model (CAPM) is used. As a result sample consisted of REITs outperform than other indicators within the period of 1963-1974.

Han and Liang (1985) evaluated the return performance of REITs within the period of 1970-1993. According to the Jensen model results, REITs similarly perform with market portfolio and treasury bills. Titman and Warga (1986) examined the performance of REIT shares within the period of 1973-1982 via CAPM and arbitrage pricing model (APM). According to their results REITs based portfolio similarly perform with market portfolio.

Kuhle and Walther (1987) compared the net income values of 102 REITs in the period of 1973-1984. Goebel and Kim (1989) examined the return performance of portfolio consisted of finite life real estate investment trusts (FREITs) in the period of 1983-1987. With this aim Jensen's performance measure is used.

Mcintosh et al. (1991) investigated the relationships between size of enterprise and return of REITs for the period of 1974-1988 and found significant negative relation. Peterson and Hsieh (1997) studied the effect of market value/book value and size of enterprise on the return of REITs and found significant positive relation between return of REITs and size of enterprise and market value/book value respectively.

Chen, Hsieh, Vines, and Chiou (1998) analyzed the return performances of capital based REITs listed in NYSE, AMEX and NASDAQ stock exchanges within the period of 1978-1994. Buttimer, Hyland and Sanders (2001) analyzed the long term performance of REITs by using FAMA and French's three factor model in the period of 1990-1999.

Bley and Olson (2005) examined the performances of equity based REITs, mortgaged REITs and S&P 500 indexes in the range of 1973-2001. Equity based REIT index has high correlation and return on risks than mortgaged REIT index.

Glascock, Lu, and So (2006) made a study in terms of real estate markets in Asia like Taiwan, Japan, Hong Kong, South Korea, Thailand and Singapore within the period of 1980-1990. With this purpose income behavior of public companies, invest in real estate, are analyzed via regression models and supernormal rate of return is found in Taiwan real estate market apart from other markets.

Bond and Glascock (2006) examined the performance and portfolio diversification characteristics of publicly traded REITs within the period of 1990-2005. According to the results REITs contribute to portfolios as risk mitigant and income promoter. Additionally it is determined that REITs outperform than other shares in recession period.

Derwall, Huij, Brounen, and Marquering (2009) aimed to analyze the explanatory power of momentum factor in defining the return of REITs. With this aim monthly returns of REITs traded in the period of 1980-2006 are handled. As a result momentum factor is considered as an essential explanatory in making valuation the portfolio performance.

Yong et al. (2009) assessed the sensitivity of return of REITs, traded in Australia, on the firm related variables. Data is acquired via panel regression analysis in the period of 1990-2008. It is found significant negative relation between size of enterprise and return of REITs, conversely significant positive relation between return of REITs and market value/book value and degree of leverage are obtained respectively.

Chang and Chang (2010) researched the effects of firm size, market value/book value and degree of leverage on return of REITs by using Fama and French three factor model. According to the study results there is significant negative relation between firm size and return of REITs. On the other hand, there is no significant relation between degree of leverage and return of REITs.

Studies aimed to reveal relationship between size of enterprise and return of REITs are made by Chen et al. (1998), Marts and Elayan (1990) and similar results are gained. Accordingly relationship between market value/book value and return of REITs are found out by Bers and Springer (1997), Goebel et al. (2013) and Niskanen et al. (2011). Similar results are valid for this relationship (Şahin, 2014; pp. 11-12).

Studies made in Turkey are not enough as well as can be summarized as below:

Akçay (2000) evaluated the specifications and applications of REITs in Turkey. Performances of REITs are examined from 1997, first public offering time, to June 1999 and compared with return performances of other investment tools. As a result performances of REITs are changed by years.

Yetkin (2004) handled the applicability of balanced score card (BSC) on REITs traded in Turkey and concluded that traditional measuring and management models lose validity. For this reason REITs can use BSC model in order to provide successful and efficient performance management.

Güven (2006) found the factors affecting the stock yield of REITs by means of multivariable regression model. For this purpose return index of REITs are considered as outcome variable, on the other hand BIST 30 index, government debt securities, exchange rate and consumer price indices are treated as independent variables. As a result return ratio of BIST 30 index and exchange increase rate are found as the most significant variables affecting return index of REITs.

Özdemir and Türker (2007) studied the effects of inflation and interest ratios on REITS traded in Turkey. According to the study results REITs perform similarly or better than the return of market portfolio in the years 2002-2006.

4. Methodology

4.1 Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP), developed by T. L. Saaty (1980), is a decision making mechanism composed of overall goal, criteria and sub criteria (if there are any), and alternatives. AHP considers rational and intuitive domains to select the best alternative evaluated with respect to several criteria and sub criteria (Bhushan & Rai, 2004, p. 15). AHP considers subjective and objective opinions of decision makers in decision process and provide them to aggregate tangible quantitative and intangible qualitative factors (Saaty, 1990, p. 20).

AHP decomposes complex decision problem into a tree hierarchy composing of objectives, criteria, sub criteria (if needed) and alternatives. The aim of AHP is to weight criteria and indicators by pairwise comparisons. Importance of elements in a given level is judged with regard to some or all of the elements in adjacent level via pairwise comparisons (Zhou, Maumbe, Deng, & Selin, 2015, p. 72). By using AHP we can decouple problem into sub problems by evaluating subjectively manner that is transformed into numerical values and ranked on a numerical scale (Bhushan & Rai, 2004, p. 15).

Phases of AHP can be summarized as follows (Bhushan & Rai, 2004, p. 15):

a) Problem is defined and decomposed into hierarchy of goal, criteria, sub criteria and alternatives which shows relationship between components at each level. At each level of comparison decision maker consider contribution of lower level components to upper level one.

b) Data is collected from experts or decision makers that can be analyzed as pairwise comparison on fundamental scale representing intensities of judgments. Fundamental scale for multiple pairwise comparisons developed by Saaty and Vargas (2012) and showed in Table 1.

Table 1. Fundamental scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally 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 or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	

c) Pairwise comparison matrix is constructed and organized into square matrix. These matrices are positive and reciprocal ($a_{ij} = 1/a_{ji}$). If the value of component (i,j) is greater than 1, criterion in the ith row is better than the jth one. Each element in upper level is used to compare with lower level ones with regard to it (Saaty, 2008).

d) Local and global weights of each criteria and sub criteria are calculated, and the principle right eigenvector (ω) and largest eigenvalue (λ_{max}) are obtained. By using discrete paired comparisons ratio scales are derived in form of normalized right eigenvectors. Components of normalized eigenvector are determined as weights and ratings with regard to criteria/ sub criteria and alternatives.

e) Consistency of matrix is evaluated by means of consistency ratio (CR). Quality of AHP depends on consistency of pairwise comparisons. If all comparisons are perfectly consistent $a_{ij} = a_{ik}.a_{kj}$ relation is true for any combination of comparisons (Saaty, 1980). If ratio is lower than the threshold value comparisons must be re-evaluated. Consistency ratio, used for determining whether evaluations are sufficiently consistent, is derived by comparing the consistency index (CI) with the appropriate one of the following set of numbers each of which is average random consistency index (RI), developed by Saaty and Vargas (2012) and showed in Table 2, obtained by sample of randomly generated reciprocal matrices. Consistency index of a matrix of comparisons is CI= (λ_{max}- n)/ (n-1) where λ_{max} is the maximum eigenvalue of paired comparison judgement matrix. Saaty suggest that the CR value must be lower than 0,1.

Table 2. Average random consistency index (RI)

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

Source: T. Saaty & L.G. Vargas, "Models, Methods, Concepts & Applications of the Analytic Hierarchy Process (AHP)" (p.9), 2012, Boston: Springer.

f) In order to obtain local weights of each criteria, rating of each alternative is multiplied by weights of sub-criteria and then aggregated. Multiplying these local weights by criteria weights global ratings of alternatives are acquired.

AHP has been applied in a number of fields such as quality based investment (Güngör & Arıkan, 2007), machine and equipment selection (Ching & Been, 1996), purchasing decision process (Byun, 2001), strategic management (Yüksek & Akın, 2006), site selection decision (Chuang, 2001), performance measuring (Frei & Harker, 1999), resource allocation (Alphonce, 1997), sustainable city logistics planning (Awasthi & Chauhan, 2012), project selection (Amiri, 2010), maintenance strategy selection (Bevilacqua & Braglia, 2000), supplier selection planning model (Hwang, Moon, Chuang, & Goan, 2005), human performance improvement (Albayrak & Erensal, 2004), treatment selection (Richman et al., 2006).

4.2 Chang's Extent Analysis

Chang (1996) proposed an approach for dealing FAHP by using triangular fuzzy numbers for pairwise comparison and considering extent analysis for synthetic extent values of comparisons. Let $X = \{x_1, x_2, \ldots, x_n\}$ be an object set and $U = \{u_1, u_2, \ldots, u_n\}$ be a goal set. According to Chang's (1996) extent analysis each objective is taken and extent analysis for each goal is performed respectively. So m extent analysis values for each object can be obtained with the following signs:

$$M_{g_i}^1, M_{g_i}^2, \ldots, M_{g_i}^m, \quad i = 1,2,\ldots,n \tag{10}$$

Where all the $M_{g_i}^j (j = 1,2,\ldots,m)$ are triangular fuzzy numbers. Steps of Chang's extent analysis (1996) can be given as follows:

1-The value of fuzzy synthetic extent with respect to the ith object is defined as:

$$S_i = \sum_{j=1}^{m} M_{g_i}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1} \tag{11}$$

To obtain $\sum_{j=1}^{m} M_{g_i}^j$ the fuzzy addition operation of m extent analysis values for a particular matrix is performed such as

$$\sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right) \tag{12}$$

and to obtain $\left[\sum_{j=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1}$ the fuzzy addition operation of $M_{g_i}^j \ (j = 1,2,\ldots,m)$ values is performed such as:

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i \right) \tag{13}$$

and then the inverse of the vector above is computed such as

$$\left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i} \right) \tag{14}$$

2-The degree of possibility of $M_2 = (l_2, m_2, u_2); M_1 = (l_1, m_1, u_1)$ is defined as:

$$V(M_2 \geq M_1) = \sup_{y \geq x} \left[\min(\mu_{M_1}(x), \mu_{M_2}(y)) \right] \tag{15}$$

and can be expressed as follows:

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d) \tag{16}$$

$$= \begin{cases} 1, \ if \ m_2 \geq m_1 \\ 0, \ if \ l_1 \geq u_2 \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} otherwise \end{cases} \tag{17}$$

Eq. (16) where d is the ordinate of the highest intersection point D between μ_{M_1} and μ_{M_2} is illustrated in

Figure 1 (Chang, 1996). To compare M_1 and M_2, we need both the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$.

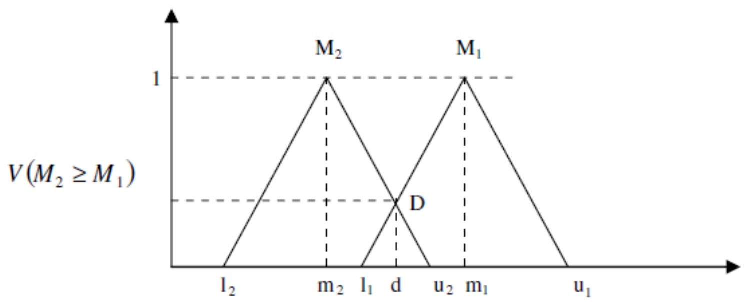

Figure 1. The definition of the degree of possibility of $V(M_2 \geq M_1)$

Source: Chang, D. Y. (1996). Applications of the extent analysis method on fuzzy AHP. *European Journal of Operational Research*, *95*, 651.

3-The degree possibility for a convex fuzzy number to be greater than k convex fuzzy $M_i(i=1,2,\ldots,k)$ numbers can be defined by

$$V(M \geq M_1, M_2, \ldots, M_k) = V\lfloor (M \geq M_1) \ and \ (M \geq M_2) \ and \ \ldots and \ (M \geq M_k) \rfloor$$
$$= \min V(M \geq M_i), i=1,2,\ldots,k \quad (18)$$

Assume that $d(A_i) = \min V(S_i \geq S_k)$ for k=1,2,…,n; $k \neq i$ .Then the weight vector is given by

$$W' = (d'(A_1), d'(A_2), \ldots, d'(A_n))^T \quad (19)$$

where $A_i(i=1,2,\ldots,n)$ are n elements.

4-Via normalization, the normalized weight vectors are:

$$W = (d(A_1), d(A_2), \ldots, d(A_n))^T \quad (20)$$

where W is a non-fuzzy number.

While computational easiness and compliance with stages of traditional AHP (additional process are not required) can be considered as advantages of this method, allowing only triangular fuzzy numbers, assigning zero weights to some relative importance values and neglecting important information, causing faulty decisions comprise disadvantage side (Wang, Luo, & Hua, 2008, p. 745).

In order to overcome assigning zero weights to some criteria firstly Saaty's 9 point scale is carried out by decision maker's to construct pair-wise comparison matrix. Then adopting Eq. (21) proposed by Chen, Lin and Huang (2006) decision makers' pairwise comparison values are transformed into triangular fuzzy numbers and comprehensive pairwise comparison matrix is acquired. Let the fuzzy rating and importance weight of the *k*th decision maker be $\tilde{x}_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk})$; i=1,2,…,m and j=1,2,…,n respectively. So the aggregated fuzzy ratings $(\tilde{x}_{ij})$ of alternatives with respect to each criterion can be calculated as below:

$$(\tilde{x}_{ij}) = (a_{ij}, b_{ij}, c_{ij})$$

where

$$l_{ij} = \min_k \{a_{ijk}\}, \qquad m_{ij} = \frac{1}{K}\sum_{k=1}^{K} b_{ijk}, \qquad u_{ij} = \max_k \{c_{ijk}\} \quad (21)$$

4.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

Hwang and Yoon (1981) assert Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for analyzing multi criteria decision making (MCDM) problems. Basis of this technique is to choose alternative having the shortest euclidean distance from positive ideal solution (PIS) which maximizes benefit and minimizes cost, and the farthest distance from negative ideal solution (NIS) which maximizes cost and minimizes benefit (Behzadian et al., 2012). TOPSIS has been applied in a number of fields such as supplier selection (Shahanaghi & Yazdian, 2009), facility layout selection (Chu, 2002), performance measurement and evaluation (Yurdakul & İç,2003), machine tool selection (Yurdakul & İç, 2009), outsourcing (Bottani & Rizzi, 2006).

Assumption of this technique is to maximize or minimize each criterion and pairwise comparisons are abstained. Structure of TOPSIS are revealed as follows (Tsaur, 2011):

1- Forming decision matrix $\left(X = (x_{ij})_{nxm}\right)$ for ranking the alternatives.

$$X = \begin{bmatrix} x_{11} & x_{12} \dots & x_{1j} \dots & x_{1m} \\ x_{21} & x_{22} \dots & x_{2j} \dots & x_{2m} \\ \vdots & \vdots \; \dots & \vdots \; \dots & \vdots \\ x_{i1} & x_{i2} \dots & x_{ij} \dots & x_{im} \\ \vdots & \vdots \; \dots & \vdots \; \dots & \vdots \\ x_{n1} & x_{n2} \dots & x_{nj} \dots & x_{nm} \end{bmatrix} \tag{22}$$

2- Normalizing decision matrix by

$$r_{ij} = \frac{w_{ij}}{\sqrt{\sum_{i=1}^{m} w_{ij}^2}} \quad i = 1,2,\dots,n \quad j = 1,2,\dots,m \tag{23}$$

3- Weighting normalized decision matrix by multiplying normalized decision matrix and its' weights.

$$v_{ij} = r_{ij}.w_j \qquad i = 1,2,\dots,n \qquad j = 1,2,\dots,m \tag{24}$$

4- Determining positive and negative ideal solution as follows:

$$PIS = A^* = \left\{v_1^*, v_2^*, \dots, v_m^*\right\} = \left\{\left(\max_i v_{ij} \mid j \in \Omega_b\right), \left(\min_i v_{ij} \mid j \in \Omega_c\right)\right\} \tag{25}$$

$$NIS = A^- = \left\{v_1^-, v_2^-, \dots, v_m^-\right\} = \left\{\left(\min_i v_{ij} \mid j \in \Omega_b\right), \left(\max_i v_{ij} \mid j \in \Omega_c\right)\right\} \tag{26}$$

5- Calculating Euclidean distance of alternatives from positive and negative ideal solution as follows:

$$d_i^* = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^*)^2} \qquad i = 1,2,\dots,n \tag{27}$$

$$d_i^- = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^-)^2} \qquad i = 1,2,\dots,n \tag{28}$$

6- Calculating relative closeness of each alternative to ideal solution as below:

$$RC_i = \frac{d_i^-}{d_i^- + d_i^*} \qquad i = 1,2,\dots,n \qquad RC_i \in [0,1] \tag{29}$$

7- Ranking alternatives according to their RC_i values in descending order from 1 to 0 and choosing the highest one.

4.4 VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje)

VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) developed by Opricovic is a multi criteria decision making method (MCDM) based on creating compromised solution by taking alternatives and criteria into the consideration. Method is oriented for selecting and ranking alternatives in case of conflicting criteria (Büyüközkan & Ruan, 2008). Compromised solution is the closest to ideal one. In other words VIKOR based on measure of closeness to ideal solution is multi criteria decision ranking index (Opricovic & Tzeng, 2004). In order to obtain solution, closest to ideal one, multi criteria ranking index is generated for alternatives and then compared between the values of closeness to ideal solution (Opricovic & Tzeng, 2007). VIKOR has been applied in a number of fields such as evaluating banking perormance (Wu et al., 2009), public transportation analysis (Tzeng et al., 2005), selection of outsourcing providers (Liou & Chuang, 2010), material selection (Shanian & Savadogo, 2009).

Decision making process of VIKOR starts with problem definition. By this way aim of problem, alternatives, criteria and sub criteria (if needed) that will be evaluated are determined. Alternatives are selected, ranked and compared by utilizing cost or benefit based criterias. In evaluation process all alternatives get related criteria scores.

Steps of VIKOR method can be summarized as below:

a) Best (f_a^*) and the worst (f_a^-) values for each evaluation criteria are identified. If evaluation criteria (b=1,2,…,n) is based on benefit ;

$$f_b^* = \max_a x_{ab} \qquad f_b^- = \min_a x_{ab} \tag{30}$$

If evaluation criteria (b=1,2,…,n) is based on cost;

$$f_b^* = \min_a x_{ab} \qquad f_b^- = \max_a x_{ab} \tag{31}$$

b) In order to make comparisons normalization process is used and by this way normalization matrix is obtained. In normalization process decision matrix (X) ,composed of k criteria and l alternatives, transformed into normalization matrix (S) with same dimensions. Before normalization decision matrix (X) consisted of elements (x_{kl}) is seen as below;

$$X = \begin{bmatrix} x_{11} & x_{12}\dots & x_{1b}\dots & x_{1l} \\ x_{21} & x_{22}\dots & x_{2b}\dots & x_{2l} \\ \vdots & \vdots\ \dots & \vdots\ \dots & \vdots \\ x_{a1} & x_{a2}\dots & x_{ab}\dots & x_{al} \\ \vdots & \vdots\ \dots & \vdots\ \dots & \vdots \\ x_{k1} & x_{k2}\dots & x_{kb}\dots & x_{kl} \end{bmatrix} \tag{32}$$

After normalization process normalization matrix (S) consisted of elements (s_{kl}) is seen as below;

$$S = \begin{bmatrix} s_{11} & s_{12}\dots & s_{1b}\dots & s_{1l} \\ s_{21} & s_{22}\dots & s_{2b}\dots & s_{2l} \\ \vdots & \vdots\ \dots & \vdots\ \dots & \vdots \\ s_{a1} & s_{a2}\dots & s_{ab}\dots & s_{al} \\ \vdots & \vdots\ \dots & \vdots\ \dots & \vdots \\ s_{k1} & s_{k2}\dots & s_{kb}\dots & s_{kl} \end{bmatrix} \qquad s_{ab} = \frac{f_b^* - x_{ab}}{f_b^* - f_b^-} \tag{33}$$

c) Weighted normalized decision matrix (T) is obtained by multiplying criteria weights (W_b) and normalized decision matrix elements (S_{ab}).

$$T = \begin{bmatrix} t_{11} & t_{12}\dots & t_{1b}\dots & t_{1l} \\ t_{21} & t_{22}\dots & t_{2b}\dots & t_{2l} \\ \vdots & \vdots\ \dots & \vdots\ \dots & \vdots \\ t_{a1} & t_{a2}\dots & t_{ab}\dots & t_{al} \\ \vdots & \vdots\ \dots & \vdots\ \dots & \vdots \\ t_{k1} & t_{k2}\dots & t_{kb}\dots & t_{kl} \end{bmatrix} \qquad t_{ab} = s_{ab}.w_b \tag{34}$$

d) Values of S_a (mean group score) and R_a (worst group score) are calculated for each alternative.

$$S_a = \sum_{b=1}^{l} w_b \frac{f_b^* - x_{ab}}{f_b^* - f_b^-} \qquad R_a = \max_b\left[w_b \frac{f_b^* - x_{ab}}{f_b^* - f_b^-}\right] \tag{35}$$

e) Value of Q_a is calculated for each alternative. Values of S^*, S^-, R^*, R^- are used to acquire the value of Q_a. Additionally q parameter showing maximum group benefit states the weight of alternative providing maximum group benefit. On the contrary (1-y) parameter refers to weight of minimum regret. Compromise is reached by majority (q>0.5), consensus (q=0.5) or veto (q<0.5) (Opricovic & Tzeng, 2007). Generally q=0.5 is used (Lixin, Ying, & Zhiguang, 2008).

$$S^* = \min_a S_a$$

$$S^- = \max_a S_a \qquad Q_a = q\frac{S_a - S^*}{S^- - S^*} + (1-q)\frac{R_a - R^*}{R^- - R^*} \tag{36}$$

$$R^* = \min_a R_a$$

$$R^- = \max_a R_a$$

f) Values of S_a, R_a and Q_a are ranked from lower to higher and alternative having minimum Q_a value is controlled by two conditions whether ranking is accurate. These conditions are named acceptable advantage and acceptable stability.

Acceptable advantage condition: According to Q_a values first (Q(C_1)) and second alternative (Q(C_2)) satisfied significant difference. Calculated threshold value (DQ) depend on the number of alternative. If the number of alternative is lower than 4 the value of DQ equals to 0.25 (Chen & Wang, 2009).

$$Q(C_1) - Q(C_2) \geq DQ \qquad DQ = \frac{1}{k-1} \tag{37}$$

Acceptable stability condition: According to Q_a values first alternative (Q(C_1)) should get the best score at least one for values of S and R. Unless these two conditions are not satisfied, compromised solution set is formed by two ways:

1- If second condition is not satisfied, first and second alternatives are accepted as compromised solution.

2- If first condition is not satisfied, $C_1, C_2, \ldots, C_k$ alternatives are contained in compromised solution set according to $Q(C_k) - Q(C_1) \geq DQ$ (Opricovic & Tzeng, 2004).

Flowchart of FAHP-VIKOR and FAHP-TOPSIS methodologies are showed in Figure 2.

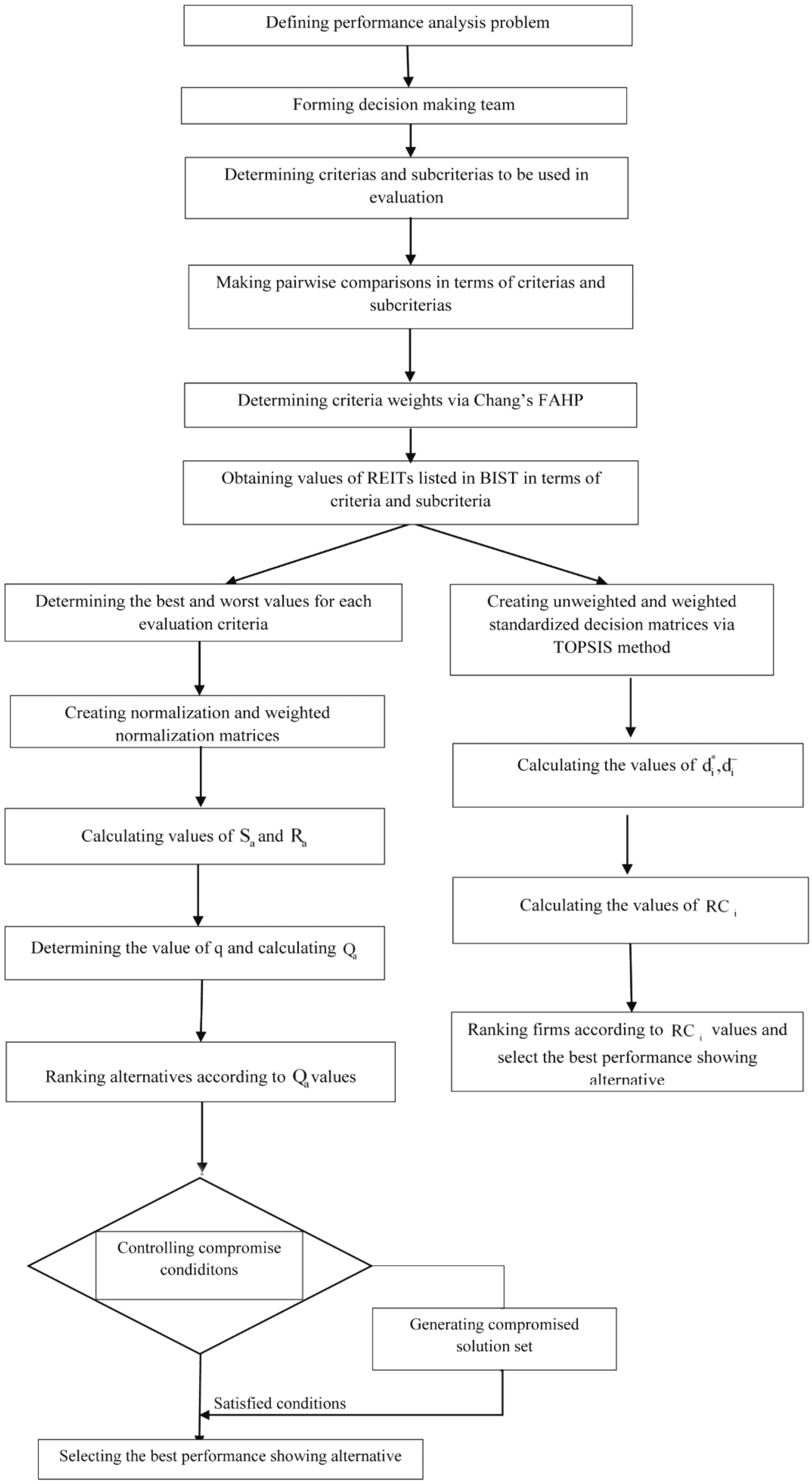

Figure 2. Flowchart of FAHP-VIKOR and FAHP-TOPSIS methodologies

5. Results

In application process a survey evaluating financial ratios was designed and conducted by face-to-face interview. Survey was applied between the dates 8 February 2016 and 20 February 2016 in order to determine weights of criteria for financial indicators. While defining the criteria, first of all, researchers made a depth literature review in order to develop the draft of the scale. 12real estate investment trusts (REIT) listed in BIST are taken into the consideration as alternatives.

Content validity is ensured by consulting to the experts' opinion (especially academicians' from finance field). After these procedures have been completed, data collection process started. Respondents were selected from financial experts worked in universities, public and private sector. Respondents were asked to compare four main criteria with respect to goal on a pair-wise basis to determine their relative importance. Also some demographic information towards respondents was collected and shown in Table 3. As a result, 17 complete surveys were collected and analyzed via Chang's FAHP method.

According to the results of FAHP weights of criteria are given in Table 4. For all comparisons including criteria consistency ratios are under the 0.1 threshold level so comparisons made were consistent. After the weights of criteria are determined, criteria related values of 12 REIT listed in BIST within the period of 2011-2015 are obtained from Public Disclosure Platform and firms' websites.

Table 3. Demographic variables of the study

Demographic Variables		**Frequency**	**Percent (%)**
Gender	Female	10	58.82
	Male	7	41.18
Age	18-30	1	5.88
	31-40	6	35.29
	41-50	7	41.18
	51-60	3	17.64
Experience in the finance	1-3	2	11.76
	4-6	1	5.88
	7-9	3	17.64
	10-12	6	35.29
	13+	5	29.41
Education	Bachelor's degree	2	11.76
	Post-graduate	7	41.18
	Doctorate	8	47.05
Institution	University (academicians)	8	47.05
	Public sector	4	23.52
	Private Sector	5	29.41

Table 4. Weights of financial indicators

Financial Indicators	**Weights**
Return on Assets	0.255596
Residual Income	0.249792
Economic Value Added	0.253283
Return on Sales	0.241329

According to the importance level of financial indicators, return on assets (ROA) was found as the most important criteria having the value of 0.255596. On the other hand return on sales was obtained as the least important one having the value of 0.241329. Relative closeness (RC_i) of each alternative and their rankings within the period of 2011-2014 are obtained via TOPSIS methodology and shown in Table 5.

Table 5. RC_i values and rankings of REITs according to descending order

	2011		2012		2013		2014	
Firms	RC_i	*Rank*	RC_i	*Rank*	RC_i	*Rank*	RC_i	*Rank*
NUGYO	0.363652	*9*	0.543981	*7*	0.55039	*5*	0.241236	*10*
KİLER GYO	0.527745	*3*	0.611882	*4*	0.449505	*9*	0.358172	*7*
OZGYO	0.565592	*2*	0.379978	*10*	0.546754	*6*	0.455646	*3*
AGYO	0.265579	*10*	0.867973	*1*	0.394781	*10*	0.328945	*8*
RYGYO	0.391972	*5*	0.574134	*5*	0.666109	*3*	0.303036	*9*
SNGYO	0.162617	*11*	0.376843	*11*	0.481068	*8*	0.585905	*2*
SAY GYO	0.658891	*1*	0.415573	*9*	0.48859	*7*	0.712948	*1*
TRGYO	0.474583	*4*	0.684152	*3*	0.681634	*1*	0.405697	*5*
TSGYO	0.372046	*6*	0.565475	*6*	0.555685	*4*	0.179965	*11*
VKGYO	0.44857	*12*	0.739762	*2*	0.681326	*2*	0.426156	*4*
YEŞİL GYO	0.370893	*7*	0.278034	*12*	0.341443	*12*	0.163785	*12*
YKGYO	0.368939	*8*	0.513973	*8*	0.377934	*11*	0.366939	*6*

According to the firms' ranking related to RC_i values YEŞİL GYO shows the worst performance and placed last in the years of 2012, 2013 and 2014; this condition is valid for VKGYO in 2011. However in the context of best financial performance SAY GYO places top position in 2011 and 2014. That is true for AGYO in 2012 and TRGYO in 2013.

By applying VIKOR methodology obtained S_a and R_a values for each REITs within the period of 2011-2014 are given in Table 6.

Table 6. S_a and R_a values of REITs

	2011		2012		2013		2014	
Firms	S_a	R_a	S_a	R_a	S_a	R_a	S_a	R_a
NUGYO	0.6662	0.2298	0.5204	0.2046	0.4471	0.1831	0.8334	0.2555
KİLER GYO	0.4621	0.2234	0.2738	0.1379	0.5499	0.2052	0.6950	0.2476
OZGYO	0.4318	0.1846	0.5939	0.2413	0.4231	0.1835	0.5569	0.1823
AGYO	0.7807	0.2413	0.1016	0.0821	0.6024	0.1937	0.7000	0.2263
RYGYO	0.7019	0.2497	0.4380	0.2442	0.2862	0.2497	0.7322	0.2497
SNGYO	0.8462	0.2532	0.5898	0.1903	0.5238	0.2413	0.3895	0.2279
SAY GYO	0.2276	0.2276	0.6126	0.2430	0.4976	0.1523	0.1829	0.1829
TRGYO	0.5267	0.2168	0.2218	0.1085	0.2917	0.1017	0.6078	0.1789
TSGYO	0.6567	0.2327	0.3947	0.2244	0.4055	0.1325	0.8466	0.2451
VKGYO	0.5749	0.2194	0.1218	0.1033	0.2349	0.1128	0.6009	0.2305
YEŞİL GYO	0.6270	0.2240	0.8418	0.2532	0.7695	0.2532	0.8697	0.2532
YKGYO	0.6950	0.2555	0.4333	0.2555	0.5483	0.2555	0.6781	0.2371

In order to obtain Q_a values of each alternative, consensus condition is considered and thus parameter (q) showing maximum group benefit is used as 0.5. Ranking of REITs in ascending order after acquiring Q_a values are shown in Table 7.

Table 7. Q_a values (q=0.5) and rankings of REITs according to ascending order

	2011		2012		2013		2014	
Firms	Q_a	*Rank*	Q_a	*Rank*	Q_a	*Rank*	Q_a	*Rank*
NUGYO	0.672929	*7*	0.635928	*6*	0.462957	*6*	0.973595	*11*
KİLER GYO	0.463023	*3*	0.277427	*4*	0.631075	*8*	0.821011	*8*
OZGYO	0.165058	*1*	0.791401	*10*	0.44192	*5*	0.294426	*2*
AGYO	0.846415	*10*	0	*1*	0.642705	*9*	0.685582	*6*
RYGYO	0.842448	*9*	0.694473	*8*	0.529164	*7*	0.862052	*9*
SNGYO	0.983689	*12*	0.641718	*7*	0.723814	*10*	0.470376	*4*

SAY GYO	0.302993	*2*	0.808923	*11*	0.410112	*4*	0.026468	*1*
TRGYO	0.468191	*4*	0.157561	*3*	0.053086	*2*	0.309321	*3*
TSGYO	0.685443	*8*	0.60827	*5*	0.259539	*3*	0.915003	*10*
VKGYO	0.525846	*5*	0.074969	*2*	0.035894	*1*	0.640665	*5*
YEŞİL GYO	0.600601	*6*	0.993334	*12*	0.992482	*12*	0.984918	*12*
YKGYO	0.877756	*11*	0.724246	*9*	0.793143	*11*	0.740488	*7*

According to the S_a, R_a and Q_a values acceptable advantage condition is satisfied for 2011 and 2014. For acceptable advantage condition, difference between first and second alternative having Q_a values are greater than or equal the threshold value (DQ = 0.090 for k=12). However according to Q_a values first alternative get the best score for values of S_a and/or R_a, thus acceptable stability condition is satisfied for four years period (2011-2014).

In terms of firms' ranking related to Q_a values YEŞİL GYO shows the worst performance and placed last in the years of 2012, 2013 and 2014 similar as ranking related to RC_i values in TOPSIS methodology. Apart from that SNGYO shows the worst performance in 2011.

However in the context of best financial performance, different firms place on the top for each year. In other words OZGYO, AGYO, VKGYO and SAY GYO place top position for each year respectively.

As a result both method give the same output in terms of finding the worst financial performance showing firm as YEŞİL GYO. Additionally they give similar and consistent results in the context of obtaining top five firms showing the best financial performance.

6. Recommendations and Future Research

There are not enough studies related to performance analysis of REITs operated in the world and especially for Turkey. In this study performances of REITs listed in BIST are analyzed in the context of different financial indicators and ranked via MCDM methods namely TOPSIS and VIKOR. For this purpose weights of financial indicators are obtained by Chang's extent analysis method on FAHP, one of the mostly used fuzzy ranking method. With these contributions it is aimed to fill the gap in literature. Ultimately both MCDM methods give the same results out of performance of VKGYO in 2011. For further researches it is recommended to integrate the different weights and ranking approaches with different financial indicators with respect to measuring performances of REITs.

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