Financial Performance Analysis of Healthcare Companies on Borsa Istanbul During COVID-19 Via MOORA And TOPSIS Methods

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Abstract

With the volatility crisis brought by the pandemic, technology and health sector companies have entered the agenda of more investors in the global capital markets. COVID-19 has increased the uncertainty in financial markets as well as paralyzing the health systems of countries. Making the optimum decision among multiple alternatives is of vital importance for investors. For this purpose, multiple criteria decision-making applications (MCDA) have been used with increasing frequency in the recent years. In this study, the financial performance of healthcare companies traded in Borsa Istanbul was examined by MOORA and TOPSIS methods for four periods during the pandemic process. Interestingly, the same companies came out first in terms of financial performance for both methods in three of the four periods analyzed. For this purpose, these two methods have been recommended to the financial decision makers who are on the verge of analyzing the companies in financial markets during uncertainty.

Keywords: Capital Markets, MCDA, Financial Performance, MOORA, TOPSIS

Introduction

Considering the period after the last millennium, there have been major epidemics affecting the world on a regional scale. The most important of these are SARS-CoV, which emerged in 2002, H1N1 that affected the world in 2009, and MERS-CoV, which mostly affected the Middle East countries in 2012. However, none of these diseases has brought about the global crisis caused by COVID-19 (Huang et al., 2021). Such uncertainty periods have also changed the paradigms of financial analysis (Bennett & Lemoine, 2014).

Companies traded in the capital markets are followed by creditors, partners and shareholders. It is of vital importance for all financial stakeholders to identify the ineffective parts of these companies by comparing them with other firms in the sector and to evaluate their financial performance. Multi-criteria decision-making applications (MCDA) are used in scenarios

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where an optimum decision must be made between multiple alternatives. For this purpose, MCDA methods are often preferred in evaluating the performance of companies.

The increasing growth and prominence of companies in the healthcare industry has shown its effect especially during the pandemic process. In this process, which is affected the whole world and paralyzed healthcare systems, companies in this sector have been preferred more by investors, and therefore healthcare company stocks have been less affected by the volatility in the capital markets compared to other sectors (Baek et al., 2020). Although financial performance calculations are very important for financial stakeholders especially in times of uncertainty, analyzes based on expert opinions can lead to subjective results.

In this study, the performance analysis of 3 Borsa Istanbul companies operating in the healthcare sector, whose popularity among investors increased significantly during the COVID-19 period, was analyzed with MOORA and TOPSIS methods. In addition, CRITIC, one of the most popular objective weighting techniques, was preferred in order to achieve recalculation efficiency and strong statistical results.

The overall outline of the research is as follows: In the second section, the literature on financial performance and preferred MCDA methods is included. In the third section, the methodology of the study is summarized with the methods analyzed and the weighting technique. In the fourth section, the findings of the study are given, and ultimately, in the fifth section, the discussion and conclusions are explained.

Literature Review

Frequently used analysis tools in making financial decisions are statistical and econometric models such as logistic regression, discriminant analysis and probit analysis (Marques et al., 2020). However, in recent years, MCDA methods have been especially preferred in financial performance studies due to the diversity and practicality they offer. Undoubtedly, the quality of analyzes depends on sufficient and quality inputs and their efficient evaluation (Stevic et al., 2022). The use of MCDA techniques in the financial sector in the analysis of both local and global stock markets is due to the methods' ability to identify the optimum alternative even when conflicting criteria exist. For this reason, MCDA methods are preferred to guide decision makers as a decision support system in complex scenarios where there is a search for better, faster and practical solution. In addition, MCDA methods currently provide the most appropriate and practical infrastructure for ranking and comparing alternatives (Aouni et al., 2018).

There are many MCDA methods in the literature and freshly introduced ones are added to these methods every single year. Undoubtedly, it is difficult to determine which method is the best for solving a particular problem, so the researches are carried out on a predetermined method or methods (Stevic et al., 2020).

Methods with different mathematical backgrounds are used in selecting the most optimal one among multiple alternatives according to multiple criteria (Yang et al., 2019). Especially in conditions of uncertainty, inconsistency and ambiguity, MCDA methods are successful in

producing strong results (Ji et al., 2018). The criteria chosen in the analysis of financial performance are also very important in order to take a general picture of the sector and the companies examined. As the risks related to the problems analyzed increase, it is critical to determine criteria that are able to reflect and evaluate these problems. In an analysis with higher quality inputs, more consistent outputs can be achieved in solving complex problems (Zavadskas et al., 2016). The ratios used for this purpose are divided into two: accounting-based and valuation-based ratios (Yalçın et al., 2012). The use of accounting-based ratios in financial performance evaluations has been a phenomenon for a very long time (Horrigan, 1968). Accounting-based ratios focus more on the company's past, while valuation-based ratios refer to the future of the company through the cash flows they generate. In this study, both accounting-based and valuation-based ratios are used together in order to make a more comprehensive analysis.

When the studies on financial performance in the literature are scrutinized, it is seen that the research are mostly done with one or two methods. In a study evaluating the performance of banks in India, analyzes were carried out with 31 financial ratios (Bawa et al., 2019). In another study evaluating the financial performance of tourism companies operating in Turkey, the TOPSIS method was used (Erdoğan & Yamaltdinova, 2018). In a study on the calculation of company rankings, the TOPSIS method was used (İç, 2014). TOPSIS method was also preferred in evaluating the performance of companies operating in the technology sector in Turkey (Bulgurcu, 2012). In another study on bank branch selection, the MOORA method was preferred (Görener et al., 2013). In a study on the privatization of companies, the MOORA method was chosen (Brauers & Zavadskas, 2006). Again, the MOORA method was preferred in calculating the sustainability of country risks (Stankeviciene, 2014). In the evaluation of the construction sector, the MOORA method has been integrated into the analysis (Brauers et al., 2013).

Methodology

The overall efficiency of total assets has been tested for many years in performance studies, and the return on assets (ROA) used for this purpose is one of the most popular financial ratios (Pradesyah & Putri, 2021). In addition, earnings per share (EPS), which measures return yieldance for investors, is also a critical parameter for shareholders (Myskova & Hajek, 2017). Debt ratio is preferred in the analysis as a cost-oriented criterion that shows how efficiently the company can use its debts compared to its equity capital (Ali & Faisal, 2020). Marketing value added (MVA), a valuation measure, is a pivotal ratio that shows how efficiently the company is managed in terms of generating returns for shareholders (Prasad & Shrimal, 2015). In addition, the market-to-book (M-to-B), which is a valuation-based ratio that shows the extent to which the company has improved its market value compared to its book value, has also been used in financial performance analyzes (Ercegovac et al., 2020).

Analyzes were carried out with MOORA and TOPSIS methods, which are practical and frequently used in financial performance studies.

In this study, 3 companies serving in the healthcare sector in Borsa Istanbul for 4 quarters from the last quarter of 2021 to the last quarter of 2022 were analyzed with the methods mentioned above. In addition, CRITIC, one of the objective weighting techniques, was preferred in this research. Multi Objective Optimization on the basis of Ratio Analysis (MOORA) In the MOORA method, the most optimal solution among a number of alternatives is ranked according to the cost and benefit-based criteria (Chakraborty, 2011). It is a method based on the ratio system, in which the answer given to the alternative of each objective is compared with the square root of the sum of the squares of all the answers (Brauers & Zavadskas, 2006).

MOORA method has been used in studies evaluating regional and international development (Brauers & Ginevicius, 2009; Brauers et al., 2010). In addition, this method has also been preferred in the calculation of country risk (Stankeviciene et al., 2014) and economic transformation applications (Brauers & Zavadskas, 2006). The application steps of this method are shown below thoroughly (Brauers & Zavadskas, 2006).

Step 1: With the following formula, normalized objective matrix is obtained via vector normalization, where F_{ij} represents the normalized values for alternatives, while f_{ij} denotes raw values before normalization:

$$F_{ij} = \frac{f_{ij}}{\sqrt{\sum_{i=1}^{m} {f_{ij}}^2}}$$

(1)

Step 2: Weighted normalized objective matrix is obtained via following equation, where v_{ij} represents the weighted normalized values, while w_j expresses criteria weights:

$$v_{ij} = F_{ij} \times w_j$$

(2)

Step 3: Ultimately the performance scores for each solution is computed by:

$$P_i = \sum_{j=1}^{g} v_{ij} - \sum_{j=g+1}^{n} v_{ij} \qquad i \in \{1,2,\dots,m\}$$

(3)

Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) The TOPSIS method uses the distances from the negative and positive ideal solutions to rank the alternatives according to the selected criteria and the calculated criterion weights (Hwang & Yoon, 1981). In addition, this method is especially preferred in scenarios where there is uncertainty (Ziemba et al., 2020).

The TOPSIS method has also been used in studies in different fields such as measuring environmental supplier performance (Awasthi et al., 2010), valuation of sustainable government practices (Bilbao-Terol et al., 2014) and determining the optimal location of manufacturing companies (Alimoradi et al., 2011). The application steps of this method are given below with the preference of vector normalization (Hwang & Yoon, 1981).

Step 1: Obtaining the normalized decision matrix, where F_{ij} denotes the normalized values for alternatives:

$$F_{ij} = \frac{f_{ij}}{\sqrt{\sum_{i=1}^{m} f_{ij}^2}}$$

(4)

Step 2: Obtaining the weighted normalized matrix, where v_{ij} expresses weighted normalized values, and w_{ij} represents criteria weights:

$$v_{ij} = F_{ij} \times w_j$$

(5)

Step 3: Determining the positive (A^+) and negative (A^-) ideal solutions:

$$A^+ = \{(Max_i(v_{ij}) \,|\, j \in J), (Min_i(v_{ij}) \,|\, j \in J') \,|\, i \in 1, 2, \dots, m\} = \{v_1^+, \dots, v_j^+, \dots, v_n^+\}$$

(6)

$$A^- = \{(Min_i(v_{ij}) \,|\, j \in J), (Max_i(v_{ij}) \,|\, j \in J') \,|\, i \in 1, 2, \dots, m\} = \{v_1^-, \dots, v_j^-, \dots, v_n^-\}$$

(7)

Step 4: Calculation of the distance values of the aforementioned positive and negative ideal solutions:

$$S_{i+} = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \qquad i = 1, 2, 3, \dots, m$$

(8)

$$S_{i-} = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \qquad i = 1, 2, 3, \dots, m$$

(9)

Step 5: Computation of the relative proximity to ideal solution:

$$C_i = \frac{S_{i-}}{S_{i-} + S_{i+}}$$

(10)

Criteria Importance Through Intercriteria Correlation (CRITIC), an objective weighting technique which draw its power from standard deviation and correlation calculations, is one of the most popular weighting methods (Mukhametzyanov, 2021). In this technique, criterion weights are calculated purely based on the mathematical relationship among criteria, which constructed the motive of its popularity in MCDA studies (Madic & Radovanovic, 2015; Rostamzadeh et al., 2018). The weights are quantified based on the mathematical relationship among the criteria. The technique utilizes standard deviation and correlation in this process (Tuş & Aytaç Adalı, 2019). The application steps of the technique are summarized below (Diakoulaki et al., 1995).

Step 1: Creation and normalization of the decision matrix to be used in the analysis with the following equation, where r_{ij} defines the normalization values, x_{ij} represents the criteria value, $x_j min$ denotes the minimum criteria value, and $x_j max$ expresses the maximum criteria value:

$$r_{ij} = \frac{x_{ij} - x_j min}{x_j max - x_j min}$$

(11)

Step 2: Computation of the correlation density with the following equation, where C_j defines the correlation density:

$$C_j = \sigma_j \sum_{i=1}^{m}(1 - r_{ij})$$

(12)

Step 3: Normalization of the correlation density and computation of the weights for every criterion via the following equation, where w_j denotes the weight of the criteria:

$$w_j = \frac{C_j}{\sum_{i=1}^{m} C_i}$$

(13)

Findings and Results

In this study, the financial performance of healthcare companies traded in Borsa Istanbul was examined over 5 criteria in 4 quarters during the pandemic period. The decision matrices used for these 3 healthcare companies examined in all quarters are given in Table 1 below.

Table 1. Decision Matrices used for all Analyzed Periods

	ROA	EPS	M-to-B	Debt	MVA	
LKMNH	0.548825	0.621857	0.052694	-0.15249	0.252872	
MPARK	0.523423	0.649879	-0.12031	-0.13535	0.074337	2021/IV
EGEPO	-0.21274	-0.22932	0.361505	-0.01721	0.599383	
LKMNH	-0.70795	-0.65116	0.210419	0.259149	0.407554	
MPARK	-0.48366	-0.43709	-0.22283	-0.18529	-0.01289	2022/I
EGEPO	-0.38552	-0.37993	-0.11476	-0.1184	-0.13329	
LKMNH	0.269161	0.748855	-0.0695	0.523575	-0.05674	
MPARK	1.863796	2.022216	-0.34051	-0.37737	0.006761	2022/II
EGEPO	0.198837	0.23008	0.47587	0.078626	0.747309	
LKMNH	0.362898	0.469946	0.764029	0.19997	1.035672	
MPARK	0.645975	0.786271	0.770252	-0.20168	1.504581	2022/III
EGEPO	-0.11928	-0.06911	0.630025	0.261457	0.816441	

According to the CRITIC weighting method used in this study, the weights calculated for each criterion are given in Table 2 below. The point that draws attention here is that when all periods are taken into account, the valuation ratios M-to-B and MVA are the ratios that take the highest weights. This again shows that valuation ratios are of vital importance in financial performance analysis.

Table 2. Criteria Weights Calculated according to the CRITIC Weighting Method

	2021/IV	2022/I	2022/II	2022/III
ROA	0.177769	0.161618	0.189661	0.10933
EPS	0.180027	0.166753	0.197067	0.109359
M-to-B	0.236345	0.243121	0.254033	0.325233
Debt	0.167634	0.175738	0.133121	0.300928
MVA	0.238225	0.25277	0.226118	0.155151

In the analysis made for companies operating in the health sector, the method scores calculated for all periods examined are given in Table 3 below. Different companies came first for the two methods calculated just for the first period, while the same companies took the first place in all other periods.

For the analysis, the criteria weights were first calculated according to the CRITIC technique by applying formulas 11 through 13. Then, the relevant criteria weights calculated and shown in Table 2 were integrated into both MOORA and TOPSIS methods. While, MOORA results were obtained by applying formulas between 1 through 3, TOPSIS results were computed by applying equations between 4 through 10. In addition, it should be noted that in MOORA and TOPSIS methods, alternatives are ranked in a descending order.

In the first quarter, Lokman Hekim company showed the highest performance in MOORA method, while Nasmed company (EGEPO) became the first company in terms of TOPSIS method. In other quarters, respectively, Lokman Hekim, Nasmed and Medical Park companies came first for both methods. From this point of view, it can be deduced that the methods produce consistent results. In this respect, these methods have been proposed to financial decision makers, in light with the findings of this analysis.

Table 3. Final Results of MOORA and TOPSIS for all Quarters Analyzed

	2021/IV		2022/I		2022/II		2022/III	
	MOORA	TOPSIS	MOORA	TOPSIS	MOORA	TOPSIS	MOORA	TOPSIS
LKMNH	*0.4937*	0.5606	*0.016145*	*0.651735*	-0.05927	0.225863	0.231308	0.261476
MPARK	0.3081	0.4215	-0.24411	0.377877	0.302946	0.41675	*0.661281*	*1*
EGEPO	0.3618	*0.5695*	-0.24155	0.35852	*0.455333*	*0.635114*	-0.00278	0

In order to establish a general benchmark, to get an overall picture of the sector, and most importantly, to provide validation for the results above, the analyses for both methods were conducted for the entire review period. The motive behind this is to investigate whether the above analysis by four quarters would yield comparable results when analyzed for the whole period. For this purpose, CRITIC weights calculated for each quarter were not used, but CRITIC weights covering the whole year were calculated separately. Afterwards, the calculated criteria weights were integrated into the relevant methods and final performance results were obtained for each method. The new CRITIC weights, with MOORA and TOPSIS performance results are shown in Table 4.

Table 4. CRITIC Weights and Final Method Results Covering Whole Year

	Weights		MOORA	TOPSIS
ROA	0.190788	LKMNH	0.126121	0.308042
EPS	0.188914	MPARK	*0.519508*	*0.595391*
M-to-B	0.243854	EGEPO	0.305092	0.454584
Debt	0.149425			
MVA	0.227019			

Ultimately, it was observed that the highest weights were again computed for M-to-B and MVA ratios. In addition, the healthcare company that showed the most successful financial performance in the pandemic process analyzed was determined as Medical Park, which was also found to be the best performer for both methods in the last quarter.

Discussion and Conclusion

It is of vital importance to make the right calculations at the right time in capital markets where different shifts are constantly experienced due to different developments in the world. There is a need for an efficient decision support system in today's modern financial environments where investor sentiments can change and transform much faster with the development of internet technologies. For this purpose, MCDA methods are used to make consistent and optimal choices.

In this study, the financial performance of companies in the healthcare sector, which has come to the fore globally in the process that has been under the effect of the pandemic in recent years, has been analyzed. In this sense, analyzes were carried out with MOORA and TOPSIS methods, which are frequently used especially for their practicality and popularity. Weights were calculated with CRITIC, one of the objective weighting techniques, and calculations were made on 5 criteria based on accounting and valuation ratios. In this sense, the same companies shared the first place for both methods in three of the four periods examined in the analysis. Therefore, the financial performance results produced by the methods are consistent with each other. Relevant methods in the financial performance analysis of companies in the healthcare sector are recommended to the financial decision makers.

In future studies, the pandemic performance of companies operating in the healthcare sector can be examined comparatively in a big data set covering various countries worldwide, in order to examine different pandemic effects on various countries. By implementing methods from different schools into the analyzes, it can be determined which method can produce more optimum results on the verge of pandemic.

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