

## The effect of pandemic conditions on financial success rankings of BIST SME industrial companies: a different evaluation with the help of comparison of special capabilities of MOORA, MABAC and FUCA methods

Salgın koşullarının BIST KOBİ sanayi firmalarının finansal başarı sıralamalarına etkisi: MOORA, MABAC ve FUCA yöntemlerinin özel kapasitelerinin karşılaştırılması yardımıyla farklı bir değerlendirme

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### Abstract

Considering COVID-19 pandemic conditions from an MCDM perspective, the change in the ranking positions of the companies before and during the pandemic conditions has become more critical for many researchers and especially financial decision-makers. In this study, different from other studies, a new methodological procedure was followed. For the first time, an MCDM method was chosen among the alternatives with an objective point of view, and the application was continued. In other words, the final performance evaluation is based on the results of this chosen method. In the first step, the financial performance of companies traded in the BIST SME Industry, which is the application area of the study, was calculated with three different MCDM methods (MOORA, MABAC and FUCA). In the second step, the ranking correlations between the calculated financial performance scores and the stock return in the current period were compared with the Spearman method. Finally, in the third step, based on this indirect objective reference verification result (as it is the most appropriate and successful), the necessary financial analyzes were made with the FUCA method. According to the findings, the FUCA method correlated higher with the stock return before and during the pandemic than the other MCDM methods. According to these results, when a performance comparison is made between before and during pandemic conditions, three changes become prominent: the most successful companies, the companies' overall ranking, and the favourite sectors have entirely changed for the base periods. This innovative procedure has been proposed for the first time in the literature and has been successfully applied.

**Keywords:** Financial Performance, MCDM, stock return, Spearman's Correlation Coefficient

**Jel Codes:** L25, G30, C44, M21

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### Öz

MCDM perspektifinden COVID-19 pandemi koşulları göz önüne alındığında, şirketlerin pandemi koşulları öncesi ve sırasındaki sıralama pozisyonlarındaki değişiklik, birçok araştırmacı ve özellikle finansal karar vericiler için daha kritik hale gelmiştir. Bu çalışmada yöntemsel prosedür açısından diğer çalışmalardan farklı olarak yeni bir yol izlenmiştir. İlk defa objektif bir bakış açısıyla alternatifler arasından bir MCDM yöntemi seçilerek uygulamaya devam edilmiştir. Başka bir ifadeyle nihai performans değerlendirmesi, seçilen bu yöntemin sonuçlarına dayandırılmıştır. İlk adımda çalışmanın uygulama sahası olan BIST KOBİ Sanayi'de işlem gören firmaların finansal performansı üç farklı MCDM yöntemiyle (MOORA, MABAC, FUCA) hesaplanmıştır. İkinci adımda hesaplanan finansal performans puanlarıyla cari dönemdeki hisse getirileri ile olan sıralama korelasyonları Spearman yöntemiyle karşılaştırılmıştır. Üçüncü adımda bu dolaylı objektif referans doğrulama sonucu baz alınarak (en uygun ve başarılı olduğu için) FUCA yöntemi ile gerekli finansal analizler yapılmıştır. Elde edilen bulgulara göre FUCA yöntemi diğer MCDM yöntemlerine kıyasla hem salgın öncesi ve salgın sürecindeki dönemlerde hisse getirisi ile daha yüksek bir korelasyon üretmiştir. Bu sonuçlara göre, salgın süreci ile öncesindeki normal dönem için bir performans karşılaştırması yapıldığında üç konuda değişim göze çarpar: en başarılı firmalar, firmaların genel sıralaması ve gözde olan sektörler baz dönemler için tamamen değişmiştir. Bu yenilikçi prosedür literatürde ilk defa önerilmiştir ve başarılı bir şekilde uygulanmıştır.

**Anahtar Kelimeler:** Finansal Performans, MCDM, hisse getirisi, Spearman Korelasyon Katsayısı

**JEL Kodları:** L25, G30, C44, M21

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## Introduction

The COVID-19 virus, which is accepted to have different effects globally, was first identified in December 2019 in Wuhan, China. The pandemic's effects, especially in the economy, has started to spread rapidly since early 2020. It has even been argued that it caused a recession in the economy (Duran and Acar, 2020: 57; Göze Kaya, 2020). At the national level, pandemic directly affected some critical areas such as sectoral, foreign trade, employment, industrial production, and tourism income in the Turkish economy (Soylu, 2020; Öztürk, Şişman, Uslu and Çıtak, 2020; Tayar, Gümüştekin, Dayan and Mandi, 2020; Demir, 2020). On the other hand, the spread of COVID-19 also affected the capital markets negatively at the global level (Cinel, 2020: 137).

The pandemic conditions that caused economic, sectoral or company-based effects have another significant and different dimension, which has not been explored yet. It is how and to what extent companies maintain their financial performance position compared to their competitors. The change in the ranking positions of companies on an individual and general basis before and during a pandemic can produce meaningful information for decision-makers. In this sense, it can be calculated to what extent the general success rankings of the companies change statistically within broad time constraints. It is also possible to determine companies that can the pandemic conditions into an opportunity or not.

This study was carried out to reveal to what extent companies maintain, increase or decrease their financial performance and stock return ranking positions after COVID-19. With different Multi-Criteria Decision Making (MCDM) methods, it has been tried to determine the direction and meaning of the change in terms of both company-based and general holistic ranking. In this sense, three different MCDM methods (FUCA, MOORA and MABAC) were used to investigate whether there is a similar, inverse or significant relationship between the rankings of companies periodically (before and during pandemic conditions). Although its effects continue, this analysis covers three years (12-quarters), 1.5 years before and 1.5 years after the pandemic. In this sense, it is expected that the study will reach more valid and reliable results.

The choice of the MCDM method is a critical issue as it directly affects the final evaluations (Wątróbski, Jankowski, Ziemia, Karczmarczyk and Ziolo, 2019; Eldrandaly, Ahmet and Abdelaziz, 2009; Kashid, Kashid and Mehta, 2019; Danesh, Ryan and Abbasi, 2017). In the methodological working procedure of this study, an objective and quite exciting approach has been proposed. In order to rank the companies from best to worst, an MCDM method selection is required. Still, this selection has generally been considered a methodological problem with an uncertain solution because different methods have different equations and assumptions. It is also often challenging to compare MCDM methods, as it is difficult to check them for accuracy. (Olson, Mechitov and Moshkovich, 2001). This study will operate the working procedure by accepting the MCDM method with the highest correlation between financial performance scores, which MCDM produces, and stock return, which expresses the external performance that companies cannot directly control. Therefore, this MCDM method is accepted as the most appropriate method. In other words, MCDM methods are first compared according to the level of their relationship with price, which is real-life data. The MCDM method with the highest relationship with the price was determined in the next stage. Thus, all financial performance and evaluation analyzes will be made with the most appropriate MCDM method. From this point of view, it can be said that an efficient, appropriate and more realistic procedure is followed for more accurate measurement (Yaakob and Gegov, 2016; Baydaş and Elma, 2021; Baydaş and Eren, 2021). In other words, it was assumed that an MCDM method, which provides a healthier relationship between two variables, makes more accurate measurements. This approach is more objective, reasonable and acceptable when compared to choosing a subjective or MCDM method under uncertainty. Thus, the study's primary purpose is to determine the change in the successive positions of the companies before and during the pandemic by more accurate and objective measurement.

In this study, first of all, the literature topics that are directly related to the focal points of the study will be discussed separately. Secondly, the method and experimental data set used in the research are explained. Thirdly, the applications of the study were revealed, and findings were discussed. Finally, the final evaluations and recommendations for researchers and financial decision-makers in the conclusion part were made.

## Literature review

In line with the purpose of the study, the studies in the literature are divided into three topics: COVID-19 pandemic and its effects, financial performance measurement with MCDM, and the methodological problem of MCDM selection.

## COVID-19 pandemic and its effects

The impact of the COVID-19 pandemic on the economy, different sectors and especially the financial performance of the companies have been researched during the pandemic conditions in many studies. (Göze Kaya, 2020; Öztürk et al., 2020; Tayar et al., 2020; Demir, 2020). For example, Rababah, Al-Haddad, Chunmei and Cherian (2020) stated that the pandemic had severe and adverse effects on the performance of companies registered in the Chinese stock market. The study determined that the pandemic has caused a decrease in sales revenue, profitability, and companies' investments. It can be said that the most negative impact was in travel, tourism, transportation companies and other companies associated with them in the first quarter of 2020, the beginning of the pandemic. Similarly, Devi, Warasniasih, Masdiantini and Musmini (2020) emphasized a decrease in companies' liquidity and profitability ratios during the pandemic, while there were also significant differences between sectors. In addition, it was determined that the liquidity and profitability ratios increased in the consumer goods sector and decreased in the real estate, building construction, finance, trade, service and investment sectors. Aifuwa, Musa and Aifuwa (2020), on the other hand, found that the pandemic damaged both the financial and non-financial performances of companies in Nigeria.

Bayraktar (2020) investigated the effect of the COVID-19 pandemic on Turkey's BIST manufacturing sector stocks. First, he determined that the manufacturing sector stocks traded in BIST 100 provided an average daily negative return on the announcement date. Then the negative return was more apparent. Additionally, it was pointed out that the returns of stock returns in these sectors during the pandemic were higher than the returns before the pandemic. Similarly, Dölen, Yanık and Ayanoğlu (2021) evaluated the effects of the COVID-19 pandemic by comparing interim financial statements of three companies operating in the pharmaceutical and aviation sectors in BIST 100 between June - September 2020 and the same period of 2019. Although interestingly, it was determined that the cash holding position increased in both sectors, the gross sales profit increased less than the revenue in the pharmaceutical sector. On the other hand, the net loss was higher in the aviation sector due to imposed restrictions on passenger transportation. Still, the loss decreased after the abolishment of these restrictions.

These studies in the literature emphasize that pandemic conditions affected the economy, various financial markets and companies more negatively, especially in the first periods. On the other hand, the relationship between the ranking positions/positions of the companies before and during the pandemic and the change between them have not been investigated in the literature. This is a significant gap that can be filled with the MCDM paradigm rather than classical methods. From a holistic point of view, it should be determined how the performance rankings of companies, in general, have changed with the pandemic. Then, the statistical relationship between the overall performance rankings for two comparatively different periods can be investigated. In this sense, it is suggested to use MCDM and Spearman correlation methods in the study. In addition, the best and worst companies (and their sectors) and their tendency to change were observed. The main critical point is that the operation of an objective working procedure in selecting the most appropriate MCDM method for a more accurate measurement affects the interpretation of the final results of research.

## MCDM and financial performance measurement

We constantly make decisions in daily life. As the number of options (alternatives) and criteria increases, we are choosing an appropriate alternative according to multiple criteria becomes more complex than a single criterion. MCDM is a mathematical process that selects the best. When there are cost or benefit-oriented criteria, the number and burden of computational operations for the decision maker become more complicated – solution among the alternatives, considering baseline evaluation criteria. MCDM has proven to be a more critical (compromise solution) than a single-criteria optimal solution in solving specific multi-criteria problems in numerous fields such as management science, engineering, medicine, finance, informatics, public administration and military issues (Kung, Chuang and Ky, 2011).

It is essential to reveal the multidimensional financial success levels of the companies in terms of being a decision support system element for the information users (investors, shareholders, creditors, suppliers, etc.) who are decision-makers. The performance level can be determined based on criteria and weight ratios for different numbers of companies. MCDM methods make the analysis that can determine the most successful company as an objective consensus based on different indicators. Financial performance measurement can be made by using a multiple decision-making technique that can summarize different performance criteria in a standard score (Yükçü and Atağan, 2010). The search for an appropriate and accurate measure of financial performance is among the most researched issues in finance, especially in MCDM-based research. Experimental testing of such studies over 20 years has focused on improving the measurement of sequences obtained by MCDM methods with different

computational processes. Different MCDM methods directly affect the results because they use different calculation equations, normalization types, thresholds and ideal values, outranking, value, or utility approaches.

Different weighting and MCDM methods were used in many studies with different constraints to provide originality and added value. In other words, the comparative financial performance of the companies was measured with different MCDM methods by using the historical ratio data of the companies (Feng and Wang, 2000; Ertuğrul and Karakaşoğlu 2009; Baležentis, Baležentis and Misiunas, 2012; Tavana, Keramatpour, Santos-Arteaga and Ghorbaniane, 2015; Ban, Ban, Bogdan, Sabau Popa and Tuse, 2020). In these studies, with different datasets, it has also been tried to ensure the authenticity of the measurement and test the accuracy. Because their primary goal is using different ratios, weights, normalization methods, threshold values, MCDM methods, sectors and periods (different problem scenarios). For instance, De Almeida-Filho, De Lima Silva and Ferreira (2020) reviewed the studies that used MCDM methods for finance in the literature. First, the findings showed that AHP and TOPSIS are widely-used MCDM methods in such studies. Secondly, MCDM methods generally produced similar ranking results by assuming that the exact weighting and decision matrix were used. Furthermore, among the top main criteria groups used for financial modelling, profitability and risk-based are the most widely adopted indicators. Finally, MCDM-based financial performance measurement has been one of the most studied topics in finance.

The main common point of these studies is that they suggest the most appropriate ranking and the best company for a particular financial performance measurement problem. Although this is the case, it is still unclear whether these studies suggest the most appropriate method for us because there is no generalizable reference criterion in this regard. Therefore, in this study, share price data was used as a referee to select an appropriate MCDM method to calculate financial performance.

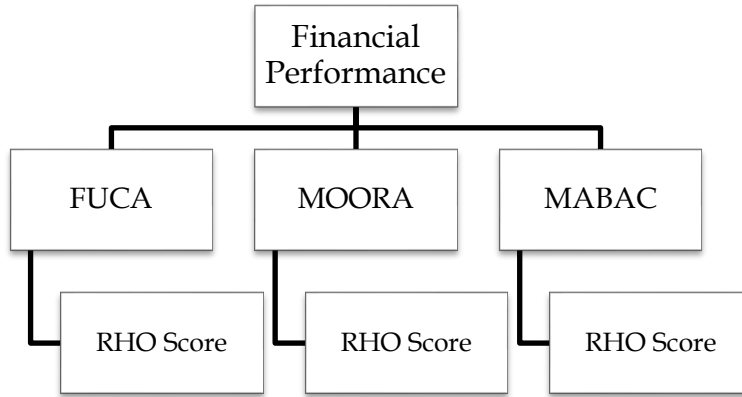
#### **A half-century problem: the methodological problem of MCDM selection**

This section discusses approaches related to MCDM selection in the literature. Comparing MCDM methods is often difficult because it is difficult to check their accuracy in different computational procedures (Olson et al., 2001; Wątróbski et al., 2019; Eldrandaly et al., 2009; Kashid et al., 2019; Danesh et al., 2017). Ozernoy (1992) claims that there is no perfect MCDM method. Therefore, there is not yet a clear and generalizable consensus on which MCDM method is the most appropriate in different cases. However, there is no consensus on the most appropriate method for ranking problems. Depending on the situation, it can be said that there is a high statistical similarity between different MCDM method rankings that use the same decision matrix and weighting with varying severity (Karaođlan and Şahin, 2018).

The capacity of an MCDM ranking to generate a relationship with an external referee ranking can be used to compare, evaluate, and select methods. However, selecting the most appropriate method is still controversial and ambiguous. In particular, it is an advantage and can be recommended to use the correlation coefficient between financial performance and simultaneously developing stock return rankings (Baydaş and Elma, 2021; Baydaş and Eren, 2021). In other words, an MCDM-based financial performance ranking type that produces a higher correlation with an external criterion (price) is also better able to capture real life. Moreover, the fact that an MCDM method consistently and constantly produces a relationship at a higher level of closeness, which is evident from the comparisons, gives us an important clue about the capacity and capability of that MCDM method. At the same time, it can provide us with a solid insight to compare and then choose any of the MCDM methods.

#### **Research methodology and experimental data set**

This study calculates the change-based financial performance scores of 24 companies traded in the BIST KOBİ (SME) industry index with MCDM. The period for this comparative analysis covers six quarters, 1.5 years before and 1.5 years during pandemic conditions. Commonly used essential ratios such as ROA, ROE, Altman-Z, MVA spread, MVA margin, and MV/BV were calculated using the balance sheet and income statement items. Financial ratio data and share price data were obtained from the FINNET commercial database. MINITAB was used for statistical analysis. MCDM method calculations consisting of FUCA, MABAC, MOORA were done in Excel by the literature (Wang and Rangaiah, 2017; Wang, Parhi, Rangaiah and Jana, 2020). In addition, the formulas are presented in the method sections. Finally, the ranking performance of 24 companies for two different periods was compared over six financial indicators (criteria) of these companies (alternatives). In this study, financial performance-based MCDM analyses of BIST-SME INDUSTRY companies were made within the scope of the study.



**Figure 1:** The Diagram of the Analysis Process

Table 1 below shows the preferred financial ratios and calculations about whether MVA derivatives and MV/BV companies produce value or not. In this study, ROE and ROA values are preferred because they express the profitability yields of the companies. Altman-z Score expresses the future risk of companies. All of these indicators are utility-based. In other words, when the change-based value is positive for these indicators, there is a positive increase for a company or a negative decrease when it is negative. Since the change values between the two base periods are taken for all indicators, they have been turned into utility-oriented. In the quantitative observations made according to the study data, it has been determined that the change values in the MV/BV ratio of the companies are utility based. This made the calculation a great convenience. Thus, if the MV/BV value, which is desired to be greater than 1 for the static value, is calculated on a change basis, it is sufficient to be positive. Thus, the basis of utility-based was provided for all indicators. And then, for the stock return calculations, the percentage change in price between two base periods is calculated based on capital gains.

**Table 1:** Formulas of Financial Indicators (Criteria)

Ratios	Formulas	References
1.MVA Spread	MVA / Invested Capital	Stewart (2013)
2.MVA Margin	MVA/ Net Sales	Stewart (2013)
3. MV/BV	Market Value/ Book Value	Stewart (2013)
4.ROE	Net Profit / Equity	Brigham and Houston (2019)
5.ROA	Net Profit / Total Assets	Brigham and Houston (2019)
6.ALTMAN-Z Score	$1.2A + 1.4B + 3.3C + 0.6D + 1.0E$ A= Working Capital/Total Assets B= Retained Profits/Total Assets C= Earnings Before Interest and Taxes/Total Assets D= Market Value of Assets/Total Liabilities E= Sales/Total Assets	Carton (2004)
Stock Return	$(Current\ Stock\ Price - Previous\ Period\ Base\ Price) / Base\ Price$	Carton (2004)

Table 2 below displays the performance criteria, weighting and MCDM methods used in this study. Equal weighting, which is widely used, was preferred as the weighting method. In addition to MOORA and MABAC methods, which are popular methods of recent times, the FUCA method was also preferred because it has similar features to “outranking” methods. In the FUCA method, the rank of that value among the alternatives (from best to worst) is more significant than the quantitative value of any company criterion.

**Table 2:** Performance Criteria, Weighting and MCDM Methods

Weighting Method	MCDM Methods	Performance Criteria
Equal Weighting (Mean Weight)	MOORA	<ul style="list-style-type: none"> <li>▪ <math>\Delta</math> ROE (return on equity), <math>\Delta</math> ROA (profit-based)</li> <li>▪ <math>\Delta</math> Altman-Z score, (risk based)</li> <li>▪ MVA Margin, MVA Spread, <math>\Delta</math> MV/BV (value-based)</li> </ul>
	MABAC	
	FUCA	

In order to choose the best alternative among others with multiple criteria, it is necessary to determine the best compromise solution, so it makes sense to use MCDM methods. In general, approaches of total utility, value or transition schools are widely used. The popular MCDM methods used in this study are introduced below, and the formulas of the methods are presented in the section after the explanations.

**FUCA (Faire Un Choix Adéquat/ Make an Adequate Choice)**

For each of the targets in this method, the first rank is assigned the best value, and the “m” rank is assigned the worst value. Then, a weighted sum is calculated for each solution on the Pareto-optimal front. The chosen solution should have the smallest total ranking value (Wang et al., 2020).

**Multi-Objective Optimization Method by Ratio Analysis (MOORA)**

The MOORA method, which Brauers and Zavadskas (2006) proposed, is a popular technique for MCDM problems in various fields. In this method, a normalized objective matrix is obtained by first applying vector normalization. Each column is then multiplied by its weight to obtain a weighted and normalized objective matrix. Finally, performance values are generated for each solution. The solution with the most considerable Pi value is accepted as the optimal solution (Wang and Rangaiah, 2017).

**The Multi-Attribute Border Approximation Area Comparison (MABAC)**

A key concept of MABAC, a popular method, is defining the distance of each non-dominated solution from the target’s boundary approximation area (Pamučar and Ćirović, 2015; Wang et al., 2020).

Remarkably, the FUCA method does not need normalization, and it has a similar character to outranking methods. Table 3 displays the calculation process of the recently popular methods MOORA, MABAC, and the FUCA method, which is not known in the literature despite its simple calculation process (Wang and Rangaiah, 2017; Wang et al., 2020).

**Table 3:** Formulas of MCDM Methods (Wang and Rangaiah, 2017; Wang et al., 2020)

Steps	MOORA	MABAC	FUCA
1	Standardization: $F_{ij} = \frac{f_{ij}}{\sqrt{\sum_{k=1}^m f_{kj}^2}}$ $i \in \{1,2, \dots, m\};$ $j \in \{1,2, \dots, n\}$	Standardization: $F_{ij} = \frac{f_{ij} - \min_{i \in m} f_{ij}}{\max_{i \in m} f_{ij} - \min_{i \in m} f_{ij}} \quad i \in \{1,2, \dots, m\}; j \in \{1,2, \dots, n\} \text{ for benefit objectives}$ $F_{ij} = \frac{\max_{i \in m} f_{ij} - f_{ij}}{\max_{i \in m} f_{ij} - \min_{i \in m} f_{ij}} \quad i \in \{1,2, \dots, m\}; j \in \{1,2, \dots, n\} \text{ for cost objectives}$	For each criterion value, 1 is assigned to the best value, m is assigned to the worst value.
2	Weighting: $v_{ij} = F_{ij} \times w_j$ $i \in \{1,2, \dots, m\};$ $j \in \{1,2, \dots, n\}$	Weighting: $v_{ij} = (1 + F_{ij}) \times w_j \quad i \in \{1,2, \dots, m\}; j \in \{1,2, \dots, n\}$ $b_j = (\prod_{i=1}^m v_{ij})^{1/m} \quad j \in \{1,2, \dots, n\}$	Weighted Final Scores: $v_i = \sum_{j=1}^n (r_{ij} \times w_j)$
3	Final Scores: $P_i = \sum_{j=1}^g v_{ij} - \sum_{j=g+1}^n v_{ij}$ $i \in \{1,2, \dots, m\}$	Final Scores: $Q_i = \sum_{j=1}^n (v_{ij} - b_j) \quad i \in \{1,2, \dots, m\}$	

## Results and discussion

The findings for the relationship between the MCDM Based financial performance and the stock return ranking results of the companies within the scope of the study are given below.

### MCDM Based Financial Performance and Stock Return Results before COVID-19 (2018/09- 2019/12)

Table 4 displays the standard initial decision matrix, which is used for all MCDM methods, and consists of the pre-COVID-19 ratios of the companies. It can also be observed that the values before COVID-19 show a positive increase when the averages/mean of the performance indicators.

**Table 4:** Ratios (Initial Decision Matrix) and Stock Return Values Before COVID-19

	ROA	ROE	ALTMAN Z SCORE	MVA Margin	MVA Spread	MV/BV	Stock Return Before COVID-19
ACSEL	0.0679	0.0708	3.2381	0.4977	0.52	0.5337	1.324818
BLCYT	0.1816	0.1758	3.3866	0.7778	0.6627	0.5201	1.801282
BRKSN	-0.0209	-0.0564	0.3169	0.286	0.6643	0.6423	0.630952
BURCE	-0.0471	-0.1044	-0.1743	-0.2604	0.0189	-0.0765	0.776758
BURVA	-0.0556	-0.1695	2.9573	5.1441	9.0973	9.3894	5.388158
DAGI	0.1154	0.2236	0.4311	0.2969	0.137	0.2232	0.461988
DITAS	-0.039	-0.121	0.4591	0.2977	1.4275	1.4348	0.527157
DOBUR	-0.1104	-0.2616	0.4488	0.6612	3.0763	3.2886	1.050676
DOGUB	-0.0458	-1E-04	3.1921	-12.2607	-5.3131	-5.3888	-0.50476
EMKEL	0.008	0.036	0.1393	0.8673	0.3769	0.3124	0.37069
ERSU	0.0783	0.109	1.3752	3.989	0.982	0.9753	1.15625
FMIZP	-0.0298	-0.0249	24.8475	2.9079	7.4631	7.4696	1.843786
FRIGO	0.2342	0.9206	1.453	0.9308	3.9071	1.6593	11.11215
GEDZA	-0.0075	-0.0161	0.654	0.2494	0.2175	0.2283	0.529412
LUKSK	0.063	0.1211	0.8132	1.0212	0.4171	0.395	0.858065
MAKTK	-0.0048	-0.0209	1.3145	-0.0321	-0.2161	-0.1912	0.528455
NIBAS	0.1904	0.2737	8.9164	9.1262	2.6772	2.7079	8.117647
OYLUM	0.0667	0.1566	1.8282	1.0873	1.7773	2.013	3.990196
PRZMA	0.0106	0.0125	4.4013	5.2876	1.3328	1.3311	1.51462
SAMAT	-0.1565	-1.3952	0.4698	0.5532	1.4943	2.7085	0.808081
SANFM	0.031	0.1468	0.7708	0.4618	1.9814	2.4195	2.875969
SELGD	0.0958	0.1238	1.6751	0.0412	-0.1047	-0.107	2.307692
TMPOL	0.17	0.5768	0.9451	0.05	-0.178	-0.5666	0.539823
YAPRK	-0.0169	-0.0267	0.8971	1.2873	1.0481	1.0593	1.943662
<b>Mean</b>	<b>0.032442</b>	<b>0.031263</b>	<b>2.698175</b>	<b>0.969517</b>	<b>1.394454</b>	<b>1.374217</b>	<b>2.081397</b>

Table 5 below displays MCDM based FP scores and ranking results of the companies before COVID-19. The FUCA method seems more successful since it provides the best statistical correlation with stock return (Spearman rho: 0.806 and P-Value: 0.000). FMIZP is the best company solution for MABAC, while FRIGO is the best for MOORA. On the other hand, the best company for the FUCA method is entirely different because it suggests that NIBAS is the best solution. These results point to a different and exciting capability of FUCA. Because other methods produce a meaningful relationship between financial performance and stock return at a lower level, which can be observed from the results. It is also noteworthy that they (MOORA and MABAC) produce the same sorting result for our sample, although they have different equations. And when the results are the same, the correlation results with the stock return are also the same.

**Table 5:** Scores and Rankings Produced by MCDM Methods and Stock Return (SR) Rankings before COVID-19

	FUCA Final	Rank	MABAC Q	Rank	MOORA y	Rank	SR	Rank
ACSEL	11.16669	10	0.010705	12	0.065219	12	1.324818	11
BLCYT	8.666684	6	0.071434	5	0.117969	5	1.801282	9
BRKSN	17.00003	21	-0.05454	20	0.007259	20	0.630952	17
BURCE	21.33338	24	-0.09228	22	-0.02933	22	0.776758	16
BURVA	9.333352	7	0.174143	4	0.240876	4	5.388158	3
DAGI	14.1667	14	0.013772	11	0.068338	11	0.461988	22
DITAS	15.50003	19	-0.04811	18	0.013948	18	0.527157	21
DOBUR	14.1667	15	-0.04595	17	0.020233	17	1.050676	13
DOGUB	18.6667	23	-0.27689	24	-0.23164	24	-0.50476	24
EMKEL	15.33336	18	-0.03926	16	0.022624	16	0.37069	23
ERSU	9.333352	8	0.043014	8	0.103716	8	1.15625	12
FMIZP	7.500015	4	0.283385	1	0.332637	1	1.843786	8
FRIGO	5.333344	2	0.18616	3	0.241574	3	11.11215	1
GEDZA	17.00003	20	-0.0538	19	0.007317	19	0.529412	19
LUKSK	12.33336	11	-0.00259	14	0.055653	13	0.858065	14
MAKTK	18.1667	22	-0.06054	21	-0.00051	21	0.528455	20
<b>NIBAS</b>	<b>3.000006</b>	<b>1</b>	0.232099	2	0.2881	2	8.117647	2
OYLUM	7.333348	3	0.042797	9	0.100442	9	3.990196	4
PRZMA	8.33335	5	0.045535	7	0.110465	6	1.51462	10
SAMAT	15.1667	17	-0.17274	23	-0.12165	23	0.808081	15
SANFM	10.16669	9	0.02189	10	0.082236	10	2.875969	5
SELGD	14.33336	16	-0.002	13	0.051435	14	2.307692	6
TMPOL	14.00003	13	0.051432	6	0.106542	7	0.539823	18
YAPRK	12.66669	12	-0.02989	15	0.033118	15	1.943662	7

Findings in Table 6 show that the FUCA method seems to be more successful since it provides the best statistical correlation with stock return (Spearman rho: 0.806 and P-Value: 0.000).

**Table 6:** Spearman Rho and P-Values for FUCA, MOORA and MABAC Methods

	Spearman Rho	P-Value	
FUCA	0.806	0.000	<i>Best/Most Suitable</i>
MOORA	0.692	0.000	
MABAC	0.692	0.000	

Accordingly, if we base on the FUCA method, which produces the best relations with stock return results, we can make the following evaluations: “NIBAS” company is the best solution in terms of financial performance when it is considered for 1.5 years (6 quarters) before the pandemic. However, this company is also the second-best company in terms of stock return. In this case, FUCA is more successful as a model that best measures financial performance and captures real life. The calculation process of the final scores reached for the FUCA method, which was selected because it is more appropriate for financial analysis, is shown below as an example:



1. Stage: In the FUCA method, common decision matrix values (ratio data) have been shown before. In this stage, as Table 7 displays, the best value is assigned a rating of 1 and the worst value a rating of 24 (number of companies) for each of the criteria values.

**Table 7:** First Stage Decision Matrix of FUCA Method

	c1 rank	c2 rank	c3 rank	c4 rank	c5 rank	c6 rank
ACSEL	8	11	5	14	15	14
BLCYT	3	5	4	11	14	15
BRKSN	17	19	22	18	13	13
BURCE	21	20	24	23	20	20
BURVA	22	22	7	3	1	1
DAGI	5	4	21	17	19	19
DITAS	19	21	19	16	9	9
DOBUR	23	23	20	12	4	3
DOGUB	20	14	6	24	24	24
EMKEL	13	12	23	10	17	17
ERSU	7	10	11	4	12	12
FMIZP	18	17	1	5	2	2
FRIGO	1	1	10	9	3	8
GEDZA	15	15	17	19	18	18
LUKSK	10	9	15	8	16	16
MAKTK	14	16	12	22	23	22
NIBAS	2	3	2	1	5	5
OYLUM	9	6	8	7	7	7
PRZMA	12	13	3	2	10	10
SAMAT	24	24	18	13	8	4
SANFM	11	7	16	15	6	6
SELGD	6	8	9	21	21	21
TMPOL	4	2	13	20	22	23
YAPRK	16	18	14	6	11	11

Stage 2: Weighted matrix and final (final) scores expressing the second stage in the FUCA method:

**Table 8:** Weighted Matrix and Final (Final) Scores Expressing the Second Stage in the FUCA method

	<b>c1</b> Weightage rank	<b>c2</b> Weightage rank	<b>c3</b> Weightage rank	<b>c4</b> Weightage rank	<b>c5</b> Weightage rank	<b>c6</b> Weightage rank	<i>Final</i> <i>Rank</i>
ACSEL	1.333336	1.833337	0.833335	2.333338	2.500005	2.333338	<b>11.16669</b>
BLCYT	0.500001	0.833335	0.666668	1.833337	2.333338	2.500005	<b>8.666684</b>
BRKSN	2.833339	3.166673	3.666674	3.000006	2.166671	2.166671	<b>17.00003</b>
BURCE	3.500007	3.333334	4.000008	3.833341	3.333334	3.333334	<b>21.33338</b>
BURVA	3.666674	3.666674	1.166669	0.500001	0.166667	0.166667	<b>9.333352</b>
DAGI	0.833335	0.666668	3.500007	2.833339	3.166673	3.166673	<b>14.1667</b>
DITAS	3.166673	3.500007	3.166673	2.666672	1.500003	1.500003	<b>15.50003</b>
DOBUR	3.833341	3.833341	3.333334	2.000004	0.666668	0.500001	<b>14.1667</b>
DOGUB	3.333334	2.333338	1.000002	4.000008	4.000008	4.000008	<b>18.6667</b>
EMKEL	2.166671	2.000004	3.833341	1.66667	2.833339	2.833339	<b>15.33336</b>
ERSU	1.166669	1.66667	1.833337	0.666668	2.000004	2.000004	<b>9.333352</b>
FMIZP	3.000006	2.833339	0.166667	0.833335	0.333334	0.333334	<b>7.500015</b>
FRIGO	0.166667	0.166667	1.66667	1.500003	0.500001	1.333336	<b>5.333344</b>
GEDZA	2.500005	2.500005	2.833339	3.166673	3.000006	3.000006	<b>17.00003</b>
LUKSK	1.66667	1.500003	2.500005	1.333336	2.666672	2.666672	<b>12.33336</b>
MAKTK	2.333338	2.666672	2.000004	3.666674	3.833341	3.666674	<b>18.1667</b>
NIBAS	0.333334	0.500001	0.333334	0.166667	0.833335	0.833335	<b>3.000006</b>
OYLUM	1.500003	1.000002	1.333336	1.166669	1.166669	1.166669	<b>7.333348</b>
PRZMA	2.000004	2.166671	0.500001	0.333334	1.66667	1.66667	<b>8.33335</b>
SAMAT	4.000008	4.000008	3.000006	2.166671	1.333336	0.666668	<b>15.1667</b>
SANFM	1.833337	1.166669	2.666672	2.500005	1.000002	1.000002	<b>10.16669</b>
SELGD	1.000002	1.333336	1.500003	3.500007	3.500007	3.500007	<b>14.33336</b>
TMPOL	0.666668	0.333334	2.166671	3.33334	3.666674	3.833341	<b>14.00003</b>
YAPRK	2.666672	3.000006	2.333338	1.000002	1.833337	1.833337	<b>12.66669</b>

### MCDM Based Financial Performance and Stock Return Results During COVID-19 Period (2020/03-2021/06)

The joint decision matrix consists of the ratios (criteria) of the companies during the COVID-19 period and is used for all methods, and stock return values are shown in Table 9 below. When the ratios (initial decision matrix) and stock return values of the companies during and before the COVID-19 are compared, the ROA average is almost the same, while ROE, ALTMAN-Z Score, MVA Margin, MV/BV mean values increase. On the other hand, it is noteworthy that the MVA Spread and stock return average values have decreased compared to the previous base period.

**Table 9:** Ratios (Initial Decision Matrix) and Stock Return Values of Companies during COVID-19 Period

	ROA	ROE	ALTMAN Z Score	MVA Margin	MVA Spread	MV/BV	Stock Return
ACSEL	0.0441	0.054	5.1239	1.8061	2.492	1.8002	2.117372
BLCYT	0.0821	0.0861	16.9452	1.8712	4.354	3.0996	1.376
BRKSN	0.0184	0.0503	1.132	2.176	1.1244	1.967	2.620968
BURCE	0.0134	0.0268	0.8993	1.4754	6.1063	1.4701	2.431559
BURVA	-0.0096	-0.0381	2.4631	11.66	-26.1532	11.4074	0.660756
DAGI	-0.0101	0.0021	1.1765	0.5215	1.9183	0.2891	0.142105
DITAS	0.1701	0.401	3.4203	1.4728	0.3973	1.1133	0.322368
DOBUR	0.1073	0.2861	4.2732	9.2803	3.7604	9.2923	3.134897
DOGUB	0.0604	0.0864	5.7763	7.0413	-20.3378	7.0135	2.60479
EMKEL	0.0382	0.1019	1.0701	1.4631	2.5074	0.8893	0.691176
ERSU	-0.0105	-0.0134	-2.1281	-1.308	-9.0434	-1.229	-0.00288
FMIZP	0.1731	0.2368	19.2693	11.071	-6.5704	11.0687	1.476309
FRIGO	0.0005	-0.0062	0.976	2.0129	2.0089	1.7861	0.966887
GEDZA	0.0682	0.1087	3.4738	2.9555	5.9451	3.2574	4.587097
LUKSK	0.0568	0.1106	2.5927	3.7046	9.0775	3.5711	5.595628
MAKTK	0.0104	0.0285	0.2709	1.7161	1.6444	1.813	1.121951
NIBAS	-0.0285	-0.0376	5.0338	5.587	-23.9561	5.6115	1.396552
OYLUM	0.0538	0.0938	0.6658	0.2501	-0.5835	0.1917	0.308917
PRZMA	0.0089	0.0165	-8.3878	-0.7225	-39.9995	-0.7335	-0.11715
SAMAT	-0.104	-0.5303	0.6134	5.3864	3.6985	4.3011	1.776398
SANFM	0.0388	0.1784	1.0472	3.3584	1.3199	3.2987	2.630705
SELGD	-0.0003	-0.0011	12.0037	2.1668	14.9556	2.1209	2.168831
TMPOL	0.039	0.1344	1.1336	2.0981	-0.1272	2.0394	1.855769
YAPRK	-0.0108	-0.0215	8.8968	13.2232	19.5324	13.1644	4.157122
<b>Mean</b>	<b>0.033738</b>	<b>0.056425</b>	<b>3.655875</b>	<b>3.761138</b>	<b>-1.9137</b>	<b>3.691804</b>	<b>1.834338</b>

### MCDM Based Financial Performance Results and Their Relationship with Stock Return during COVID-19 Period

The findings in Table-10 and Table-11 show that the FUCA method, in which DOBUR firm is the best solution, is the method that provides the best statistical correlation and significance with stock return (Spearman rho: 0.746 and P-Value: 0.000) during the COVID-19 period as it was before COVID-19 period. It is noteworthy that the other two methods, the MOORA and MABAC, produce relative correlation values (though not the same) during the COVID-19 period, even though they have different equations. So, as before the COVID-19 period, these results indicate that FUCA has a different and exciting capability again. Because other methods provide a weaker or lower level of a significant relationship between financial performance and stock return, previously, many studies have been looking for a relationship or causality between two variables. In this sense, comparison between MCDM methods that generate variables is generally investigated with spearman correlation (Sařabun and Urbaniak, 2020).

**Table 10:** Scores and Rankings Produced by MCDM Methods and Rankings of Stock Return during COVID-19 Period

	FUCA Final	Rank	MABAC Q	Rank	MOORA y	Rank	HG normal	Rank
ACSEL	11.50002	11	7.9E-06	12	0.087779	11	2.117372	10
BLCYT	8.166683	5	0.120852	4	0.185937	5	1.376	15
BRKSN	13.50003	13	-0.03782	15	0.054047	15	2.620968	6
BURCE	14.6667	17	-0.04628	16	0.050876	16	2.431559	8
BURVA	13.50003	14	0.079262	6	0.07909	12	0.660756	19
DAGI	17.33337	22	-0.09951	21	0.011303	21	0.142105	22
DITAS	11.16669	10	0.109985	5	0.199679	4	0.322368	20
<b>DOBUR</b>	<b>4.666676</b>	<b>1</b>	0.250462	3	0.259533	2	3.134897	4
DOGUB	8.666684	7	0.076039	7	0.113378	9	2.60479	7
EMKEL	14.1667	15	-0.03384	14	0.066124	14	0.691176	18
ERSU	22.00004	24	-0.19168	23	-0.05785	22	-0.00288	23
FMIZP	5.00001	2	0.383772	1	0.353967	1	1.476309	13
FRIGO	16.00003	19	-0.06113	20	0.033121	19	0.966887	17
GEDZA	7.666682	4	0.054073	9	0.12786	7	4.587097	2
LUKSK	7.166681	3	0.06324	8	0.132858	6	5.595628	1
MAKTK	16.00003	20	-0.05733	18	0.03883	18	1.121951	16
NIBAS	14.33336	16	-0.04714	17	0.013041	20	1.396552	14
OYLUM	16.50003	21	-0.05898	19	0.050285	17	0.308917	21
PRZMA	21.00004	23	-0.2866	24	-0.14604	24	-0.11715	24
SAMAT	15.1667	18	-0.14742	22	-0.08391	23	1.776398	12
SANFM	10.66669	8	0.026391	11	0.105817	10	2.630705	5
SELGD	10.83336	9	0.047645	10	0.125304	8	2.168831	9
TMPOL	12.00002	12	-0.01393	13	0.077902	13	1.855769	11
YAPRK	8.33335	6	0.286459	2	0.252176	3	4.157122	3

This study revealed the relationship between MCDM methods and a third factor (referee) by Spearman correlation (not the relationship between different MCDM methods).

**Table 11:** Spearman Rho and P-Values of MCDM Methods

	Spearman Rho	P-Value	
FUCA	0.746	0.000	<i>Best/Most Suitable</i>
MOORA	0.573	0.003	
MABAC	0.525	0.008	

If we take the FUCA method, which produces the best results, as a basis, it can be said that the “DOBUR” company is the best in terms of financial performance during pandemic periods. This company is also the fourth-best company in stock returns during the same period. In this case, it can be said that FUCA is a more prosperous and best model capturing real life. Similarly, before COVID-19, MABAC and MOORA methods produced a lower significant correlation between financial performance and stock return.

The study findings are consistent with the previous studies of Baydaş and Eren (2021) and Baydaş and Elma (2021). These studies show that some MCDM methods (PROMETHEE and TOPSIS) consistently provide higher significant correlations with stock return than their competitors, depending on the case. In other words, it is understood that some methods, especially PROMETHEE or FUCA, have a unique capacity that was proved by empirical analysis. Thus, these results show that a significant and as high as the possible relationship between FP and SR, which acts almost like parallel dynamical universes to some extent, can be used in MCDM comparisons. And this confirms that this approach needs to be adopted more in future studies. We strongly recommend this approach to decision-makers who aim to measure MCDM-based financial performance, focusing on shareholder value. This model of financial

performance measurement is highly compatible with the ultimate goal of companies (maximizing market value). In addition, we think that decision-makers will not easily object to a financial performance model that produces shareholder value so that this practical approach will be adopted quickly. It is clear that this model, which acts in parallel to maximize the market value of the companies, is practical, verifiable and realistic.

The comparison, determination and selection of the most appropriate MCDM method by objective criteria is a chronic problem that has not been solved for more than half a century. This issue has paved the way for the subjective method, and it has become challenging to understand what is right and what is wrong. In order to solve this problem, as an objective step, a method that provides a better relationship with stock return can be recommended for financial performance studies. In this study, the FUCA method revealed the highest correlation between financial performance and stock return in the case of two periods before and during pandemic conditions. However, it can be said that this approach may show weakness for cases with a low number of alternatives. If there are not enough alternatives that are low in number, non-significant correlations can be obtained. Therefore, this problem needs to be minimized. In other words, a generalizable MCDM selection criterion would be helpful not only for a large number of companies but also for a low number of companies, as in our study. More importantly, developing a standard criterion for financial performance studies and all applied sciences would be beneficial. The current approach can be developed mathematically or statistically to solve this problem in future studies. In our opinion, methods with special abilities such as PROMETHEE and FUCA are reasonable for many, if not all, scenarios.

MCDM method selection is also critical for an accurate measure of financial performance. A particular objective approach was applied in this study, and the results were consistent. Compared to other methods, the correlation of the FUCA method with the stock market price was much higher. And, of course, it was about his capacity. Once the appropriate method has been selected, it can be moved to the next step. At this stage, financial performance analysis can be made according to the results of the FUCA method.

One of the critical issues investigated in this study for financial performance analysis is to what extent the general ranking positions of companies have changed. Firstly, based on the FUCA method, which was more successful, it was concluded that there was an inverse but insignificant, weak relationship between the two FUCA rankings before and after the pandemic (Spearman rho: -0.127 and P-Value: 0.553). In other words, the general ranking positions of the companies did not show the same trend after the pandemic and even changed in the opposite direction to a certain extent. Secondly, the trio of NIBAS, FRIGO, and OYLUM, the best companies for the BIST-KOBI Industry in the 1.5 years/6 quarters period before pandemic conditions, replaced their place to DOBUR, FIZP, LUKSK companies. FRIGO (Food, Beverage and Tobacco) and LUKSK (Manufacturing/Textile, Apparel and Leather), which ranked in the top three in financial performance according to the FUCA method, also achieved the best stock return in all periods. Therefore, according to FUCA, companies with the best financial performance scores are also among the best companies in terms of stock returns. We want to remind you that three different financial performance variables calculated with MOORA, MABAC and FUCA consist of six criteria. Also, considering that the stock return, which is a third party (arbitrator/referee) variable, is the singular criterion, the ability of FUCA to establish a relationship is indisputable.

Considering the pure ratio findings, we can state that the financial performance of companies during the COVID-19 period is better than before. However, there are different nuances to this general situation. One of them is that the general positions of the best and worst companies are different before and during pandemic conditions. In other words, our findings show that popular companies, their ranking positions and popular sub-sectors have changed due to pandemic conditions.

The following can be said for the contribution of our study to the MCDM literature in particular:

- It should be emphasized that this study is not “input” based, but it is instead “output” based, which refers to the final results of MCDM methods. In other words, we are not concerned with the input itself, but with the results it produces. This study discovered objective and consistent information about the performance of the result scores of MCDM methods through the companies' historical data. Of course, it is pretty controversial and challenging to say which of the methods is best with this comparison criterion. However, the findings obtained from the study reveals clear and exciting indications about the specific capacity of MCDM methods according to the “rho” criteria. Furthermore, these results are consistent with the studies of Yaakob and Gegov (2016), Baydaş and Elma (2021) and Baydaş and Eren (2021).

- An important conclusion of this study based on the findings obtained is that selecting a more appropriate MCDM method, which is based on the solid evidence on the outputs (scores), was discussed, and an appropriate procedure with objective criteria was proposed.
- The random selection of any MCDM method may affect the decision. In this study, three different MCDM-based financial performance measurements were recommended. Based on the data of the most appropriate MCDM selection according to the results obtained, measuring the financial performance of companies more accurately will help financial decision makers (firm owners, managers, creditors, suppliers, investors, etc.) make healthy decisions.

## Conclusion

In this study, financial performance, which is an indicator of the success level of companies, was measured with three different MCDM methods. In this sense, measurements were made in two different periods, pre-pandemic and pandemic periods. Contrary to the previous literature, one of the three MCDM methods was preferred, and analyses were continued. At this point, the FUCA method, which has a better relationship with the actual price data, was chosen. This preference can be considered an additional step to the procedure in previous studies discussed above.

Moreover, different MCDM methods were used in this study. According to the results, companies were slightly affected by the pandemic conditions at the beginning of the pandemic. But in general, it can be said that companies performed better during the pandemic than the pre-pandemic period. Although these results are compatible with the literature at some points, there are also firm and sector-based nuanced points. The unique aspect of this study that distinguishes it from the others is that it proposes an interesting, different and objective procedure for selecting an appropriate MCDM method. According to the results of this study, in which three MCDM methods were compared, the FUCA method was chosen as the most appropriate MCDM method for financial performance measurement because this method produces a stronger relationship with stock returns than other methods. According to the findings, the specific capacity of the FUCA method is higher than other methods. And all analysis evaluations are based on this method. This procedure has been proposed for the first time in the MCDM-based calculated financial performance literature.

In this study, some general, sectoral and company-scale interesting evaluations were made depending on the financial performance results calculated with the FUCA method, which is thought to give better results. It is a known and predicted issue that the global COVID-19 pandemic affects countries in terms of economy. It can be said that the negative impact of this pandemic, especially during the first quarter, decreased in the following years. However, a specific issue seems missing in previous studies on the COVID-19 impact. A satisfactory answer could not be given whether the most successful and stable companies before COVID-19 showed the same performance after the pandemic conditions. The opposite can also be asked. It is also important whether the general ranking positions of the companies changed during pandemic conditions or not. In other words, there might be a significant change in the success ranking or success positions of the companies due to the pandemic conditions. This study sought answers to these questions in terms of the MCDM paradigm. The 3-year performances of BIST-KOBI Industry companies for two 1.5-year periods before and during pandemic conditions are calculated on a ratio basis. According to the findings, the positions of the companies in the ranking are not the same, and it can even be said that they have changed to a certain extent in the opposite direction after the pandemic. NIBAS, FRIGO, OYLUM, the companies that had the best performance in the BIST-KOBI Industry index before pandemic conditions, were replaced with DOBUR, FIZP, LUKSK during the pandemic conditions. In addition, according to the general average findings of the ratios, it can be said that the situation of the companies under the pandemic conditions is at a better point than before. However, there are also different nuances to this general case. One of them is that the best companies differ periodically.

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