

# AN EVALUATION OF ALTERNATIVE METHODS FOR FINANCIAL PERFORMANCE: EVIDENCE FROM TURKEY (ISTANBUL STOCK EXCHANGE)

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## Abstract

This study aims to determine which financial performance ranking methods accurately predict the actual rankings by using multiple criteria decision techniques, and it compares the accuracy of the rankings based on the financial performance indicators and the market based approach which involves market value and average return. Companies listed in BIST50 index (Borsa Istanbul) were investigated, as a result, when considering average return, Promethee and Copras produced similar and consistent rankings. Besides, since it places emphasize on the functional structures of variables, Promethee method was noted to produce the most accurate rankings, thus deemed most effective method helping investors give rational decisions.

**Key Words:** Financial Performance, Stock Exchange, Multi-criteria Decision Making Techniques

**Jel Code:** C52, F37, F47

## 1. Introduction

The financial statements, which are the final outputs of the activities of the enterprises, are prepared and announced to the public on a quarterly basis if the entity is publicly traded. However, these tables do not make any sense on their own, they are subjected to various analysis techniques and become meaningful indicators for enterprise (owners and partners, employees) and non-enterprise (current and potential investors, financial institutions, government) users. In particular, rates obtained from

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rate analysis, sometimes used in the decision-making process by comparing with the sector average, also take on the task of independent variables that are evaluated in calculations of productivity (Feng and Wang, 2000, Peslak, 2003; Sparse and Ata, 2010), success/failure (Beaver, 1966; Altman, 1968; Almamy et al., 2016; Karaca and Özen, 2017; Acosta et al., 2019) and performance. As a result of the interpretation of the financial statements, the findings obtained provide critical information about the past performance of the enterprises evaluated and are considered as effective indicators in the future of the decision-making process (Needles et al., 2013: 2; Dabbaoğlu, 2011: 32).

Current and potential investors who are in the decision-making position determine the most suitable investment choices among various alternatives while determining the control of whether the instruments such as profit, cost, production and labor, capital and foreign resources are used successfully in this process through performance measurement and evaluation (Bülbül and Köse, 2016: 189). Apart from investors, for enterprises to evaluate their own performances and to develop solutions to increase their performance in line with the results is very important in terms of the economic environment in which our day and age shows global competitiveness. The basis for achieving competitive advantage and achieving corporate sustainability is based on performance measurements (Karadeniz et al., 2016: 1118).

Financial performance measurement (Ecer et al., 2011), which expresses the degree of realization of economic objectives of enterprises, is of great importance in determining the decisions of decision makers (internal and external users) (Karaoğlu and Şahin, 2018). Therefore, effective measurement of financial performance is of great importance. Determination of objectives and comparable appropriate performance indicators in the first step in financial performance measurement, which expresses the process of establishing and interpreting relationships between account items in financial statements such as revenue, profit, number of personnel, total assets, equity and growth is required. For this reason, financial ratios such as liquidity, growth, profitability and financial structure are mostly used to determine the strengths and weaknesses of the company (Hitchner, 2003).

If the performance of the enterprise is to be compared within itself, the financial ratios of the previous years are used, and in case of comparison with other enterprises, it is very important for comparability that the financial ratios of the enterprises being compared belong to the same period. Another important issue is the selection of the rates to be used. Although there are many ratios that can be used in financial performance measurement, random rate selection may cause deviations from the objective. For this reason, the ratios that can provide information about the liquidity status of the enterprise, the efficiency of the use of assets, the financial structure and the profitability are preferred in parallel with the literature. Through this study, the financial performances of companies who operate within BIST 50 are compared and

their results are evaluated by considering the companies that are stable and have no problems in accessing their data. The methods used are basically divided into two. Firstly, the ranking of companies according to their position in the stock market was examined by taking stock market data into consideration. Then, by using different financial indicators, companies are ranked in terms of financial performance with the help of Multi Criteria Decision Making Techniques and both methodological results were compared.

## **2. Literature Review**

There are many studies on financial performance analysis conducted in different sectors with different methods and variables. When international literature is examined (Wu et al., 2009; Feng and Wang, 2000; Deng et al., 2000; Rezaie et al., 2014; Wanke et al., 2016;) TOPSIS and VIKOR methods are the two most commonly used methods to evaluate the financial performance of enterprises, while Fuzzy AHP method is preferred in weighting the criteria (Karaođlan and Şahin, 2018: 64). In the studies conducted at the national level however, performance comparisons were generally made on a sectoral basis and the TOPSIS method was used extensively for this purpose. VIKOR, ELECTRE, GRA and Data Envelopment Analysis are among the methods used in the measurement of performance. In addition, when the literature is examined, ENTROPI method is mostly used in portfolio selection (Bera and Park, 2008; Qin et al., 2008; Usta and Kantar, 2011; Zhang et al., 2012; Huang, 2012; Zhou et al., 2013; Sarikaya and Tatlıdil, 2013) and recently, it has been used in financial performance measurements (Karaatlı, 2016; Ural et al., 2018). Performance analyzes are also performed through PROMETHEE method and companies can be ranked according to their performance (Ünal & Yüksel, 2017). In the majority of these studies, rates selected from among the financial ratios published by the CBRT are used (Karaođlan & Şahin, 2018: 65).

In the study, different financial ratios of 38 companies from the BIST 50 index, which are suitable for comparing financial statements, were used. These financial ratios are grouped according to the traditional rate classifications. For example, current rate and cash rate are classified as liquidity ratios in many studies (Acar, 2003; Dumanođlu, 2010; Akyüz et al., 2011; Peker and Baki, 2011; Uygurtürk and Korkmaz, 2012) financial structure ratios. The fact that liquidity ratios are high and financial structure ratios are low indicate that the entity is financially strong. For this reason, these two groups of ratios were combined under one roof, namely financial soundness ratios. Thus, more accurate comparisons can be made in accordance with the purpose of the study. Similarly, since the turnover rates are indicative of the activities of the enterprises, they are grouped as management efficiency rates under the name of activity efficiency ratios as they indicate whether they are used in accordance with the equity and assets.

*Financial Soundness Rates:* Financial soundness generally means that the enterprises can successfully carry out their activities. The successful execution of the activities depends mainly on the provision of an optimal balance of foreign resources and equity, and the ability of enterprises to maintain sufficient cash to ensure that they will not default and benefit from the opportunities that may arise. With the globalization of the economy, the acceleration of capital movements increased the importance of financial soundness, and financial stability indicators started to be published by the IMF as a representative of stability for financial institutions. For all these reasons, current rate, cash rate, debt / equity, debt rate, equity / total asset rates were used as indicators of financial soundness. As a matter of fact, Koç and Karahan (2017) also used similar rates in their studies to identify the determinants of financial soundness in the banking sector. Financial rates constituting financial soundness can be explained briefly as follows.

Current Rates and Cash Rates are the rates that indicate the ability of enterprises to fulfill their short term liabilities. In this respect, the fact that these rates are low indicates that the risk of the enterprises are high (Ayıkoğlu Zaif, 2007: 119), while the high rates both enable the company to pay its debts on time and increase the power to respond to new investments and opportunities thanks to its high working capital which effects the companies performance. For this reason, current rate and cash rates are used in performance measurement (Kim and Ayoun, 2005; Kula et al., 2016; Öztürk, 2017).

The debt / equity rate indicates the degree of financial independence of the entity and the equation is required to be at most 1/1. While the fact that the rate less than 1 saves the business from the pressure of the creditors, the fact that it is greater than 1 indicates that the creditors of the enterprise have invested in more enterprises than the owners and partners. As the debt/equity rate is regarded as an indicator of financial performance (Ecer and Günay, 2014; Meydan et al., 2016), the increase in the rate is considered as a risk indicator.

Financial Leverage Rate provides information about the financial structure of the enterprise and is formed by the managers in line with the developments in the economy and the sector. For example, in an inflationary environment, businesses may prefer to borrow at a fixed rate over cash to avoid loss of purchasing power. However, the increase in debts within the financial structure will cause financial distress, and therefore, the costs will increase due to the expectations of lenders. It will eliminate the positive effect of borrowing on firm value (Ayıkoğlu Zaif, 2007: 120).

Equity/Total Asset Rate shows how much of the entity's assets are covered by the business partners. The high rate reduces the likelihood of unexpected price reductions being risky for the enterprise. The fact that this ratio is high is considered as an indicator of low operating debts and reflects a positive situation for the enterprise.

Therefore, Equity/Total Assets rate is also used as performance indicator (Bektaş and Tuna, 2013; Ecer and Günay, 2014; Öztürk, 2017).

Activity Efficiency Rates: Activity analysis shows the position of enterprises in the competitive environment and how much output can be obtained from existing inputs (Çelik, 2016: 70). Basically, the activity rates determine whether there is more or less investment in assets compared to sales. Excessive investment in assets causes inefficient use of funds and rise of costs, while under-investment in assets causes insufficient production and sales to meet the current demand in the market (Elmas, 2015: 214). Within the scope of activity rates, the rate of receivables turnover (ADH), inventory turnover (SDH), asset turnover (VDH) and sales growth rates are analyzed.

On the other hand, the growth of sales shows to what extent the sales have changed compared to the sales in previous year and therefore is among the activity efficiency rates as an output of the operations.

When evaluating operational efficiency rates, sector averages are taken into consideration rather than making a standard value assessment and these rates are generally used when performance comparisons are made among competing firms (Bülbül & Köse, 2011; Aygün et al., 2016; Gümüş & Bolel, 2017). Therefore, the high turnover rate, inventory turnover and active turnover rates in this category are considered as a desirable situation, indicating that the performance of these enterprises is also high.

Management Efficiency Rates: Management efficiency refers to the extent to which managers can produce output using production resources or inputs. Therefore, when calculating management efficiency rates, return is regarded as the final output and, equity and total assets are applied as inputs used to obtain this return. The rate of return on assets from these rates shows how much profit the total investment made in assets in a period (Peker and Baki, 2011: 11), while the return on equity shows whether the investment made by the partners is used effectively or not. The difference between this rate and the return on assets is the effect of the financial leverage level. If the financial leverage is used well, the return on equity is high as a result of the use of low equity. In order to increase these two rates of return, managers should establish an effective control mechanism over expenses and revenues. Therefore, return rates are used as independent variables in financial performance measurements (Thomson and Pedersen, 2000; Klingenberg et al., 2013; Ecer and Günay, 2014).

Profitability Rates: Profitability ratios are used to determine the extent to which the company uses its own equity, foreign resources and assets efficiently and whether it operates profitably in its activities as a whole. It can be said that these rates provide important information in evaluating the financial performance of the enterprises as they are an indicator of how efficiently the enterprise is being managed (Karadeniz et al.,

2016; Bülbül and Köse, 2016; Orçun and Eren, 2017;). Generally, profitability per employee (Aslan, 2017), net profit margin (Kaya and Öztürk, Kula et al., 2016;), earnings per share (Kula et al., 2016; Şenol and Ulutaş, 2018;) and operations margin (Kaya and Ozturk, 2015; Aksoy et al., 2015; Ozturk, 2017; Unal and Yuksel, 2017) are used as profitability rates when measuring performance.

Net profit/personnel is also called profit per employee and is used to evaluate personnel-based productivity. Since the profit per share shows the net profit that can be obtained against a stock, it is more important for the shareholders than other profitability rates (Şenol & Ulutaş, 2018: 87). At the same time, the operating margin is an important performance indicator since it reflects the profits of the companies as a result of their core business.

The performance of enterprises affects all stakeholders as well as macroeconomics. Although sometimes criticized for its reliability, financial ratios are frequently used in performance measurement in the literature (Ünal & Yüksel, 2017: 266). A majority of the studies in Turkey put a group of companies within any sector or index in order according to their performance (Ecer and Günay, 2014, Aksoy et al., 2015; Bulbul and Kose, 2016; Aygun et al., 2016; Karadeniz et al., 2016; Kula et al., 2016; Meydan et al., 2016; Kendirli and Kaya, 2016; Orçun and Eren, 2017; Şenol and Ulutaş, 2018; Güleç and Özkan, 2018; Karaoğlan and Şahin, 2018; Ural et al., 2018). Very few studies have attempted to establish a relationship between performance values and other variables. In the studies carried out for this purpose, the relationship between financial performance and return rates (Ünal and Yüksel, 2017; Temizel and Bayçelebi, 2016) and market value (Öztürk, 2017) has been investigated generally. Studies to measure the relationship between risk and performance, which is an important factor in affecting the investor decision (Kök et al., 2015; Ağazade et al. 2017) is almost nonexistent. However, risk, return rate and performance are the main factors affecting the investor decision in the investment process. Therefore, evaluation of all three elements together will enable more rational decision making.

In this study, it is aimed to contribute to the literature by trying to establish the relationship between the performance rankings obtained by using different multi criteria decision techniques and, market value and average return rankings of the same period with the help of the financial ratios of companies included in BIST 50 index for 2018.

### **3. Methods Used in the Study**

In this study, Multi-Criteria Decision Making methods (MCDM) have been used in order to reveal how companies evaluate the performance indicators, which are the final outputs, with the variables of market value and average return that financial

information users take into consideration in the decision-making process. One of the subjective or objective weighting approaches is generally adopted in the weighting process, which indicates the importance levels of the criteria discussed in the MCDM methods. In subjective weighting (Analytic Hierarchy Process - AHP, Delphi, Least Weighted Squares, etc.), while the decision makers' evaluations on the criteria are taken into consideration, the weighting decision can be made by the matrix rather than the opinions of decision maker in objective weighting (Lotfi and Fallahnejad, 2010: 54). One of the objective methods used in weighting the criteria is the Entropy method.

### ***3.1. Shannon's Entropy Method***

The origin of the term entropy is based on the thermodynamic studies of Clausius (1864) and Boltzman (1872) (cf. Ullah, 1996: 137). The combination of entropy with the information theory and measuring the uncertainty level of entropy is based on the study by Shannon (1948). Today, entropy is found in many engineering and physics branches and is also used in social sciences (such as social entropy, economic entropy) (Ghorbani et al., 2012: 522).

Entropy is a frequently used approach in the application of multi-criteria decision-making methods because it allows the weighting of the criteria that are handled without the personal opinions of the decision-makers.

### ***3.2. Moora Method***

Although MOORA (Multi-Objective Optimization on basis of Ratio Analysis) method developed by Brauers and Zavadskas (2006) is a new method, it has been used in many decision making problems. Compared to other methods used in multi-criteria decision making methods, the method stands out because of the fact that the calculation time and mathematical operations are very low and the reliability is good and simple. The results obtained by the method provide measurable values for each alternative.

### ***3.3. Gray Relational Analysis***

The Gray Relational Analysis (GRA) method is a highly preferred method in recent years compared to other MCDM CM methods because of its simple calculation, ability to work with a small data set and also being applicable to quantitative and qualitative data sets. It is seen that GRA usage comes to the forefront especially in studies on performance measurements. For example, Xue et al. (2018) while examined the operational performance of the companies operating in the field of logistics on the Chinese stock exchange through the GRA, Pourmohammadi et al. (2018) used this method in evaluating the health system financing of the countries of the Eastern Mediterranean Region. Moreover, it is possible to see how they benefit from GRA when measuring the financial performance of the participation banks (Gundogdu, 2018) and measuring the corporate sustainability performance (Ersoy, 2018) in Turkey.

### ***3.4. Promethee Method***

PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) is a method first proposed by Jean Pierra Brans in 1982 and is well adapted for the sequencing of a limited number of alternatives, sometimes by pairing alternatives, taking contradictory criteria (Safari et al., 2012: 100) into account. Mathematical properties and ease of use made the method widely used.

### ***3.5. The Copras Method***

COPRAS (Complex Proportional Assessment) is a method that can evaluate both qualitative and quantitative criteria together, and take the maximization and minimization of the criteria into account. The method developed by Zavadskas and Kakluaskas for the first time in 1996 is a very suitable method of MCDM to sort and evaluate alternatives thanks to it.

## **4. Measurement of Financial Performance Using MCDM Methods**

In the research part of the study, the data set was formed by combining financial ratios calculated on the balance sheet and income statement of the companies included in the review with market data such as market value and average return which were announced to the public in 2018. Since the most recently revealed data belongs to 2018, the study was based on 2018 data. In addition, in order to make the data more stable and reliable, the companies in the BIST 50 index, involving the 50 companies which trade the most in Istanbul's stock exchange, were included in the research. However, in order to be able to apply the calculated ratios to all companies, companies in the financial sectors were excluded from the review and finally, the balance sheet and income statement data of 38 companies were compiled and prepared for analysis.

### *Determination of Criteria*

Reference values are needed to determine whether enterprises' financial performance is good and to compare measured performance with other enterprises. As reference values, financial ratios are often used in order to perform more meaningful and accurate comparisons between different sized enterprises (Acar, 2003: 26). In this context, the ratios classified under financial soundness, operational efficiency, management efficiency and profitability were used to determine the financial performance of the companies.

### *Creating a Data Set*

The 2018 data on the criteria to be used in the measurement of financial performances were obtained from the Public Disclosure Platform (PDP) and Investing

databases. The explanations regarding the criteria are given in Table 1. Since the decision matrix for these 15 criteria, market values and the average returns identified for the 38 companies trading within BIST-50 is a  $38 \times 18$  dimensional matrix, only the data of the first four companies are presented as examples in Annex 1.

**Table 1.** *Financial Performance Criteria and Explanations*

<b>Criterion</b>	<b>Normalization Direction</b>	<b>Data Source</b>
Current rate	Maximum	Investing <sup>1</sup>
Cash rate	Maximum	Investing
Debt / Equity	Minimum	KAP <sup>2</sup>
Borrowing rate	Minimum	Investing
Equity / Total. Act.	Maximum	KAP
Takeover speed	Maximum	Investing
Inventory turnover	Maximum	Investing
Active rotation speed	Maximum	Investing
Net Profit / Employee	Maximum	Investing
Return on equity	Maximum	Investing
Return on assets	Maximum	Investing
Earnings per share	Maximum	Investing
Sales growth	Maximum	Investing
Operating margin	Maximum	Investing
Net profit margin	Maximum	Investing

*Note:* <sup>1</sup> Investing is a global finance portal that includes real-time financial data and economic analysis. <sup>2</sup> KAP is an electronic system in which the notifications required to be disclosed to the public in accordance with the capital markets and exchange legislation are transmitted in electronic signatures and announced to the public.

**Source:** Authors' calculations

### *Determination of Weights through the Entropy Method*

The criteria used in evaluating the financial performance of selected companies trading within BIST-50 through GRA and PROMETHEE were not only weighed equally but also weighted through entropy and analyses were performed accordingly.

Shannon entropy has been applied to the decision matrix and the weights obtained for the criteria are presented in Table 2. Accordingly, return on equity is the highest weighted criteria and therefore the highest priority. It was concluded that the lowest weight was met by the Debt/Equity and Borrowing ratio criteria.

**Table 2.** *Criteria Weights*

<b>Criterion</b>	<b>Weight</b>
Debt / Equity	0.03
Borrowing Rate	0.03
Receivable Turnover Rate	0.06
Earnings Per Share	0.06
Inventory Turnover	0.06
Cash Rate	0.07

Current Rate	0.07
Active Cycle Speed	0.07
Net Profit Per Employee	0.07
Equity / Total Asset	0.07
Net Profit Margin	0.07
Operating margin	0.07
Sales Growth	0.07
Return on Asset	0.07
Return on Equity	0.12
<b>Total</b>	<b>1</b>

**Source:** Authors' calculations

### *Financial Performance Ranking Results*

In this chapter of the study, the financial performances of 38 selected companies listed in BIST-50 are analysed based on 15 criteria. For this purpose, firstly, the PROMETHEE method, which is one of the MCDM techniques, was used. Of the 15 criteria discussed in the study, the preference function for the current ratio, cash ratio, debt/equity and return on equity criteria have been determined as the third type (V-type) function, while the remaining 11 criteria have been considered as the first type, the usual type function. In determining the preference functions for the criteria, the structure of the criteria and the values are taken into consideration.

Since PROMETHEE is a MCDM technique that allows the weighting of criteria, the criteria in this study are considered both in terms of equal weight and weights obtained with the Shannon entropy method. The ranking of the 38 companies obtained in both forms regarding their financial performance is presented in Table 3. According to the results of the PROMETHEE II analysis, which is carried out both by prioritizing the criteria and considering them equally, Koza Gold ranks first in terms of financial performance. Koza Altın was followed by Doğan Companies Group and Global Investment ranked last in terms of financial performance.

Apart from the PROMETHEE, the results of Gray Relational Analysis were included in this study. In determining the references, the lowest or maximum values in the decision matrix were taken into account by considering the normalisation direction of each criterion. As in the PROMETHEE method, the criteria were considered as equal weighted in the determination of the financial performances for the companies by using the TIA, and the results of the TIA were evaluated based on the weights obtained from the Shannon entropy. According to the results in Table 3, Koza Gold was determined as the highest performance company as a result of the TIA, while Koza Anadolu was the highest company according to the results of the TIA supported by entropy. As the

worst performing company, the TIA points to Migros, while the TIA supported by entropy put Aksa Energy in the last place.

In this study, the MOORA Rate method and MOORA Reference Point approach, one of the MCDM techniques, were applied this time. For this purpose, the minimum observation value of the relevant criterion in the decision matrix and the maximum observation value for the maximization were determined as reference by considering the normalization aspects of the criteria and these values are presented in Table 4.

**Table 3.** *Financial Performance Rankings*

Company	Promethee	Entropy		Moora		Entropy Copras	Market Value	Average Return	
		Promethee	GRA	Entropy GRA	Moora Ratio				
Aksa Enerji	27	24	12	38	12	11	28	35	31
Anadolu Cam	29	29	10	8	24	24	31	30	18
Arcelik	32	32	31	22	30	34	33	14	17
Aselsan	7	7	8	16	7	10	10	2	12
BIM	8	10	7	12	20	31	9	6	6
Coco-Cola	31	33	34	19	33	35	34	18	23
Dogan Sirketler	2	2	2	10	5	6	2	26	4
EIS Eczacibasi	9	12	6	2	6	5	6	31	35
Emlak Konut GYO	26	27	13	6	16	37	17	21	38
Enka	21	28	17	14	27	29	24	7	28
Erdemir	5	6	11	13	8	9	12	5	16
Ford Otomotiv	11	9	19	15	21	15	11	8	11
Global Yatirim	38	38	36	32	31	13	36	37	30
Haci Omer Sabancı	33	31	15	34	23	18	23	10	21
İpek Dogal	6	5	4	4	4	4	4	36	20
Kardemir	19	20	23	7	19	19	27	34	32
Koc Holding	28	26	30	25	32	27	32	1	9
Koza Altın	1	1	1	3	1	2	1	17	7
Koza Anadolu	4	4	3	1	3	3	3	25	10
Mavi Giyim	24	21	27	9	29	30	22	33	22
Migros	35	35	38	37	38	38	38	27	15
Pegasus Hava	13	13	14	36	11	20	8	28	27
Petkim	10	8	22	20	9	7	13	15	36
SASA Polyester	16	14	21	23	13	12	14	23	24
Soda Sanayi	14	15	5	5	2	1	19	20	1
Sisecam	3	3	20	18	18	14	5	12	8
Tav Havalimanları	22	22	28	11	25	26	29	16	5
Tekfen Holding	12	11	16	21	17	28	15	19	2
THY	30	30	33	24	26	21	30	9	34
Tofas	20	18	32	29	34	17	16	13	25
Trakya Cam	17	19	24	26	22	16	26	24	14
Tupras	18	16	9	17	10	8	7	3	3
Turk Telekom	25	25	37	31	37	22	37	11	26
Turkcell	36	36	25	35	15	23	21	4	19
Ulker Gıda	15	17	29	28	35	25	18	22	13
Vestel Elektronik	37	37	35	33	36	36	35	32	29
Yatas	23	23	26	30	28	32	25	38	33
Zorlu Enerji	34	34	18	27	14	33	20	29	37

**Source:** Authors' calculations

When the performance rankings of companies according to the MOORA Rate and MOORA Reference Point approaches are examined, it is seen that Koza Altın has

the highest performance in the Rate approach and Soda Sanayi company takes the highest place according to Reference Point approach. As in the TIA results, Migros ranked last in the performance ranking according to both MOORA approaches.

Finally, the COPRAS method, one of the MCDM techniques, is included in the study. In line with the financial performance rankings obtained by ranking degrees of benefit from large to small, Koza Gold was ranked as the best company while Migros ranked last just as in the PROMETHEE, TIA and MOORA Rate results.

**Table 4.** *Reference Points for Criteria*

<b>Criterion</b>	<b>Reference Value</b>	<b>Criterion</b>	<b>Reference Value</b>	<b>Criterion</b>	<b>Reference Value</b>
Current Rate	11,38	Takeover Speed	198,79	Return on Assets	42,14
Cash Rate	10,28	Inventory Turnover	199,74	Earnings per Share	15,22
Debt / Equity	0,111	Active Rotation Speed	4,16	Sales Growth	81,29
Borrowing Rate	0	Net Profit / Personnel	1100	Operating Margin	69,06
Equity / Total. Act.	0,899	Return on Equity	94,25	Net Profit Margin	84,33

**Source:** Authors' calculations

When the performance rankings of companies according to the MOORA Rate and MOORA Reference Point approaches are examined, it is seen that Koza Altın has the highest performance in the Rate approach and Soda Sanayi company takes the highest place according to Reference Point approach. As in the TIA results, Migros ranked last in the performance ranking according to both MOORA approaches.

Finally, the COPRAS method, which is one of the MCDM techniques, is included in the study. In the COPRAS method using criterion weights determined by Shannon entropy, the relative importance and utility ratings of the companies were calculated as indicated in the table in Appendix 1. In line with the financial performance rankings obtained by ranking the utility rankings from large to small, Koza Gold was ranked as the best company in terms of PROMETHEE, TIA and MOORA Rate results, while Migros ranked last.

In Table 3, in addition to the CCPV techniques, a performance ranking is made according to the market values and average returns of the companies. Soda Sanayi has the best score in terms of average return, while Koç Holding ranks first in terms of market value.

#### *The Relationship Between Financial Performance Ranking Results*

In this part of the study, the relationship between the company performance rankings obtained from market value and average return is examined by using MCDM techniques in the previous section. According to the results of Spearman rank differences correlation tests given in Table 5, it is seen that the MCDM techniques have

a positive and significant relationship with each other. In other words, both the methods using entropy weighted criteria and the sequences performed without weighting are seen in harmony with each other. On the other hand, the ranking ranking based on market value has a different and independent structure from all other rankings. As a result, this ranking result was found to be unrelated to the results of other methods. On the other hand, the company's financial performance ranking based on average return has a positive and significant relationship with both PROMETHEE and PROMETHEE supported by entropy.

**Table 5. Spearman Rank Differences Correlation Tests Regarding Performance Rankings**

		Moora Ratio	Moora Reference	Entropy GRA	Entropy GRA	Promethee	Entropy Promethee	Market Value	Entropy- COPRAS
Moora Reference	Coefficient p	,742 ,000*	1,000 .						
Entropy GRA	Coefficient p	,534 ,001*	,377 ,020*	1,000 .					
GRA	Coefficient p	,881 ,000*	,606 ,000*	,625 ,000*	1,000 .				
Promethee	Coefficient p	,672 ,000*	,652 ,000*	,597 ,000*	,686 ,000*	1,000 .			
Entropy Promethee	Coefficient p	,682 ,000*	,682 ,000*	,556 ,000*	,674 ,000*	,986 ,000*	1,000 .		
Market Value	Coefficient p	-,005 ,975	,029 ,865	-,004 ,980	,010 ,952	,134 ,422	,125 ,455	1,000 .	
Entropy- COPRAS	Coefficient p	,786 ,000*	,623 ,000*	,512 ,001*	,786 ,000*	,858 ,000*	,865 ,000*	,133 ,425	1,000 .
Average Return	Coefficient p	,200 ,229	,248 ,134	,277 ,093	,318 ,052	,440 ,006*	,453 ,004*	,402 ,012*	,320 ,050*

Note: Correlation coefficient at 0.05 error level is statistically significant.

Source: Authors' calculations

Finally, an average rank number was determined for each company by using the averages of companies' financial performance rankings formed by ten different methods and given in Table 3, and by sorting from small to large. Thus, it was aimed to create an average performance ranking by considering the results of all methods equally. The relationship between the ranking obtained and the performance information provided by the methods was also examined through Spearman order difference correlation. According to the results given in Table 6, it is seen that PROMETHEE and TIA are the methods with the highest and most significant correlation coefficient with the average sequence number. In this case, it can be stated that it is appropriate to use PROMETHEE and TIA methods considering the functional forms of the criteria instead of applying all the methods separately. Also, it can be said that the use of entropy provides an effective ranking.

**Table 6.** *Comparison of Methods by Average Sequence Number*

<b>Method</b>	<b>Spearman Rho Coefficient</b>	<b>p</b>
PROMETHEE	0.887	0.000
Entropy – PROMETHEE	0.879	0.000
GRA	0.819	0.000
Entropy - GRA	0.682	0.000
MOORA Ratio	0.794	0.000
MOORA Reference	0.713	0.000
COPRAS	0.865	0.000
Market Value	0.284	0.084
Average Return	0.563	0.000

**Source:** Authors' calculations

## 5. Result

In parallel with the disappearance of economic borders, financial globalization and technological developments, investors can easily invest in public companies. Their expectations in line with these investments are to be able to generate returns in proportion to the risk they assume. Therefore, a rational investor evaluates many criteria related to companies in order to make an optimum decision before making an investment. The most important criteria that investors take into account in the decision-making process are the performance indicators, risk levels (beta), market values and average return rates obtained by the investors. The main motivation of this study is to determine the most effective variable in the optimum decision making process by establishing a relationship between the performance rankings obtained by using different multi criteria decision making techniques rate of return and market value rankings. Even though there are studies determining the relationship between performance and risk (Ağazade, 2017; Çelik and Manan, 2018), return (Sakarya and Aytekin, 2013; Temizel and Bayçelebi, 2016; Ünal and Yüksel, 2017) and market value (Öztürk, 2017) in the literature. This study differs from other studies in terms of determining the most accurate method among multiple methods.

By examining Table 3, which evaluates the financial performance of companies according to different decision-making methods, it is possible to determine how different methods rank companies. For this purpose, it is necessary to evaluate the market value and average return data which are taken into consideration by the investors in making their investment decisions on the stock market and financial performance rankings concluded from the financial data of the companies. For example, Global Investment and Vestel Electronics companies are in the last place in terms of financial performance according to all methods. According to the stock market data, it is correct to say that the companies ranked in the last place are ranked correctly by all methods in terms of market value. Koç Holding is ranked as the most successful company in terms of market value, while it is in the middle for financial performance. Therefore, when compared with the market value of Koç Holding it is seen that the methods rank unsuccessfully. In another case, Doğan Companies Group and Koza Altın companies, which are listed as the best companies by MCDM in terms of

financial performance, are ranked best by the methods considering the average return. It can be said that the main cause of this is that investors' attitudes towards risk are different from each other and that each investor makes their investment considering different criteria.

According to Table 5, it is seen that the MCDM techniques generally give consistent results among themselves. To put it in a different way, a classification can be made using any technique. However, it is seen that a ranking according to market value has no statistically significant relationship with any method ranking and is separated from them in this respect. In an evaluation to be performed considering the average return, it is seen that there is a compatible ranking with PROMETHEE and COPRAS.

In Table 6, average rankings are obtained by using the ranking results of 10 company-based and market-based ranking alternatives and their relationship with each method is examined. The highest correlation coefficient is obtained through PROMETHEE. It is possible to state that the method taking the functional structures of the variables into account has an effect on providing the highest relationship level. As a result, it is seen that the ranking made by this method can provide a more rational decision for the investor.

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**Appendix 1. Application Steps of Multi Criteria Decision Making Techniques**

Stage	Shannon Entropy	MOORA RATIO	MOORA REFERENCE	GRA
1	Normalization is performed $r_{ij} = \frac{x_{ij}}{\sum_{p=1}^m x_{pj}}$ $i=1,2,\dots,m$ $j=1,2,\dots,n$	Normalization is performed $x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$	Normalization is performed $x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$	The reference series is determined $x_0 = (x_0(j))$
2	Entropy values are calculated $k = \frac{1}{\ln m}$ $e = -k \sum_{i=1}^m r_{ij} \ln r_{ij}$	Performance values are calculated and sorted from top to bottom. The first-ranked alternative is identified as the most appropriate option $y_i^* = \sum_{j=1}^g x_{ij}^* - \sum_{j=g+1}^n x_{ij}^*$	The reference point is determined: the best value in the case of maximization and the worst in case of minimization $(r_i)$	Normalization is performed Beneficial way: $x_i^* = \frac{x_i(j) - \min_j x_i(j)}{\max_j x_i(j) - \min_j x_i(j)}$ Cost-effective: $x_i^* = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - \min_j x_i(j)}$ Optimum condition: $x_i^* = \frac{ x_i(j) - x_{0b}(j) }{\max_j x_i(j) - x_{0b}(j)}$
3	The degree of differentiation is calculated $d_j = 1 - e_j$		Distances to the reference point are determined $d_{ij} =  r_j - x_{ij}^* $	Decision matrix reconstructed $X_i^* = \begin{bmatrix} x_1^*(1) & \dots & x_1^*(n) \\ \vdots & \ddots & \vdots \\ x_m^*(1) & \dots & x_m^*(n) \end{bmatrix}$
4	Criteria weights are determined $w_j = \frac{d_j}{\sum_p d_j}$		Scores are obtained and glazed from small to large. The first alternative is determined as the best alternative. $P_i = \min_i (\max_j d_{ij})$	Absolute value matrix are created $\Delta_{oi} =  x_0(j) - x_i^*(j) $ $X_i^* = \begin{bmatrix} \Delta_{o1}(1) & \dots & \Delta_{o1}(n) \\ \vdots & \ddots & \vdots \\ \Delta_{om}(1) & \dots & \Delta_{om}(n) \end{bmatrix}$
				Gray relational coefficient matrix are created

				$\gamma_{oi}(j) = \frac{\Delta_{min} + \zeta \Delta_{max}}{\Delta_{oi}(j) + \zeta \Delta_{max}}$ $\Delta_{max} = \max_i \max_j \Delta_{oi}(j)$ $\Delta_{min} = \min_i \min_j \Delta_{oi}(j)$
				Determination of gray relationship degrees $\Gamma_{oi} = \frac{1}{n} \sum_{j=1}^n \gamma_{oi}(j)$

### Appendix 1 Continuing. Application Steps of Multi Criteria Decision Making Techniques

Stage	PROMETHEE	COPRAS
1	Preference functions for criteria: Usual type, U type, V type, Stepped, Linear and Gaussian	Normalization is performed. $q_j$ : to indicate benchmark weights $d_{ij} = \frac{x_{ij} q_j}{\sum_{i=1}^m x_{ij}}$ $q_j = \sum_{i=1}^m d_{ij}$
2	Common preference functions are determined: $P(a, b) = \begin{cases} 0, & f(a) \leq f(b) \\ p[f(a) - f(b)], & f(a) > f(b) \end{cases}$	Weighted normalized indexes are added $S_{+i} = \sum_{j=1}^n d_{+ij}$ $S_{-i} = \sum_{j=1}^n d_{-ij}$
3	W: to determine the importance weights, preference indices are determined. $\pi(a, b) = \sum_{i=1}^K w_i P_i(a, b)$	Relative significance of alternatives is calculated and sorted from top to bottom. $Q_i = S_{+i} + \frac{S_{-min} \sum_i^m S_{-i}}{S_{-i} \sum_i^m \frac{S_{-min}}{S_{-i}}}$
4	Positive $\Phi^+$ and negative $\Phi^-$ advantages are determined for alternatives. $\Phi^+(a) = \frac{1}{n-1} \sum \pi(a, b)$ $\Phi^-(a) = \frac{1}{n-1} \sum \pi(b, a)$	The degree of benefit of alternatives is determined. $N_i = \left( \frac{Q_i}{Q_{max}} \right) \times 100\%$
5	PROMETHEE I and partial priorities are determined by binary comparisons of positive and negative priorities	
6	With PROMETHEE II full sorting is performed. Full priorities are set for this: $\Phi(a) = \Phi^+(a) - \Phi^-(a)$ The full priority value is sorted from top to bottom and the first-line alternative is determined to be the best alternative.	

Source: Authors' calculations

**APPENDIX 2. Decision Matrix**

<b>Company</b>	<b>Aksa Enerji</b>	<b>Anadolu Cam</b>	<b>Arcelik</b>	<b>Aselsan</b>
Market value	1655556619	2055000001	9358835639	31441200000
Average Return	-0.1465	-0.0152	0.0101	0.0612
Current rate	0.97	1.07	1.58	2.72
Cash rate	0.82	0.85	1.11	1.87
Debt / Equity	2.641	1.579	2.402	0.898
Borrowing rate	1.98	118.84	127.71	9.44
Equity / Total. Act.	0.274	0.387	0.293	0.526
Takeover speed	3.7	4.08	4.14	3.23
Inventory turnover	9.36	5.73	3.41	2.06
Active rotation speed	0.83	0.6	1.11	0.52
Net Profit / Personnel	370.5	93.14	22.13	421.92
Return on equity	32.15	19.26	8.55	33.21
Return on assets	6.9	7.84	2.64	16.82
Earnings per share	0.58	0.24	1.25	1.39
Sales growth	28.01	51.6	41.48	56.05
Operating margin	13.68	13.78	11.61	34.62
Net profit margin	-2.21	12.98	2.64	32.21

**Source:** Authors' calculations