AN APPLICATION OF TOPSIS METHOD FOR FINANCIAL DECISION MAKING PROCESS : A RESEARCH ON REAL ESTATE INVESTMENT TRUSTS LISTED IN BORSA ISTANBUL

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Abstract:

Managerial decision-making involves a difficult and complex process. Since executives shape the future of the company by making strategic decisions, it is vital that the decisions taken are accurate and efficient in terms of sustainability in the long term. Many managerial decision-making methods have been developed for companies to make the most accurate selection under multiple parameters and alternatives. In this study, the TOPSIS method, which is one of these methods, will examine how investors will choose the most reasonable one for investment from multiple companies.ween China and EU, we need to further strengthen China-EU comprehensive strategic partnership.

Keywords:

Borsa İstanbul, TOPSIS Method, Financial Ratios, Decision Making, Portfolio Management, REITs

1. Introduction

The adventure of decision making has become more difficult and complex over the years. Because of globalization in economic, sociological, cultural, financial fields, the convergence between countries has increased and the economic borders have disappeared. With the globalization and the huge advances in information and communication technologies, increasing competition, changing consumer profile and differentiating business models, managerial decision making process requires more parameters to be managed and controlled at the same time compared to previous years. Increasing competition among firms has reached a more destructive dimension and has shortened the life expectancy of firms. Therefore, many strategic decision-making methods are being applied in order to increase the managerial decision making ability. One of these methods is TOPSIS (Technique for Order - Preference by Similarity to Ideal Solution).

The TOPSIS method is a technique that allows the best selection of among alternatives according to various criteria. It was developed in 1981 by Hwang and Yoon. This method can be used in response to the problems encountered in daily life as well as in scientific studies. When deciding with this method, it is expected that a selected alternative should be close to the ideal solution and be far from the negative ideal solution. If financial return is in question, closeness to the ideal solution means maximization of return, and distance to negative ideal solution means minimization of cost. While the desired alternative is expected to be close to the ideal solution, it is expected to be as far from the negative ideal solution. Among the alternatives, the one close to the ideal solution, the one away from the negative ideal solution is selected.

In this study, the most suitable investment among the cement companies whose shares are traded on Borsa Istanbul will be determined based on the selected financial indicators with TOPSIS method.

2. Literature Review

Shih et al. (2007) developed a classic TOPSIS model and proposed a new model. They observed that the model they developed provide more successful results under different situations. They are not interested in weighting the criteria used in the TOPSIS method. Their focus is to develop the TOPSIS method, according to which weighting is already done at the beginning of the TOPSIS method. They stated that they did not discuss the interaction with other groups in their studies.

Cascales and Lamata (2012) stated that TOPSIS method can produce reversible sequence results as in many other qualified decision making methods. In their study, they first analyzed and ranked the 4 alternatives, and then observed that the ranking of the other remaining 3 alternatives changed as the last alternative was eliminated from the valuation. They found out that these changes violated the principle of invariance of utility theory and therefore stated that the validity of the TOPSIS method should be questioned. They found that this was caused by two factors: Negative Ideal Solution (NIS) and Positive Ideal Solution (PIS).

Sarraf and Bazargani (2013) emphasized that many firms are trying to create competitive advantages by using Knowledge Management (KM) efficiently. In their study, they tried to find out how firms can select and apply better KM strategies. They conducted an extension of TOPSIS called Multi – Attribute Decision Making (MADM) technique. TOPSIS is very beneficial technique for sorting and choosing of a number of externally determined options based on distance measures. According to their findings, among the six criteria evaluation, the most suitable KM strategy to be conducted is Personalization.

Bai (2013) proposes an intuitive fuzzy TOPSIS method based on the score function to solve multi-criteria decision-making problems in which information about all preferences of scoring is provided to decision makers. In order to determine the relative proximity coefficient, the scoring function was applied to calculate the separation / deviation measurements of each alternative from positive and negative ideal solutions. He stated that the best option could be chosen in the decision-making process by sorting the alternatives according to the proximity coefficient values. Two explanatory examples were used for multicriteria fuzzy decision making problems of alternatives in order to reveal the application and effectiveness of the proposed decision making method.

Shahrabi et al. (2007) propose a new model for the project selection problem using fuzzy AHP and TOPSIS techniques. In order to compare investment alternatives, NBD, Cost - Benefit Method and Payback Period were examined and used them as criteria in the AHP tree. In the analysis, firstly the weight of each criterion was calculated by using Fuzzy set theory and developed analytic hierarchy process. In the next stage, TOPSIS algorithm was applied and the projects were evaluated.

Jadidi et al. (2010) applied TOPSIS method in supplier selection process. They stated that supplier selection is a critical issue and is one of the most important activities of the purchasing department in particular. They emphasized that the selection of suppliers becomes more difficult because the managers who are the decision makers in the supplier valuation process do not have precise and complete information. During the selection process of the suppliers, they carried out a detailed comparison analysis of the TOPSIS method with other methods.

3. Sample Construction and Methodology

The data was obtained through interviews with experts in this study. As a result of the interviews conducted with 100 experts, the geometric mean of the responses received regarding financial indicators was used in the analysis. As a result of these data, comparison matrix was formed.

The companies included in the study are REIT companies whose shares are traded on Borsa İstanbul A.Ş. Using the financial data of 34 REITs, the most suitable ones for the investment will be determined.

Since the data of some firms in the sample could not be provided for the relevant period, they were excluded from the analysis. Thus, the number of firms in the final sample decreased to 22.

As a result of the interviews, it was concluded that the indicators reflecting the financial performance of the firms should be taken into consideration separately for short and long term investment analysis. For the short-term investment, as Market-Performance ratios, Price / Earnings (P / E) ratio and Market Value / Book Value (M / B) ratios are used in this study.

For the purpose of investment, the most attractive ones whose price performance is increasing while their above mentioned financial multipliers is decreasing. Suitable stocks will be determined based on this condition to clarify

cheaper (discounted) but have a significiant growth potential. Since P/ E and M / B financial multipliers become flat or even decrease in response to observing increasing substantial in stock prices, it will suggest that these sample firms' financial statement performance is higher than their price performance. Based on this finding, it will be available to underline that purchasing or holding this stocks will be reasonable decision for the investors.

Analytical Hierarchy Process (AHP) (Saaty, 1994) was used to weight the financial indicators used in the study. In AHP, both quantitative and qualitative variables are analyzed together. The determination of quantitative and qualitative variables is based on the priorities and feedback of individuals. After determination of variables and weights, TOPSIS method is applied.

In the basic logic of TOPSIS, which is a multi-criteria decision making method, the alternatives that are closest to the positive ideal solution and the farthest away from the negative ideal solution are selected.

The steps of the TOPSIS method are shown below (Mahmoodzadeh, 2007: 273-274):
1- Establishing of decision matrix for ranking:

$$B = \begin{bmatrix} b11 & b12 & ... & b1n \\ b21 & b22 & ... & b2n \\ ... & ... & ... & \cdots \\ ... & ... & ... & ... \\ ... & ... & ... & ... \\ bn1 & bn2 & bn3 & bn4 \end{bmatrix} \quad (1)$$

The rows in the decision matrix represent the alternatives presented for the investors and the columns represent the evaluation criteria and b11 in the matrix reveals the real value of the 1st alternative in the matrix according to the 1st criterion (Shih et al., 2007: 805).

2- Creating a Normalized Decision Matrix:
In order to calculate normalized decision matrix the following equation will be used:

$$\frac{bij}{\sqrt{\int_{j=1}^{n} bij2}} \quad (2)$$

3- Calculating of Weighted Normalized Decision Matrix:
The weighted decision matrix is calculated by multiplying the normalized decision matrix by the associated weights. The weighted normalized value Vij is calculated as follows:

$$Vij = wij * rij \quad (3)$$

4- Calculating Positive and Negative Ideal Solutions:
The best value of the weighted decision matrix represents the positive ideal solution and the worst value represents the negative ideal solution, and the positive and negative ideal solutions are calculated as follows (Baykal, 2007: 27):

$$V^+ = \{V1^+, V2^+, V3^+, \dots\dots\dots, VN^+\} \quad (4)$$

$$\{(\ Max\ vij|\ j \in J\ ), (\ Min\ vij|\ j \in J\ )\ \}$$

$$V^- = \{V1^-, V2^-, V3^-, \dots\dots\dots, VN^-\} \quad (5)$$

$$\{(\ Min\ vij|\ j \in J^\iota\ ), (\ Max\ vij|\ j \in J^\iota\ )\ \}$$

In Equations 4 and 5, J stands for positive and J 1 stands for negative.

5- Calculating of Separation Measures:
Equations 6 and 7 show the distance from the positive and negative ideal solution, respectively.

$$\text{Di}^+ = \sqrt{\int_{j=1}^{n} (vij - vj^+)\dot{2}} \,, i = 1, \dots \dots \dots m \qquad (6)$$

$$\text{Di}^- = \sqrt{\int_{j=1}^{n} (vij - vj^-)\dot{2}} \,, i = 1, \dots \dots \dots m \qquad (7)$$

6- Calculating the Relative Closeness to the Ideal Solution:
The relative closeness of alternative B to the positive ideal solution is calculated by the following equation:

$$\overline{C\dot{I}} \;=\; \frac{Di^-}{Di^+ + D^-} \qquad (8)$$

$\pi/C\dot{I}$ takes values between 0 and 1. The higher the value of the index refers that related alternative provides a better solution than other alternatives.

4. Test Result - Findings
Table 1. shows REITs price performance, P /E and M / B financial multiplies as follows:

Table.1: Descriptive Information of Sample Firms

Equity Codes	Stock Price Performance % (Annual Basis)	P / E	M / B
AGYO	*-8,33*	12,9	0,6
AKFGY	*36,36*	1,8	0,5
AKMGY	*38,29*	8,8	3,7
AKSGY	*12,72*	1,4	0,3
ALGYO	*18,66*	2,4	0,4
AVGYO	*27,27*	3,7	0,5
DZGYO	*12,17*	5,3	0,7
EKGYO	*-13,7*	9,7	0,4
HLGYO	*46,88*	2,3	0,4
ISGYO	*-14,81*	3,9	0,2
KLGYO	*6,86*	5,2	0,2
KRGYO	*13,11*	5,6	0,8
MSGYO	*-13,73*	22	0,8

OZKGY	*8,97*	2,9	0,3
PAGYO	*22,55*	5,6	0,4
RYGYO	*108,7*	1,5	0,3
SRVGY	*10,21*	7,8	0,6
TDGYO	*14,96*	23,9	0,9
TRGYO	*3,31*	1,3	0,2
VKGYO	*-10,26*	10,7	0,4
YGGYO	*41,09*	5,5	0,8
YKGYO	*8,14*	9,1	1

Ratios are caculated based on financial indicators reported in financial statements as of 6/2019

Based on table 1 above, what first thing that should be done is determining maximum and minimum objective definitions. Among the criteria, stock prices should be maximum while other criteria refer to minimum.

Based on TOPSIS method approach, following calculations will be performed respectively:

Step-1 : Calculation of Normalized Decision Matrix

Normalized Decision Matrix is shown in Table 2 as follows:

Table.2: Normalized Decision Matrix

Equity Codes	Stock Price Performance % (Annual Basis)		P / E	M / B
AGYO	-	0,06	0,30	0,13
AKFGY		0,25	0,01	0,11
AKMGY		0,26	0,06	0,82
AKSGY		0,09	0,01	0,07
ALGYO		0,13	0,02	0,09
AVGYO		0,18	0,03	0,11
DZGYO		0,08	0,04	0,16
EKGYO	-	0,09	0,07	0,09
HLGYO		0,32	0,02	0,09
ISGYO	-	0,10	0,03	0,04
KLGYO		0,05	0,04	0,04
KRGYO		0,09	0,04	0,18
MSGYO	-	0,09	0,15	0,18
OZKGY		0,06	0,02	0,07
PAGYO		0,15	0,04	0,09
RYGYO		0,73	0,01	0,07
SRVGY		0,07	0,05	0,13
TDGYO		0,10	0,16	0,20

TRGYO	0,02	0,01	0,04
VKGYO	- 0,07	0,07	0,09
YGGYO	0,28	0,04	0,18
YKGYO	0,06	0,06	0,22

Step-2 : Calculation of Weighted Normalized Decision Matrix

Weighted Normalized Decision Matrix is Shown in Table 3 as follows:

Table.3: Weighted Normalized Decision Matrix

Equity Codes	Stock Price Performance % (Annual Basis)	P / E	M / B
AGYO	- 0,02	0,10	0,04
AKFGY	0,09	0,00	0,03
AKMGY	0,09	0,02	0,25
AKSGY	0,03	0,00	0,02
ALGYO	0,04	0,01	0,03
AVGYO	0,06	0,01	0,03
DZGYO	0,03	0,01	0,05
EKGYO	- 0,03	0,02	0,03
HLGYO	0,11	0,01	0,03
ISGYO	- 0,04	0,01	0,01
KLGYO	0,02	0,01	0,01
KRGYO	0,03	0,01	0,05
MSGYO	- 0,03	0,05	0,05
OZKGY	0,02	0,01	0,02
PAGYO	0,05	0,01	0,03
RYGYO	0,26	0,00	0,02
SRVGY	0,02	0,02	0,04
TDGYO	0,04	0,06	0,06
TRGYO	0,01	0,00	0,01
VKGYO	- 0,02	0,03	0,03
YGGYO	0,10	0,01	0,05
YKGYO	0,02	0,02	0,07

Step-3 : Calculation of İdeal Best (Positive Ideal Solution-PIS) and İdeal Worst (Negative Ideal Solution – NIS) Values

Ideal best and ideal worst values are calculated according to each criteria's objectives.

Table.4: Ideal Best and Ideal Worst Values

V+	0,26	0,00	0,01
V-	-0,04	0,10	0,25

V+ and V- refer to PIS and NIS respectively.

Step-4 : Calculating of Separation Measures

By subtracting PIS and NIS from each value included in the matrix, separation measures can be calculated as follows:

Table.5: Separation Measures

Equity Codes	Stock Price Performance % (Annual Basis)		P / E	M / B	Di+	Di-
AGYO	-	0,02	0,10	0,04	0,30	0,21
AKFGY		0,09	0,00	0,03	0,17	0,26
AKMGY		0,09	0,02	0,25	0,29	0,15
AKSGY		0,03	0,00	0,02	0,23	0,26
ALGYO		0,04	0,01	0,03	0,21	0,25
AVGYO		0,06	0,01	0,03	0,19	0,25
DZGYO		0,03	0,01	0,05	0,23	0,23
EKGYO	-	0,03	0,02	0,03	0,29	0,23
HLGYO		0,11	0,01	0,03	0,15	0,28
ISGYO	-	0,04	0,01	0,01	0,29	0,25
KLGYO		0,02	0,01	0,01	0,24	0,26
KRGYO		0,03	0,01	0,05	0,23	0,22
MSGYO	-	0,03	0,05	0,05	0,30	0,20
OZKGY		0,02	0,01	0,02	0,24	0,25
PAGYO		0,05	0,01	0,03	0,20	0,25
RYGYO		0,26	0,00	0,02	0,01	0,38
SRVGY		0,02	0,02	0,04	0,24	0,23
TDGYO		0,04	0,06	0,06	0,23	0,20
TRGYO		0,01	0,00	0,01	0,25	0,26
VKGYO	-	0,02	0,03	0,03	0,28	0,23
YGGYO		0,10	0,01	0,05	0,17	0,25
YKGYO		0,02	0,02	0,07	0,24	0,21

Step-5 : Relative Closeness to the Ideal Solution (Performance Score)
Performance scores of each alternative can be represented in table 6 as follow:

Table.6: Performance Score of Each Alternatives

Equity Codes	Stock Price Performance % (Annual Basis)	P / E	M / B	Di+	Di-	Ci
AGYO	-0,02	0,10	0,04	0,30	0,21	0,41
AKFGY	0,09	0,00	0,03	0,17	0,26	0,61
AKMGY	0,09	0,02	0,25	0,29	0,15	0,34
AKSGY	0,03	0,00	0,02	0,23	0,26	0,53
ALGYO	0,04	0,01	0,03	0,21	0,25	0,54
AVGYO	0,06	0,01	0,03	0,19	0,25	0,57
DZGYO	0,03	0,01	0,05	0,23	0,23	0,50
EKGYO	-0,03	0,02	0,03	0,29	0,23	0,45
HLGYO	0,11	0,01	0,03	0,15	0,28	0,66
ISGYO	-0,04	0,01	0,01	0,29	0,25	0,46
KLGYO	0,02	0,01	0,01	0,24	0,26	0,51
KRGYO	0,03	0,01	0,05	0,23	0,22	0,49
MSGYO	-0,03	0,05	0,05	0,30	0,20	0,40
OZKGY	0,02	0,01	0,02	0,24	0,25	0,52
PAGYO	0,05	0,01	0,03	0,20	0,25	0,55
RYGYO	0,26	0,00	0,02	0,01	0,38	0,98
SRVGY	0,02	0,02	0,04	0,24	0,23	0,50

TDGYO	0,04	0,06	0,06	0,23	0,20	0,47
TRGYO	0,01	0,00	0,01	0,25	0,26	0,51
VKGYO	-0,02	0,03	0,03	0,28	0,23	0,45
YGGYO	0,10	0,01	0,05	0,17	0,25	0,60
YKGYO	0,02	0,02	0,07	0,24	0,21	0,46

Based on performance scores of each alternative, alternatives can be ranked as descending as shown in Table 7.

Table.7: Ranking of Alternatives

Equity Codes	Stock Price Performance % (Annual Basis)	P / E	M / B	Di+	Di-	Ci	Ranking
AGYO	-0,02	0,10	0,04	0,30	0,21	0,41	20
AKFGY	0,09	0,00	0,03	0,17	0,26	0,61	3
AKMGY	0,09	0,02	0,25	0,29	0,15	0,34	22
AKSGY	0,03	0,00	0,02	0,23	0,26	0,53	8
ALGYO	0,04	0,01	0,03	0,21	0,25	0,54	7
AVGYO	0,06	0,01	0,03	0,19	0,25	0,57	5
DZGYO	0,03	0,01	0,05	0,23	0,23	0,50	12
EKGYO	-0,03	0,02	0,03	0,29	0,23	0,45	19
HLGYO	0,11	0,01	0,03	0,15	0,28	0,66	2
ISGYO	-0,04	0,01	0,01	0,29	0,25	0,46	16
KLGYO	0,02	0,01	0,01	0,24	0,26	0,51	10
KRGYO	0,03	0,01	0,05	0,23	0,22	0,49	14
MSGYO	-						21

	0,03	0,05	0,05	0,30	0,20	0,40	
OZKGY	0,02	0,01	0,02	0,24	0,25	0,52	9
PAGYO	0,05	0,01	0,03	0,20	0,25	0,55	6
RYGYO	0,26	0,00	0,02	0,01	0,38	0,98	1
SRVGY	0,02	0,02	0,04	0,24	0,23	0,50	13
TDGYO	0,04	0,06	0,06	0,23	0,20	0,47	15
TRGYO	0,01	0,00	0,01	0,25	0,26	0,51	11
VKGYO	-0,02	0,03	0,03	0,28	0,23	0,45	18
YGGYO	0,10	0,01	0,05	0,17	0,25	0,60	4
YKGYO	0,02	0,02	0,07	0,24	0,21	0,46	17

According to the above results, the most suitable company for investment in the short term according to the financial ratios prepared on the basis of financial statements dated 30/6/2019 among the REIT companies traded in BIST is Reysaş REIT corp.

6. Conclusion

In today's world of competition, there are many internal and external factors that affect the decisions of businesses. Making accurate and effective decisions requires managing a much more difficult and complex process than ever before. Managers take benefits from their own professional experience, intuition, and knowledge of other experts and consultants in the decision-making process. However, they also apply various types of quantitative techniques to approach to the problem analytically during the decision-making process. One of these methods is TOPSIS method. This method focuses on choosing the most appropriate of the available alternatives in line with the predetermined purpose and the criteria established for this purpose.

In this study, it is tried to select the most suitable stock among the 34 REIT companies that shares are traded on the BIST for the short term investment by using the data that covers financial ratios calculated on the financial statements dated 30/06/2019 and stock price performance. As a result of the interview with the experts, the financial ratios to be used in the short-term stock portfolio preferences are determined as Price / Earnings (P / E) and Market Value / Book Value (M / B) ratios.

The objective of the study is to find the stocks that these ratios still give cheap / discounted signals after performing high price performance. For this purpose, a decision matrix consisting of 3 criteria (include stock price performance, P / E and M / B ratios) and investment alternatives (include 34 REIT companies) was prepared and analyzed through the TOPSIS method.

As a result of the analysis, for short-term investment, the most suitable stock for investment among the REIT companies in BIST is determined as RYGYO. RYGYO performed more than 100 increase but it has still upside approximately %300 upside potential according to financial multiplies.

It is worth noting that the result calculated in the study was obtained according to the objective function determined as a result of the 100 capital markets and stock exchange experts interviewed. In line with the answers received from

the experts, the main purpose of the study was to find the stocks whose financial ratios still give cheap signals despite the high price performance.

In addition, investment analysis horizon is defined as short term in this study. In the medium to long term, this result may be misleading. The results of this test may be different depending on the selected term and the desired objective function.

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