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Performance Measurement in Retail Industry By Using A Multi-Criteria Decision Making Methods

Çok Kriterli Karar Verme Metodları Kullanılarak Perakende Sektöründe Performans Ölçümü

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ABSTRACT

The retail industry is vital to the development of every country's economy in terms of its contribution to the economy and positive effects on employment. Recently, performance measurement has become critical to this industry that constantly improves significantly. The aim of this study was to compare the retail firms' performances between the years 2010 and 2014 measured with integrated MCDM (Multi Criteria Decision Making) techniques. For this purpose, 8 retail firms from the list of top 500 companies published by "Fortune TURKEY" were analyzed with the TOPSIS, MAUT and SAW methods using the eight financial ratios within the liquidity, leverage, profitability and activity indicators. At the end of the analysis, three different methods provided three different performance rankings.

Keywords: Performance measurement, MCDM techniques, Retail industry

ÖZET

Perakende sektörü, gerek ekonomiye sağladığı katkı gerekse istihdam üzerindeki olumlu etkisi nedeniyle ülkelerin ekonomik kalkınmalarında önemli bir yere sahiptir. Son yıllarda görülen gelişmeler ile önemli mesafeler kat edilen bu sektörde performans ölçümü oldukça önemli hale gelmiştir. Bu çalışmanın amacı bütünleşik ÇKKV (Çok Kriterli Karar Verme) yöntemlerini kullanarak 2010-2014 dönemi çerçevesinde perakende sektöründe faaliyet gösteren firmaların performanslarını karşılaştırmaktır. Bu amaçla "Fortune TÜRKİYE" dergisinin açıkladığı ilk 500 firma listesinde yer alan 8 perakendeci firma likidite, kaldıraç, karlılık ve faaliyet göstergeleri kapsamındaki sekiz finansal orana göre TOPSIS, MAUT ve SAW yöntemleri ile değerlendirilmiştir. Uygulama sonunda kullanılan her üç yönteme göre firma performans sıralamalarının farklı olduğu tespit edilmiştir.

Anahtar Kelimeler: Performans ölçümü, ÇKKV teknikleri, Perakende sektörü

1. INTRODUCTION

Rapid changes in industry and technology in conjunction with increasing world population cause new requirements to emerge. Commerce has a share and constantly grows in such an interactive world. Indicators of the changes in trade are perceptibly marked in retail sector.

Retail sector, made remarkable progress in Turkey within the last decade. The ability of finding and using the right opportunities has enabled the retail industry of Turkey where traditional retail business turns into modern retail business to make a great progress. With its growing economy and young population, Turkey's retail sector has been targeted by retail giant countries which aim at groups with high purchasing power and are mostly focused on demographic trends. This increased the competition in the market, enabled successful retailers who endeavored to survive the competition in the market to constantly adapt themselves to the changing conditions, and aim at having a sustainable competitive advantage. These developments made performance measurement vital to the retail industry.

Performance measurement can be defined as the process of collecting, analyzing and/or reporting information systematically to monitor the sources used, products manufactured and services provided by an enterprise (Eleren and Soba, 2009). By this means, enterprise activities and outputs are inspected, evaluated and improved, and the extent of deviation from goals may be determined through comparison of predetermined goals and realized results (Lebas,

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1995: 24-26).In the literature, it is seen that methods such as ratio analysis based on financial ratios in balance sheets, or regression analysis are used in performance measurements. The mostly preferred method among the nonparametric methods is the Data Envelopment Analysis (DEA). Multi-Criteria Decision Making is an alternative method employed in performance evaluation (Çakır and Perçin, 2013: 450).

MCDM is comprised of cumulative analytic methods which evaluate advantages and disadvantages of alternatives based on multiple criteria (Wang et al., 2004: 574). MCDM methods are used in performance measurement and results obtained can be used to rank, choose and classify alternatives.

In the domestic and foreign literatures are scanned, it is seen that studies on the retail industry are very limited. Performance measurement of retail suppliers (Akdeniz and Turgutlu, 2007), (Gemici, 2009), (Ganesan et al., 2009); selection of suppliers (Yavuz, 2013), (Kaplan, 2010), (Wagner et al., 1989), (Wu and Olson, 2008), (Yeğin, 2009), (Kazançoğlu and Ada, 2010); customers (Duygun and Menteş, 2016), (Gagliano and Hathcote, 1994), (Razzaque, 2008), (Tayfun, 2015) and employees(Yüksekbilgili and Akduman, 2015), (Rapp et al., 2015), (Knight et al., 2007), (Candemir et al., 2015) have been the topics studied mostly. Mentionedstudies seem to use multi-variable statistical methods and non-parametric methods such as Data Envelopment Analysis in general and often use MCDM methods.

The number of studies done to measure retail firms' performances using MCDM techniques is not high, and no hybrid MCDM models but singular distributions were used in those studies.

Özgüven (2011), evaluated performances of retail companies Migros, Carrefour and Kipa, which were ranked in the list of top ten published by the Economist magazine in the year 2009. Five criteria were considered in performance measurement: 'capacity ratio', 'PE/C ratio', 'store turnover ratio', 'net profit/net sales', 'marketing sales distribution expenditures/ total expenditures'. The TOPSIS method was used to evaluate performances between 2005-2009, which is the pre-crisis period.

Gökalp (2009), evaluated 'financial and non-financial' performances of retail companies CarrefourSA, Migros, Tesco Kipa and BİM in an integrated manner. In the said study, the survey method was utilized to collect necessary data and performances of companies in question were revealed using the TOPSIS analysis on the collected data.

Özbek (2016), measured the performance of BİM a retail company publicly traded in Istanbul Stock Exchange between 2008-2015. In the study conducted using the ELECTRE III method of MCDM, the firm's liquidity ratios, financial ratios, activity ratios, and profitability ratios that may have impacts on its financial status were taken into account.

This study aims to compare the performance measurement of 8 companies which operate in the retail sector and are among the top 500 companies announced by "Fortune TURKEY" magazine for 2010-2014 period by using TOPSIS, MAUT and SAW methods from MCDM techniques. In the related literature, though there have been some recent studies on the performance evaluation in the retail sector by using MCDM methods, there are no studies where the performance evaluation of the retailer companies have been conducted by using integrated MCDM methods. In this context, the main difference of this study from other studies in the retail sector is that it aims to measure the performance measurement of multiple retail companies by multiple MCDM methods. Therefore, the main contribution of this study to the current literature is to perform performance measurement in the retail sector by using multiple integrated MCDM methods instead of a single method, and to fill the gap in the literature by putting forward the differences between the methods.

This paper will first introduce MCDM analysis and the TOPSIS, MAUT and SAW methods thereof. Then, it will explain the aforementioned methods used and applied to measure retailers' performances, and finally, will scrutinize the findings.

2. METHODOLOGY

In this part of the study, mathematical notations of and approaches to the MCDM methods TOPSIS, MAUT and SAW were described.

2.1. Topsis Method

TOPSIS (technique for order preference by similarity to an ideal solution) method is presented in Chen and Hwang (1992), with reference to Hwang and Yoon (1981).The basic principle is that the chosen alternative should have the shortest distance from the ideal solution and the farthest distance from the negative-ideal solution (Opricovic and Tzeng, 2002:

448). The TOPSIS procedure consists of the following steps (Triantaphyllou, 2000: 18):

Step 1: Calculate the Normalized Decision Matrix

Decision matrix is needed to be normalized in order to make the different criteria comparable and it is calculated with the help of formula (1) and;

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \quad (1)$$

where r_{ij} is the normalized criteria/attribute value /rating.

and $R = \left[r_{ij} \right]_{mxn}$ matris is established.

Step 2: Calculate the Weighted Normalized Decision Matrix

The value v_{ij} is calculated by using formula (2)

$$v_{ij} = r_{ij} * w_j \quad (2)$$

where w_j is the relative weight of the j. criterion or attribute and $\sum_{j=1}^{n} w_j = 1$.Thus, the weighted normalized decision matrix $V_{ij} = \left[v_{ij} \right]_{mxn}$ is established.

Step 3: Determine The Positive-İdeal and Negative-İdeal Solutions.

The positive ideal (A^*) and the negative ideal (A^-) solutions are defined according to the weighted decision matrix via formula (3) and (4) below;

$$A^* = \left\{ (\max_i v_{ij} \,\middle|\, j \in J), (\min_i v_{ij} \,\middle|\, j \in J^{\mathrm{I}}, i = 1,2,...m) \right\} = \left\{ v_1^* \, v_2^* ..., v_n^* \right\} \quad (3)$$

$$A^- = \left\{ (\min_i v_{ij} \,\middle|\, j \in J), (\max_i v_{ij} \,\middle|\, j \in J^{\mathrm{I}}, i = 1,2,...m) \right\} = \left\{ v_1^- \, v_2^- ..., v_n^- \right\} \quad (4)$$

Step 4: Calculate the Separation Measures

The separation of each alternative from the positive ideal one is given by:

$$S_i^* = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2} \quad (5)$$

Similarly, the separation of each alternative from the negative ideal one is given by:

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad (6)$$

Ideal and negative ideal discrimination measures are found by the two formula given above and calculated (S_i^*) and (S_i^-) numbers are equal to the number of alternatives.

Step 5: Calculate the Relative Closeness to the Ideal Solution

The relative closeness of the i. alternative with respect to the ideal solution C_i is defined as

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \; 0 \le C_i^* \le 1 (_{i=1,2,3,...,m.}) \quad (7)$$

2.2. Maut Method

MAUT (Multiple Attribute Utility Theory) is widely used in the Anglo-Saxon world and is based on the main hypothesis that every decision maker tries to optimize, consciously or implicitly, a function which aggregates all their points of view. This means that the decision maker's preferences can be represented by a function, called the utility function U (Keeney and Raiffa, 1976). The primary rationale of MAUT method is that there is a U utility function with real value defined over suitable alternatives cluster in every decision making problem, and decision maker maximizes such function (Olson, 1995). The steps of the method are as follows(Zietsman et al., 2006: 259-260; Erol et al., 2011: 1092).

Step 1: Generate Criteria and Alternatives

Step 2: Determination of the Weight Values.

All values of w_j must be equal to 1.

$$\sum_{1}^{m} w_j = 1$$

Step 3: Form the Decision Matrix

Step 4: Figures assigned are placed into a decision matrix, and then a normalization process is performed. The normalization step is usually based on the minimum and maximum performance of the alternatives on each criterion. When maximizing the criterion;

$$r_{ij} = \frac{x_{ij} - l_j^-}{u_j^+ - l_j^-} \quad (8)$$

or when minimizing the criterion;

$$r_{ij} = \frac{u_j^+ - x_{ij}}{u_j^+ - l_j^-} \quad (9)$$

where $l_j^- = \min_i x_{ij} \text{and} u_j^+ = \max_i x_{ij}$

Step 5: After normalization, utility values are determined. The utility function formula is as shown in formula (10).

$$U_j = \sum_{k=1}^{n_k} w_k n_{kj} \quad (10)$$

Terms used in this formula are shown below:

U_j: utility of alternative j
n_{kj}: normalised criterion k value for alternative j
w_k: weight of the *kth* criterion

Step 6: Rank the alternatives, choose an alternative which gain the most utility.

2.3.Saw Method

Churchman and Ackoff (1954) first utilized the SAW (Simple Additive Weighting) method to cope with a portfolio selection problem. The SAW method is probably the best known and widely used method for multiple attribute decision making (Jain and Raj, 2013: 225). SAW technique is simple and is the basis of most MADM (Multiple Attribute Decision Making) techniques such as AHP and PROMETHEE that benefits from additive property for calculating final score of alternatives (Memariani et al., 2009: 14). The basic logic of the SAW method is to obtain a weighted sum of performance ratings of each alternative over all attributes (Adriyendi, 2015: 10). The steps of the method are as follows(Yeh and Willis, 2001: 42-43).

Step 1: Normalization of Decision Matrix

In SAW Method, decision matrix which is initially comprised of m alternatives and n evaluation criteria is normalized with formula (11) and (12).

$$r_{ij} = \frac{X_{ij}}{\max_i X_{ij}} \textit{ if j is a benefit attribute} \quad (11)$$

$$r_{ij} = \frac{\min_i X_{ij}}{X_{ij}} \quad \textit{if j is a cost attribute} \quad (12)$$

$i = 1, \ldots, m; j = 1, \ldots, n$

where $r_{ij} (0 \le r_{ij} \le 1)$ is defined as the normalized performance rating of altemative A_i on criterion C_j.

Step 2: Calculation of Preference Values of Alternatives

Total preference values of each alternative are calculated with the formula (13).

$$V_i = \sum_{j=1}^{n} W_j r_{ij} \quad (13)$$

$i = 1, 2, \ldots, m.$

Here, (W_j) notation indicates the importance weight assigned to the criterion j.The greater the value (V_i), the more preferred the altemative (A_i).

3. APPLICATION

The retail sector has become a very important sector for Turkey due to its significant contribution to both employment and economy. Despite the growing importance of the retail sector, few studies have been found in the literature on the performance evaluation of the retailer companies. The studies to be performed to evaluate the performance of the retailer companies in this sector, where the tax contribution to the national economy is of great importance, will contribute to the productivity of the growing industry. In this respect, the performance measurement in the sector in question has now become a necessity for the retailer companies to be able to monitor and measure their performance compared to their rivals and for the businesses to increase their sensitivity against the internal and external environment.

In this study, within the scope of practice, the performance of companies which operate in the retail sector and are included in "Fortune TURKEY" list has been measured according to the TOPSIS, MAUT and SAW methods of MCDM techniques based on 2010-2014 period.

3.1. Data and Sample

Multi-criteria decision making method has been used since the performance is evaluated with many criteria. In order for a multi-criteria decision-making problem to occur, there must be at least two alternatives for the multiple conflicting criteria and decisions. In such problems, examining the alternatives for the decision maker and ranking them according to their importance level, and choosing the priority alternative play a key role in decision analysis (Jahanshahloo et al., 2006: 1545). Criteria are used to measure the effects of the alternatives and include the features that will form the basis of evaluation activities (Lai

and Hwang, 1994: 27). These criteria are important in determining which alternative we will take into consideration when making the choice.

Although there are 21 retailers in the "Fortune TURKEY" list, 8 companies whose data is sufficient for the analysis have been included into the analysis. Despite the low number of companies included into the analysis, the reason for preferring the retail sector, which has great importance for the country and is a newer sector compared to other sectors, is the fact that the sector in question is one of the locomotive sectors of the Turkish economy and is of great importance for our country. Likewise, the performance measurement in this highly competitive sector allows the retailer companies to monitor and measure their performance compared to their rivals, and increases the sensitivity of the businesses towards their internal and external environment. In this respect, 8 companies mentioned as alternative have been chosen in order to make the performance ranking of the companies as of the years and be able to determine which company has the highest performance.

Table 1 shows the list of retailers subject to this analysis, and their ranking and codes published in Fortune Magazine.

In the study as a criterion, 8 financial ratios including current ratio and acid test ratio within the scope of liquidity ratio; Liability/Equity Ratio ve Liability Ratio within the scope of Leverage Ratio; Gross Profit Margin and Profit before Interest and Tax/Total Assets Ratio within teh scope ofProfitability Ratio; Receivable Turnover and Assets Turnover within the scope of Activity Ratio have been taken the basis as the criteria.

The type of financial criteria that should be used to measure the performance of the retail industry has not been cleared yet. Due to differences in accounting applications, and delicacy of gathering financial data, different types of financial criteria have been used in former studies (Gökalp, 2009: 70). The financial rates to be used in measuring retailers' performances were not clearly available in the literature; so, the relevant literature, expert opinion and data convenience were considered to obtain data in this study. The data needed were obtained from Fortune Magazine (http://www.fortuneturkey.com/fortune500), and the firms' annual reports. Financial ratios used in the study were selected based on their ability to give information on liquidity of companies, efficient use of company assets, financial structure and profitability. Criteria used in performance evaluation of retail companies and their optimization directions are given in Table 2.

Table 1: Retail Companies Ranked in the List of Fortune 500

Code	Firms	Ranking
A1	BİM	8
A2	MİGROS	19
A3	CARREFOURSA	35
A4	TEKNOSA	43
A5	TESCO-KİPA	64
A6	BİMEKS	100
A7	ADESE	247
A8	UYUM	364

Table 2: Criteria Used in Performance Measurement

Type of Ratio	Criteria	Code	Optimization State
Liquidity Ratio	Current Ratio=Current Assets/Current Liabilities	**B1**	**max**
	Acid Test Ratio=(Current Assets-Inventories)/Current Liabilities	**B2**	**max**
Leverage Ratio	Liability/Equity Ratio=Long-Term Liabilities/Equity	**B3**	**min**
	Liability Ratio=Total Liabilities/Total Assets	**B4**	**min**
Profitability Ratio	Gross Profit Margin=Gross Sales Profit/Net Sales	**B5**	**max**
	Profit before Interest and Tax/Total Assets Ratio=Profit before Interest and Tax/Total Assets	**B6**	**max**
Activity Ratio	Receivable Turnover=Net Sales/Trade Receivables	**B7**	**max**
	Assets Turnover=Net Sales/Total Assets	**B8**	**max**

The financial ratios in Table 2 are the most frequently used financial ratios (Dağlı, 2009: 33-62). The descriptions of the financial ratios are given below based on ratio groups.

Liquidity Ratio

Liquidity ratios are used for measuring solvency of company to meet its short term liabilities or in other words, for evaluating its liquidity risk and to determine whether its net working capital is sufficient (Akgüç, 2011: 436).

Leverage Ratio

This ratio represents the proportions of liabilities and equities used to finance a firm's assets. Higher ratios point out a heavy burden of debt and interest on a firm, and a lower safety margin for creditors, and higher risk of failure to pay for debts (Peker and Baki, 2011: 10).

Profitability Ratio

This ratio provides information about company's ability to generate earnings and efficiency of activities in the past (Akdoğan and Tenker, 2007: 668), and reflects the net result of company's financing policies and activities (Brigham and Houston, 2014: 102).

Activity Ratio

Activity ratios are financial ratios which represent a firm's assets, how much a firm invests in proportion to the income from those assets, and measure how effectively a firm is using its assets. Although higher activity ratios are desirable, it is more significant when profitability is as high as these ratios (Aydın et al., 2011: 68).

In this study, within the scope of application, 5 different data sets were prepared for 8 different alternatives and 8 criteria for the period 2010-2014 and the performances of retailer firms were measured according to the TOPSIS, MAUT and SAW methods. Tables of retail companies for 2014 are given in Table 3 according to 8 identified criteria.

In the first step, the criteria were equally weighted using the data given in Table 3, and then the firms' performances were measured using the TOPSIS, MAUT and SAW methods.

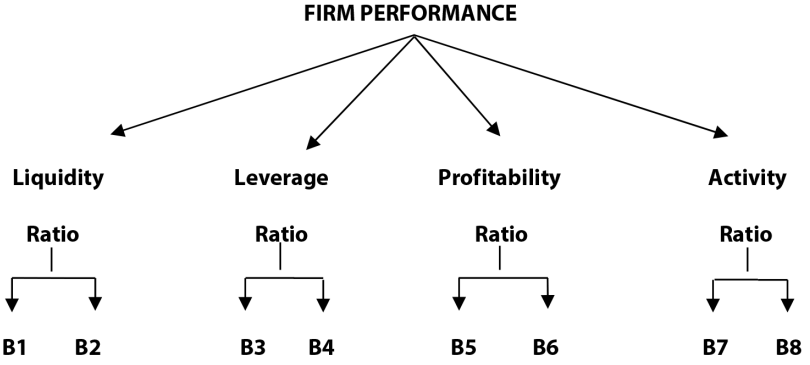

Figure 1: Hierarchical Structure of Firm Performance Assessment System

Table 3: Decision Matrix of Criteria for the year 2014

2014	Criteria							
Alternatives	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**
A1	0,8966	0,4972	0,0585	0,6450	0,1539	160,82	32,48	4,47
A2	0,6367	0,2822	2,1301	0,8360	0,2667	65,61	169,76	1,45
A3	0,6874	0,1848	0,0541	0,5059	0,2505	0,08	282,30	1,703
A4	1,0060	0,3062	0,0179	0,8016	0,1826	-1,89	109,48	25,507
A5	0,6433	0,2843	0,0469	0,4363	0,2109	-0,33	51,82	5,568
A6	1,4098	0,3307	0,8369	0,7691	0,1929	0,09	41,48	1,962
A7	1,0281	0,5869	0,2403	0,4836	0,2118	0,06	4,96	0,787
A8	0,3741	0,3533	0,4051	0,5069	0,0229	0,05	21,83	2,084

3.3. Application of TOPSIS

Performance evaluation was conducted through TOPSIS method for determination of performance of retail companies in this section of the study. In this regard, the decision matrix for the year 2014 given in Table 3 was used. After the decision matrix has been created the normalization matrix generated using formula (1) is given in Table 4. Here, the normalization value for the year 2014 has been calculated as;

$$\frac{0,8966}{\sqrt{0,8966^2 \oplus 0,6367^2 \oplus 0,6874^2 \oplus 1,0060^2 \oplus 0,6433^2 \oplus 1,4098^2 \oplus 1,0281^2 \oplus 0,3741^2}} = 0,357437$$

Similarly, other normalized values were calculated and the normalized decision matrix shown in Table 4 was obtained.

Table 4: Normalized Decision Matrix

2014	Criteria							
Alternatives	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**
A1	0,3574	0,4710	0,0250	0,3558	0,2729	0,9259	0,0913	0,1671
A2	0,2538	0,2673	0,9109	0,4612	0,4730	0,3777	0,4774	0,0542
A3	0,2740	0,1751	0,0231	0,2791	0,4442	0,0005	0,7938	0,0637
A4	0,4011	0,2901	0,0077	0,4422	0,3238	-0,0109	0,3079	0,9536
A5	0,2565	0,2693	0,0201	0,2407	0,3740	-0,0019	0,1457	0,2082
A6	0,5620	0,3133	0,3579	0,4243	0,3421	0,0005	0,1166	0,0734
A7	0,4099	0,5560	0,1028	0,2668	0,3756	0,0003	0,0139	0,0294
A8	0,1491	0,3347	0,1732	0,2796	0,0406	0,0003	0,0614	0,0779

A weighted standard decision matrix was developed with the help of equal weights attributed to criteria using formula (2) and the results are shown in Table 5.

Table 5: Weighted Standart Decision Matrix

2014	Criteria							
Alternatives	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**
A1	0,04468	0,05888	0,00313	0,04448	0,03412	0,11573	0,01142	0,02089
A2	0,03173	0,03342	0,11386	0,05764	0,05912	0,04722	0,05967	0,00678
A3	0,03425	0,02188	0,00289	0,03489	0,05553	0,00006	0,09923	0,00796
A4	0,05013	0,03626	0,00096	0,05528	0,04048	-0,00136	0,03848	0,11921
A5	0,03206	0,03367	0,00251	0,03009	0,04675	-0,00024	0,01822	0,02602
A6	0,07025	0,03916	0,04474	0,05303	0,04276	0,00006	0,01458	0,00917
A7	0,05123	0,06950	0,01285	0,03335	0,04695	0,00004	0,00174	0,00368
A8	0,01864	0,04184	0,02165	0,03495	0,00508	0,00004	0,00767	0,00974

Thereafter, positive and negative ideal solutions were developed with the help of formulas (3) and (4). For benefit criteria (B1, B2, B5, B6, B7, B8) the highest value of each column of the matrix in set A^+, and the lowest value of each column of the matrix in set A^- were taken. For cost criteria (B3, B4) the lowest value of each column of the matrix in set A^+, and the highest value of each column of the matrix in set A^- were taken. Positive and negative ideal solution values created are presented in Table 6.

Table 6: Ideal (A^+) and Negative Ideal (A^-) Solution Values

	B1	B2	B3	B4	B5	B6	B7	B8
A^+	0,0702535	0,0695	0,00096	0,03009	0,05912	0,115731613	0,09923	0,11921
A^-	0,01864225	0,02188	0,11386	0,05765	0,00508	-0,00136011	0,00174	0,00368

After the positive and negative ideal solution values are determined, the separation measures are calculated by using formula (5) and (6) and it was presented in Table 7.

Table 7: Pozitive (S^+) and Negative (S^-) Measure Accounts

	B1	B2	B3	B4	B5	B6	B7	B8
S^+	0,138	0,188	0,171	0,141	0,178	0,191	0,192	0,201
S^-	0,172	0,095	0,159	0,173	0,126	0,097	0,126	0,097

After solution measures were calculated, final sequence was obtained with the help of formula (7), and is given in Table 8.

Table 8: TOPSIS Method Application Results in the Year 2014

2014		
Alternatives	**Value**	**Ranking**
A1	0,555	**1**
A2	0,335	**7**
A3	0,481	**3**
A4	0,551	**2**
A5	0,416	**4**
A6	0,337	**6**
A7	0,396	**5**
A8	0,326	**8**

According to these results, A4 (TEKNOSA) had the best performance, whereas A2 (MİGROS) had the worst performance.

3.4. Application of MAUT

For the performance measurement using the MAUT method, firstly, the decision matrix (Table 3), composed of 8 alternatives and 8 criteria was used. Then, each criterion was equally weighted to the total weight of 1.

Table 9: Weight Ratings of Criteria

Criteria	**Weight Vector**
Current Ratio	0,125
Acid Test Ratio	0,125
Liability/Equity Ratio	0,125
Liability Ratio	0,125
Gross Profit Margin	0,125
Profit before Interest and Tax/Total Assets Ratio	0,125
Receivable Turnover	0,125
Assets Turnover	0,125
TOTAL	1

The normalize procedure is the next step. Maximization criteria (B1,B2,B5,B6,B7,B8) were normalized with formula (8) and minimization criteria (B3,B4) were normalized with formula (9). The results obtained are presented in Table 10.

Following the normalization process, the benefit values were calculated with the equal weights defined for the normalized benefit values and criteria, using the formula number (10).The results are shown in Table 11.

Table 10: Normalized decision matrix

	B1	B2	B3	B4	B5	B6	B7	B8
A1	0,50449	0,77692	0,98078	0,47786	0,53733	1	0,09923	0,14899
A2	0,25355	0,24223	0	0	1	0,41485	0,59422	0,02682
A3	0,3025	0	0,98286	0,82587	0,93355	0,01211	1	0,03706
A4	0,61012	0,30191	1	0,08606	0,65505	0	0,37687	1
A5	0,25992	0,24745	0,98627	1	0,77112	0,00959	0,16896	0,19341
A6	1	0,36285	0,61225	0,16738	0,69729	0,01217	0,13168	0,04753
A7	0,63146	1	0,89471	0,88166	0,77482	0,01198	0	0
A8	0	0,41905	0,81668	0,82337	0	0,01192	0,06083	0,05247

Table 11: Weighted Standart Decision Matrix

	B1	B2	B3	B4	B5	B6	B7	B8
A1	0,06306	0,09712	0,1226	0,05973	0,06717	0,125	0,0124	0,01862
A2	0,03169	0,03028	0	0	0,125	0,05186	0,07428	0,00335
A3	0,03781	0	0,12286	0,10323	0,11669	0,00151	0,125	0,00463
A4	0,07627	0,03774	0,125	0,01076	0,08188	0	0,04711	0,125
A5	0,03249	0,03093	0,12328	0,125	0,09639	0,0012	0,02112	0,02418
A6	0,125	0,04536	0,07653	0,02092	0,08716	0,00152	0,01646	0,00594
A7	0,07893	0,125	0,11184	0,11021	0,09685	0,0015	0	0
A8	0	0,05238	0,10209	0,10292	0	0,00149	0,0076	0,00656

In the last step, alternatives were sequenced based on their utility values. Obtained results are given in Table 12.

Table 12: MAUT Method Application Results in the year 2014

2014		
Alternatives	**MAUT Multiple Benefits Function Value**	**Ranking**
A1	0,565699	**1**
A2	0,316458	**7**
A3	0,511743	**3**
A4	0,503751	**4**
A5	0,45459	**5**
A6	0,378893	**6**
A7	0,524328	**2**
A8	0,27304	**8**

According to the results obtained with the MAUT method, the performance of Firm A1 was the highest, and the performance of Firm A8 was the lowest, in the year 2014.

3.5. Application of SAW

Firstly, the decision matrix given in Table 3 was normalized for the performance measurement to be carried out with the SAW method. Utility based criteria (B1, B2, B5, B6, B7, B8), were normalized with formula (11) and cost based criteria (B3, B4), were normalized with formula (12). The results are as shown in Table 13.

en, the values normalized were multiplied with the equal weights assigned to the criteria in advance, and according to the sum total, the final ranking was obtained. Obtained results are given in Table 14.

Table 13: Normalized Decision Matrix

	B1	B2	B3	B4	B5	B6	B7	B8
A1	0,63598	0,84716	0,30598	0,67643	0,57705	1	0,11505	0,17525
A2	0,45162	0,48083	0,0084	0,52189	1	0,40797	0,60135	0,05685
A3	0,48759	0,31487	0,33087	0,86242	0,93926	0,0005	1	0,06677
A4	0,71358	0,52172	1	0,54429	0,68466	-0,0118	0,38781	1
A5	0,45631	0,48441	0,38166	1	0,79078	-0,0021	0,18356	0,21829
A6	1	0,56347	0,02139	0,56729	0,72328	0,00056	0,14694	0,07692
A7	0,72925	1	0,07449	0,90219	0,79415	0,00037	0,01757	0,03085
A8	0,26536	0,60198	0,04419	0,86072	0,08586	0,00031	0,07733	0,0817

Table 14: Weighted Standart Decision Matrix

	B1	B2	B3	B4	B5	B6	B7	B8
A1	0,0795	0,1059	0,03825	0,08455	0,07213	0,125	0,01438	0,02191
A2	0,05645	0,0601	0,00105	0,06524	0,125	0,051	0,07517	0,00711
A3	0,06095	0,03936	0,04136	0,1078	0,11741	0,00006	0,125	0,00835
A4	0,0892	0,06522	0,125	0,06804	0,08558	-0,0015	0,04848	0,125
A5	0,05704	0,06055	0,04771	0,125	0,09885	-0,0003	0,02295	0,02729
A6	0,125	0,07043	0,00267	0,07091	0,09041	0,00007	0,01837	0,00962
A7	0,09116	0,125	0,00931	0,11277	0,09927	0,00005	0,0022	0,00386
A8	0,03317	0,07525	0,00552	0,10759	0,01073	0,00004	0,00967	0,01021

The results obtained by multiplying the normalized values by the equal weights given are summed. Thus, the performance of the companies included into the analysis has been found. The results are as shown in Table 15.

According to results in Table 15, A4 (TEKNOSA) had the best performance, whereas A8 (UYUM) had the worst performance. Rankings and scores of the companies for all years can be found in the next section.

3.6. Comparison of MCDM Methods

Seeing the results of disciplines all together, after the retail firms' performances are ranked with the TOPSIS, MAUT and SAW methods, offers a systematical approach to the comparison of methods. Ranking per methods are given in Table 16.

Table 15: SAW Method Application Results in the year 2014

2014		
Alternatives	**Value**	**Ranking**
A1	0,5416138	**2**
A2	0,4411143	**5**
A3	0,5002844	**3**
A4	0,6050392	**1**
A5	0,4391199	**6**
A6	0,3874805	**7**
A7	0,4436103	**4**
A8	0,2521812	**8**

Table 16: Performance Ranks of Firms.

	2010			2011			2012			2013			2014		
	RANKİNG			RANKİNG			RANKİNG			RANKİNG			RANKİNG		
FİRMS	**TOPSİS**	**MAUT**	**SAW**	**TOPSİS**	**MAUT**	**SAW**	**TOPSİS**	**MAUT**	**SAW**	**TOPSİS**	**MAUT**	**SAW**	**TOPSİS**	**MAUT**	**SAW**
A1	1	2	3	1	1	2	2	1	2	4	1	2	1	1	2
A2	6	6	6	8	7	4	7	6	3	6	7	7	7	7	5
A3	5	5	5	6	8	8	6	3	6	7	6	6	3	3	3
A4	4	3	2	3	2	1	3	5	1	1	2	1	2	4	1
A5	8	8	8	7	3	6	8	8	8	8	8	8	4	5	6
A6	7	7	7	4	5	3	1	4	4	3	3	3	6	6	7
A7	2	4	4	5	4	7	5	2	5	5	4	4	5	2	4
A8	3	1	1	2	6	5	4	7	7	2	5	5	8	8	8

4. CONCLUSION

Performance measurement has become vital to the retail industry, due to the recent developments, and consequently the increased competition in the industry. On the other hand, performance evaluation results are important as they inform executives on their current position and enable them to develop concrete steps. Thus, companies are capable of seizing opportunities and gaining sustainable competitive advantage.

In this study, eight retail companies were compared based on their financial performance.In this regard, suitable indicators were identified based on the findings of the literature research done, and data convenience, and all financial ratios specified were equally weighted. In this study, performances of firms were measured with the TOPSIS, MAUT and SAW methods, using the data collected in the period of time between 2010 and 2014.

Several MCDM methods were used to obtain the opportunity to compare resulting sequences. Analysis of the results obtained by comparing the methods showed that generally, the rankings provided by the TOPSIS, MAUT and SAW methods are very different from each other. For instance, the analysis of the results for the year 2010 showed that according to the TOPSIS ranking, Firm A1 won first place, whereas according to the MAUT analysis, the same firm won second place, and according to the SAW analysis, it won third place. Similarly, depending on the methods

used, different performance measurement results were obtained for other years. For the year 2010, the A2, A3, A5, and A6 alternatives; and finally for the year 2014, A3 and A8 alternatives ranked the same by all three methods. It was taken into account that the deviations observed in the comparison of these three methods might have been caused by the unique approach of each method, and the differences in normalization methods.

The methods applied in this study are the rational methods to be preferred for the performance measurement thanks to their conceptual simplicity and convenience advantages in the calculation. Furthermore, the use of multiple MCDM methods in the practice presents another advantage in terms of comparing the ranking results.The most important disadvantage of these methods is that each gives different results, which makes it difficult to evaluate the results of the research.

In addition to its aforementioned advantages, this study has also some limitations. This study was restricted due to the fact that all financial ratios were not taken into consideration. Moreover, the low number of the companies included into the analysis constitutes another limitation of the study. The next studies on this subject may improve this study, if they include all financial ratios. Some fuzzy applications of MCDM techniques such as the VIKOR, PROMETHEE and ELECTRE can be used to compare the results.

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