



Research Article /Araştırma Makalesi

FINANCIAL PERFORMANCE OF BIST-CEMENT COMPANIES ANALYSIS BY TOPSIS AND ELECTRE METHODS

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Abstract

In the scope of this study, the financial performance of companies in the cement sector listed on BIST (Borsa Istanbul) has been measured using two different methods. A comprehensive literature review was conducted to determine the financial ratios used in the analysis, and commonly used financial ratios in the literature were identified. The research included fifteen companies for which financial data spanning the period from 2013 to 2022 was available, and the CRITIC-based TOPSIS and ELECTRE methods, which are multi-criteria decision-making methods, were used for data analysis to measure their financial performance. As a result of the analysis, three separate performance groups were identified for the 15 companies: good, moderate, and poor. According to the findings of the analysis, in both methods, OYAK, NUHCM, and KONYA companies were the most successful in terms of financial performance, while BTCIM company was the least successful. It is recommended that the cement sector, which is expected to become even more important after the earthquake disaster in our country, should be continuously analyzed in the future with different data periods and different methods, and suggestions have been made for implementing corrective innovations in the sector.

Keywords: Financial performance, cement industry, financial statement analysis, TOPSIS, ELECTRE.

Jel Codes: M10, M20, M40, C10

BİST-ÇİMENTO ŞİRKETLERİNİN FİNANSAL PERFORMANSLARININ TOPSIS VE ELECTRE YÖNTEMLERİYLE ANALİZİ

Öz

Bu çalışma kapsamında BİST'te işlem gören çimento sektöründeki şirketlerin finansal performansı farklı iki yöntemin uygulanmasıyla ölçülmüştür. Analizde kullanılan finansal oranları belirlemek için kapsamlı bir literatür analizi yapılmış ve literatürde sıklıkla kullanılan finansal oranlar belirlenmiştir. 2013-2022 dönemine ait finansal verilerine ulaşılabilen 15 şirket araştırmaya dahil edilmiş ve finansal performanslarının ölçümünde verilerin analizi için çok kriterli karar verme yöntemlerinden CRITIC temelli TOPSIS ve ELECTRE yöntemleri kullanılmıştır. Analiz sonucunda 15 şirket için iyi, orta ve kötü olmak üzere üç ayrı başarı grubu belirlenmiştir. Analizden elde edilen bulgulara göre her iki yöntemde de OYAK, NUHCM ve KONYA şirketleri en başarılı finansal performansa sahip şirketler olurken, BTCIM şirketi ise en başarısız şirket olmuştur. Özellikle ülkemizde yaşanan deprem felaketinden sonra öneminin iyice artması beklenen çimento sektörünün, gelecekte farklı veri dönemleri ve farklı yöntemlerle sürekli olarak analiz edilmesi gerektiği ve sektöre ilişkin iyileştirici yeniliklerin sağlanması önerisinde bulunulmuştur.

Anahtar Kelimeler: Finansal performans, çimento sektörü, finansal tablolar analizi, TOPSIS, ELECTRE.

Jel Kodları: M10, M20, M40, C10

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Introduction

The use of financial ratios allows for the measurement of companies' financial performance, providing information on important aspects such as profitability, financial structure, liquidity, growth, and more. Through financial performance measurement, predictions can be made about the areas where companies excel and where they may have weaknesses. Additionally, when comparing a company's performance within the sector it operates in or against other companies in the industry, it is possible to determine its level of effectiveness (Ege & Yaman, 2018, p. 76). Typically, past financial data is used for the measurement of financial performance concerning companies. Depending on the scope of the desired information, different periods from the past can be analyzed and interpreted. This makes it easier not only to assess the historical financial performance of companies but also to make strategic decisions regarding future financial matters.

In the literature, decision-making is defined as an interactive field that deals with parameters that can be contradictory and may evolve over time and space. Individuals and organizations aim to reach a final goal in various situations where a decision needs to be made. Decision-making is often applied as a scientific process when dealing with complex problems. Within this context, Multiple Criteria Decision-Making Methods (MCDM) encompass mathematics, computer science, social sciences, and economics as a scientific discipline (Abdelli, Mokdad & Hammal, 2020). MCDM is also frequently used in the measurement of financial performance. Through MCDM, the most optimal option can be selected among different alternatives based on predefined criteria. Unlike traditional methods like Ratio Analysis and Trend Analysis, MCDM relies on a mathematical foundation and is applied using certain software programs (Sakarya & Akkuş, 2015: 110). Examples of commonly used MCDM methods include TOPSIS, VIKOR, ELECTRE, Fuzzy TOPSIS, Analytic Hierarchy Process (AHP), Fuzzy Logic, and others. While measuring financial performance is essential for many industries, it holds particular significance within the cement sector. With financial performance measurement, it is possible to assess how efficiently and effectively cement companies utilize their assets and resources, make interpretations, and make strategic decisions about the company's future financial performance (Ersoy, 2023, p. 1976).

The cement sector has experienced rapid growth and development worldwide, especially in the last 20 years. Turkey, as a developing country, has also had its share of this growth and development. In 2020, Turkey ranked among the top 10 countries in the world in terms of cement production and was among the top 3 in terms of exports. As of 2021, Turkey has risen to the 5th position in global cement production with a production capacity of 78.9 million tons. In terms of exports, Turkey ranked second with 1.3 billion US dollars. In our country, the cement sector has become one of the most important stakeholders in the global cement industry, thanks to investments in production quality, the establishment of R&D centers, and training provided by authorized institutions on environmental and occupational health (Republic of Turkey Ministry of Industry and Technology, 2022, pp. 5-8).

Various studies have suggested that, through the analysis and interpretation of historical and current financial data, as well as making different forecasts, the Turkish cement sector is projected to continue gaining importance and remain one of the leading countries in the global cement industry by 2030 and 2050. While there may be threatening factors in the upcoming years for the sector, such as earthquake disasters, climate change, and migration waves, it is anticipated that with careful measures taken by both public institutions and the private sector to address these threats, what are considered threats to the sector can be mitigated, and crises can be turned into opportunities (Çağatay, 2021, p. 113; Republic of Turkey Ministry of Industry and Technology, 2022, p. 7).

Although many of the MCDM methods are frequently used in the studies on financial performance measurement of cement companies, there are not many studies using the ELECTRE method. In this study, the financial performance of cement companies was analyzed by using the ELECTRE method. This is one of the most important elements that originalize and differentiate this study.

1. The Cement Sector and Its Effects on the Economy

The cement sector, which holds a significant share in our country's export revenue, is also of great importance for meeting our local needs. From the essential need for housing to social facilities, from public services to production in various fields, the cement sector contributes to the economy in many ways. Especially after the earthquake disaster experienced in our country, the cement sector will become even more critical. In this regard, it is essential to accurately analyze the sector, assess its current situation, and determine the most appropriate steps for its development.

Due to the reasons mentioned above, making regular and transparent assessments of the sector and planning for the future is critical for the continuity of the industry. The current situation of the cement sector can be summarized as follows (Para & Borsa, 2022):

- (1) As a result of investments made in the last 15 years, Turkey has risen in the producer rankings to become the 5th largest cement producer globally, with a production capacity of 97 million tons of clinker and 151 million tons of cement as of the end of 2021. Excluding China, Turkey holds a 4% share in global cement production, and when all countries are considered, it has a 1.8% share.
- (2) From an export perspective, Turkey holds the position of being the world's second-largest cement exporter. Although domestic demand reached its peak in 2017 and subsequently declined, cement companies have adopted an export-oriented production approach, targeting the international market.
- (3) While the export rate to the Middle East and North African countries has been declining, our cement companies have been attempting to balance their exports by focusing on the North American market. Approximately a decade ago, exports to North American countries accounted for a 1% share of total exports, but by the end of 2022, this share has risen to around 40%. It is expected that export agreements with North American countries, especially the United States, will continue to increase.
- (4) Between January and October of 2022, exports of cement and clinker showed an approximately 27% increase in terms of US dollars compared to the previous year, reaching a total of 1.4 billion dollars. Export prices during the same period increased by about 36%, reaching \$56 per ton, reaching the highest point in the past decade. Despite a decrease in export volume, this increase in the export prices per ton has resulted in the export revenue not decreasing.
- (5) Between January and March of 2023, approximately 23% of the production in the cement sector has been considered within the scope of exports. While there was an increase of approximately 24% in domestic demand compared to the previous year, there was a decrease of about 20% in exports. Despite this decline in export volume, it is expected that export revenues will be balanced due to the increase in the prices of exported goods.

Table 1: Capacity Information for the Cement Sector in 2022

2022 Capacity Quantities			2022 Capacity Utilization Rates		
Region (Ton)	Clinker Capacity	Cement Capacity	Region (%)	Clinker	Ciment
Marmara	21.876.050	32.229.227	Marmara	92,59	66,31
Aegean	9.363.750	14.517.755	Aegean	80,11	51,27
Mediterranean	24.334.200	34.884.506	Mediterranean	83,99	56,50
Black Sea	11.119.550	19.757.589	Black Sea	71,66	42,27
Central Anatolia	14.929.200	21.720.761	Central Anatolia	72,83	52,88
Eastern Anatolia	7.672.830	13.053.618	Eastern Anatolia	55,09	33,55
Southeastern Anatolia	7.347.450	11.058.939	Southeastern Anatolia	75,94	48,29
TOTAL	96.643.030	147.222.396	TOTAL	79,33	52,98

Source: Türk Çimento, 2023

The information regarding the capacity quantities and capacity utilization rates for the cement sector in 2022 is provided in Table 1. The data only includes the factories that are members of TURKCIMENT.

Table 2: World Cement Production Ranking by Countries for the Year 2021

R	Countries	Production Volume for the Year 2021 (Million Tons)
1	China	2.500
2	India	330
3	Vietnam	100
4	USA.	92
5	Turkey	78
6	Indonesia	66
7	Brazil	65
8	Iran	62
9	Russia Federation	56
10	Saudi Arabia	55

Source: T.C. Sanayi ve Teknoloji Bakanlığı, 2022, p. 5

In Table 2, the production volume of the Turkish cement sector and its ranking in the global cement sector can be observed. When examining data from previous years, Turkey is typically found within the top 10, and as of 2021, it ranks 5th.

Table 3: Global Cement Export Ranking by Countries

R	Countries	World Cement Exports (1,000 US Dollars)				
		2017	2018	2019	2020	2021
1	Vietnam	706.665	1.159.196	1.301.142	1.350.139	2.145.688
2	Turkey	530.641	614.327	929.673	1.218.695	1.368.120
3	Germany	504.591	553.130	550.870	520.595	610.440
4	Canada	444.494	539.069	542.765	503.329	535.319
5	Thailand	551.113	634.233	677.410	548.433	501.890

Source: T.C. Sanayi ve Teknoloji Bakanlığı, 2022, pp. 5-6

In Table 3, the export amounts of the Turkish cement sector and its ranking in the global cement sector in terms of exports can be observed. When examining data from previous years, Turkey is typically within the top 5, and as of 2021, it ranks 2nd.

2. Literature Review

Table 4 presents the prominent studies reviewed within the scope of the research, covering approximately the last 10 years. The table includes information about the methods used, if available, and the data period, along with explanations, for the examined studies.

Table 4: *Studies Included in the Literature Review, Data Periods, and Method Information*

Author Information	Year	Data Period	Method	Explanation
Dumanoğlu	2010	2004-2009	TOPSIS	In the study, the financial performance of 15 cement companies listed on the Istanbul Stock Exchange has been analyzed. The results obtained have been compared for six periods.
Iqbal, Ahmad, Basheer & Nadeem	2012	2010-2011	Comparative Analysis of Traditional Financial Ratios	The study investigated the impact of corporate social responsibility on financial performance by evaluating data obtained from published sources by the Pakistan State Bank for 156 companies listed on the Karachi Stock Exchange, including cement companies. According to the research findings, it was concluded that corporate social responsibility has no impact on financial performance.
Özden, Başar & Kalkan	2012	2011	VIKOR	The study measured the financial performance of companies in the cement sector that supply products to the construction industry. While ranking the financial performance of cement companies listed on the Istanbul Stock Exchange, the study examined whether there was a relationship between the rankings obtained and the stock returns of the companies.
Moghimi & Anvari	2014	-	TOPSIS and Fuzzy AHP	The study analyzed the financial performance of cement companies in Iran using various financial ratios. The necessary data for the analysis were obtained from the Tehran Stock Exchange, and as a result of the analysis, the performance ranking of cement companies was found to be as follows: Sabhan, Sarab, Sedasht, Safar, Sekaroun, Sakarma, Sanir, and Sahrmoz.
Sakarya & Akkuş	2015	2010-2013	TOPSIS	In the study, financial ratios commonly used in the literature and considered as traditional ratios were compared with cash flow ratios for cement companies listed on Borsa İstanbul. According to the research findings obtained after the application, it was concluded that companies' financial performance varies according to the frequently used financial ratios.
Ege & Yaman	2018	2010-2016	TOPSIS and MOORA	In the study, the financial performance of cement and concrete companies listed on Borsa Istanbul (BIST) was analyzed by converting their financial performance into quantitative scores. After the application, the relationship between the determined scores and the stock returns of the companies was examined. The study concluded that the TOPSIS method is expected to provide more accurate information compared to the MOORA method.
Güleç & Özkan	2018	2005-2016	GRA	In the study, the financial performance of 16 cement companies listed on Borsa Istanbul was analyzed using traditional financial ratios. The stock returns of the companies were also calculated using the Buy and Hold return method and compared with the findings obtained from the financial ratios. The results of the analysis indicated that the companies operating in the cement sector were largely profitable and had high returns on their stocks. Additionally, these companies had a weak relationship between their GIA values and stock returns.

Raıkar	2018	2013-2017	VIKOR and AHP	In the study, the financial performance of companies in the cement sector that suffered losses due to excessive capacity increase during the analyzed period was examined. As a result of the examination, it was concluded that Ambuja Cement, Ultra Tech Cement, and Orient Cement were the top three most successful companies.
Saygılı & Şahin	2018	2009-2016	TOPSIS	In the study, the financial performance of companies in the cement sector listed on Borsa Istanbul (BIST) was compared with their stock prices. At the end of the study, it was concluded that there was no relationship between financial performance and stock prices.
Ahmad, Ansari & Shamsi Feroz	2019	2009-2018	Correlation and Regression	In the study, the impact of factors such as size, profitability, risk, leverage, and liquidity on dividend policy or payments of cement sector companies listed on the Pakistan Stock Exchange (PSX) was investigated. The findings indicate that profitability and liquidity factors have a positive effect on the company's dividend payments, while factors such as size, risk, and leverage have no impact.
Atukalp	2019	2013-2017	Multi-MOORA	In the study, the financial performance of cement companies listed on Borsa Istanbul (BIST) was examined, and the analysis revealed that Ünye Cement was the company with the most successful financial performance for the respective period
Çanakçıoğlu	2019	2018	Entropi-Eatwios (Hybrid Model)	In the study, the financial performance of cement companies listed on BIST was analyzed, and the findings indicated that Adana Cement is the company with the most successful financial performance.
Kızıl	2019	2015-2017	TOPSIS	In the study, the financial performance of companies operating in the cement sector listed on BIST was compared with their stock market performance, and it was found that there was a significant relationship between financial and stock market performance in 2015 and 2017, while no significant relationship was observed for the year 2016.
Malik & Handono	2019	2013-2013	DuPont	In the study, the financial performance of cement companies operating in Indonesia was analyzed, and the findings indicated that Semen Indonesia, Indocement, and Siam Cement were the companies with the most successful financial performance.
Akbulut	2020	2014-2018	CRITIC and MABAC	In the study, the financial performance of housing cement sector companies listed on Borsa Istanbul was examined. According to the results of the CRITIC method, it was concluded that the most important performance criteria for companies changed over the years. According to the MABAC method, ADANA, ADBGR, and KONYA were identified as the top three companies in terms of financial performance. In terms of stock returns, ADNAC, ADANA, and ADBGR were identified as the top three companies.
Çanakçıoğlu & Küçükönder	2020	1999-2018	Entropi, OCRA and DEA	In the study, the financial performance and efficiency of cement sector companies listed on Borsa Istanbul were evaluated using a step-by-step approach. According to the findings, the year 2009 witnessed the most significant decrease in efficiency levels, while the year 2004 was the year with the highest efficiency level. On the other hand, during the selected periods, Mardin Cement was identified as the company with the best financial performance.
Özkan	2020	2019	TOPSIS ve GRA	In the study, the financial performance of 17 cement companies listed on Borsa Istanbul was examined, and it was concluded that Adana Cement is the company with the most successful financial performance.

As a result of the literature review, it has been observed that there are studies using the TOPSIS method for the analysis of the financial performance of cement companies. However, no study using the ELECTRE method has been found in the literature.

3. Research and Methodology

This section includes the research's objectives, scope, and the findings obtained as a result of applying the financial ratios and methods used in the analysis.

3.1. Research Objective

The aim of this study is to measure the financial performance of companies listed on BIST (Borsa İstanbul) and operating in the cement sector by determining commonly used financial ratios in the literature. The analysis intends to identify companies with the most successful and least successful financial performance and provide recommendations by evaluating the financial performance of all companies.

3.2. Scope of the Research

The population of the research consists of companies operating in the cement sector. Due to the availability of publicly accessible data, the sample of the research consists of companies listed on BIST (Borsa İstanbul) and operating in the cement sector. During the analysis, data for the years 2013-2022 were available and included in the analysis, consisting of 15 cement companies, as shown in Table 5, in alphabetical order.

Table 5: *Cement Companies Included in BIST and the Analysis*

R	Abb.	Company Name
1	AFYON	Afyon Cement Industry Trade Inc.
2	AKCNS	Akçansa Cement Industry and Trade Inc.
3	BASCM	Baştaş Başkent Cement Industry and Trade Inc.
4	BTCIM	Batıçim Batı Anadolu Cement Industry Inc.
5	BSOKE	Batisöke Söke Cement Industry Trade Inc.
6	BUCIM	Bursa Cement Factory Inc.
7	CMBTN	Çimbeton Hazırbeton and Prefabrik Building Elements Industry and Trade Inc.
8	CMEN	Çimentaş İzmir Cement Factory Trade Inc.
9	CIMSA	Çimsa Cement Industry and Trade Inc.
10	GOLTS	Göлтаş Göller Bölgesi Cement Industry and Trade Inc.
11	KONYA	Konya Cement Industry Inc.
12	NIBAS	Niğbaş Niğde Beton Cement Industry and Trade Inc.
13	NUHCM	Nuh Cement Industry Inc.
14	OYAKC	Oyak Cement Factories Inc.
15	YBTAS	Yibitaş Yozgat Labor Union Construction Materials Trade and Industry Inc.

3.3. Financial Ratios Used in the Analysis

In the analysis conducted within the scope of the research, the ratios used were determined based on the frequency of ratios found in the literature review. Financial ratios used in the majority of studies, five or more, were included in the research. The distribution of the financial ratios used in the analysis is shown in Table 6.

Table 6: *Distribution of Financial Ratios Used in the Analysis in the Literature*

Author	Year	Liquidity Ratios		Financial Structure Ratios		Activity Ratios			Profitability Ratios			
		Current Ratio	Cash Ratio	Financial Leverage Ratio	Financial Ratio	Accounts Receivable Turnover Ratio	Asset Turnover Ratio	Inventory Turnover Ratio	Return on Assets Ratio	Return on Equity Ratio	Operating Profit Margin	Periodic Net Profit Margin
Dumanoğlu	2010	+	+	+	-	-	+	-	+	+	-	+
Iqbal et al.	2012	-	-	-	-	-	-	-	+	+	-	-
Özden et al.	2012	+	-	-	-	+	-	+	-	+	+	-
Moghimi & Anvari	2013	+	+	-	+	+	-	+	-	+	-	+
Sakarya & Akkuş	2015	+	+	+	+	+	-	-	-	+	-	-
Ege & Yaman	2018	+	-	-	-	+	-	+	+	+	-	-
Güleç & Özkan	2018	+	+	+	+	+	+	-	-	+	-	-
Raıkar	2018	+	-	-	-	-	-	-	-	-	-	+
Saygılı & Şahin	2018	+	-	+	-	+	-	+	-	+	+	+
Ahmad et al.	2019	+	-	+	+	-	-	-	-	-	-	+
Atukalp	2019	+	-	+	-	+	+	-	+	+	-	-
Çanakçıoğlu	2019	+	-	-	-	-	+	+	+	+	+	-
Çanakçıoğlu & Küçükönder	2019	-	-	-	+	+	-	+	+	+	+	-
Kızıl	2019	-	-	-	-	-	-	-	+	+	-	-
Malik & Handono	2019	+	+	+	-	+	+	-	-	-	-	+
Akbulut	2020	+	-	-	-	+	-	+	+	+	-	-
Özkan	2020	+	-	-	-	+	-	+	+	+	+	-
Total		14	5	7	5	11	5	8	9	14	5	6

The groups, codes, target values, and names of the financial ratios used in the analysis are shown in Table 7.

Table 7: *Ratios Used in the Research, Target Values, and Their Impact on Financial Performance*

Ratio Group	Code	Ratio	Max/Min
Liquidity Ratios	L1	Current Ratio	Max
	L2	Cash Ratio	Max
Financial Structure Ratios	M1	Financial Leverage Ratio	Min
	M2	Financial Ratio	Max
Activity Ratios	F1	Accounts Receivable Turnover Ratio	Max
	F2	Asset Turnover Ratio	Max
	F3	Inventory Turnover Ratio	Max
Profitability Ratios	K1	Return on Assets Ratio	Max
	K2	Return on Equity Ratio	Max
	K3	Operating Profit Margin	Max
	K4	Periodic Net Profit Margin	Max

3.3.1. Liquidity Ratios

Current Ratio (L1): It is used to determine a company's ability to pay its short-term debts when they come due. Among the key liquidity ratios, the current ratio, which is one of the fundamental ratios, as its value increases, the company's ability to pay its debts also increases, and its capital is considered sufficient. The calculation of this ratio is as follows: (McGowan, Gardner & Moeller, 2015, p. 42; Usta, 2008, p. 111):

Formula = Current Assets / Short-Term Liabilities

Cash Ratio (L2): The controlled cash ratio, which is used in situations where companies face issues such as making sales or collecting receivables on time, indicates a company's ability to pay short-term debts (Çabuk & Lazol, 2005, p. 192). The use of this ratio is based on the premise that short-term debts should be at an adequate level (Schmidlin, 2014, p. 89). The formula for the cash ratio is as follows:

Formula = (Cash + Marketable Securities) / Short-Term Liabilities

3.3.2. Financial Structure Ratios

Financial Leverage Ratio (M1): While evaluating this ratio, it is expected not to exceed the value of 0.50. Companies with a value above this level may face financial difficulties, provided that other financial data are analyzed. Increasing equity profitability is an obvious way to increase earnings. Perhaps a less obvious way is to have less equity or net worth. This also implies higher leverage (Wahlen, Beginski & Bradshaw, 2008, p. 300). The calculation of this ratio is as follows:

Formula = Total Liabilities / Total Assets

Financial Ratio (M2): When the financial leverage ratio of companies is high, it is possible to say that their financial independence is in better condition, and they have a more resilient financial structure against third parties. Generally, when this ratio is less than 1, it can be interpreted as companies may have difficulty paying their debts in various external adverse circumstances or financial crises (Akdoğan & Tenker, 2010, pp. 654-655). The calculation of the financial leverage ratio is as follows:

Formula = Equity / Total Liabilities

3.3.3. Activity Ratios

Accounts Receivable Turnover Ratio (F1): This ratio provides information about a company's ability to manage its receivables, indicating how many times a company can collect its receivables within a year. The calculation of the accounts receivable turnover ratio is as follows:

Formula = Net Sales / Accounts Receivable

Asset Turnover Ratio (F2): This ratio indicates how successful and efficient a company's asset management is and how much revenue its assets generate. For manufacturing companies, this ratio is considered sufficient if it falls within the range of 2-4, while for commercial companies, it is expected to be 4 or higher. The calculation of the asset turnover ratio is as follows (Fridson & Alvarez, 2002, p. 292; Özdemir, 1997, p. 38):

Formula = Net Sales / Total Assets

Inventory Turnover Ratio (F3): This ratio provides information about how many times the current inventory is sold within a year. A high inventory turnover ratio indicates that companies have the ability to sell their inventory without excessive delays (Ataman & Hacırustemoğlu, 1999, p. 133). The calculation of the inventory turnover ratio is as follows:

Formula = Cost of Goods Sold / Inventory

3.3.4. Profitability Ratios

Return on Assets Ratio (K1): The calculation of the return on assets (ROA) ratio, which indicates whether companies are using their assets efficiently and whether they are successful in generating profits from their asset utilization, is as follows (Çabuk, Karagül, Erol, Başar, Sevim & Sayılır, 2013, p. 74):

Formula = Net Profit / Total Assets

Return on Equity Ratio (K2): The calculation of the return on equity (ROE) ratio, which can be referred to as financial profitability and indicates the extent to which shareholders of companies earn a profit in return for their investment in the company, is as follows (Pamukçu, 1999, p. 51):

Formula = Net Profit / Equity

Operating Profit Margin (K3): This ratio provides information about the profit generated by companies from their operations, taking into account the expenses related to sales activities. The calculation of the operating profit margin ratio is as follows:

Formula = Operating Profit / Net Sales

Periodic Net Profit Margin (K4): The net profit margin ratio, which provides information about a company's profitability after all expenses, is subject to decline due to factors such as increasing expenses or taxes. To calculate the net profit margin ratio, which is expected to be high to indicate that a company is successful and efficient in profitability, use the following formula:

Formula = Period Net Profit / Net Sales

3.4. Research Methods and Data Collection

The financial performance of the 15 cement companies included in the study was measured using multi-criteria decision-making methods, namely, TOPSIS and ELECTRE methods. While the TOPSIS method is commonly used for the analysis of financial performance, the almost nonexistent use of the ELECTRE method, especially in the analysis of cement companies' financial performance, is the most significant factor that distinguishes this research in the analysis section.

Data related to the financial ratios determined for the analysis of companies' financial performance were obtained from www.stockkeys.com, a product of Finnet Elektronik Yayıncılık Data İletişim Industry Trade Limited Inc., a technology company. The data obtained from this source were compared with financial statements from different periods published on the Public Disclosure Platform for randomly selected companies among the 15 companies. In the research, financial ratios for the last 10 years (between December 2022 and December 2013) of the previously defined and accessible 15 companies were used.

3.5. Application of the Methods

One of the most significant challenges in the application of MCDM methods is determining the relative importance of criteria. While criterion weights may not have a distinct economic significance, the decision-making process is directly influenced by criterion weights (Ratan-Paramanik, Sarkar & Sarkar et al., 2022). In successful decision-making, the method used is as important as how well the criterion weights are determined. The weights assigned to criteria are a crucial step, as the final results of the multi-criteria decision-making method largely depend on these weights. Various methods have been developed to assign different weights to criteria. Generally, these methods can be categorized into two different forms: subjective and objective weighting methods. Integrated weighting methods, which combine these two methods, have also been developed for solving some decision-making problems.

In subjective weighting methods, criterion weights are determined based on the judgments of the decision-maker. In other words, in subjective methods, weights are determined solely based on the preferences of the decision-makers. Ranking method is the simplest approach for assigning weights to criteria. Essentially, criteria are ranked from most important to least important. Then, ranking sum, rank comparison, or rank exponent method can be used to calculate the weights (Malczewski, 1999). When the decision-maker cannot directly determine the importance weights among criteria, methods that involve pairwise comparisons of criteria can be used. The Pairwise Comparison method is a very old psychometric technique (Whitfield, 1999). Pairwise comparisons involve comparing each criterion with all other criteria in pairs. Breaking down criteria into sub-criteria and attempting to determine weights is a commonly used method. Considering the joint assessment of experts in the field can enhance the success rate in determining weights, as the decision-maker's experience in the problem domain can improve the accuracy of weight determination. However, dealing with subjective weighting problems becomes challenging when there are a large number of criteria in decision problems.

In objective methods, criterion weights are calculated based on existing data using mathematical algorithms and models without considering the decision-maker's assessment of the importance of criteria. The entropy method uses a measure of uncertainty in the formulated information based on probability theory. It indicates that a wide distribution represents more uncertainty compared to a distribution with a sharp peak (Deng, Yeh & Willis, 2000). The CRITIC (Criteria Importance Through Intercriteria Correlation) method employs correlation analysis to identify contrasts between criteria (Diakoulaki, Mavrotas & Papayannakis, 1995).

In this study, the CRITIC method was applied ten times to the data between 2013 and 2022 to determine the criterion weights, and the average of these ten years was taken as the final criterion weights. The criterion weights determined according to the CRITIC method are presented in Table 8 below.

Table 8: *Criterion Weights According to the CRITIC Method*

Cod	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	Avg.
L1	0.070	0.062	0.073	0.094	0.075	0.078	0.075	0.099	0.081	0.104	0.081
L2	0.096	0.075	0.088	0.075	0.102	0.079	0.093	0.108	0.088	0.109	0.091
M1	0.073	0.082	0.091	0.119	0.108	0.101	0.085	0.098	0.080	0.088	0.092
M2	0.086	0.080	0.107	0.120	0.098	0.089	0.076	0.088	0.078	0.091	0.091
F1	0.103	0.089	0.092	0.069	0.070	0.100	0.096	0.099	0.118	0.096	0.093
F2	0.125	0.138	0.163	0.081	0.121	0.105	0.116	0.084	0.110	0.129	0.117
F3	0.128	0.112	0.122	0.138	0.090	0.135	0.123	0.110	0.128	0.108	0.119
K1	0.066	0.068	0.053	0.050	0.068	0.063	0.081	0.079	0.076	0.071	0.068
K2	0.104	0.098	0.090	0.114	0.119	0.096	0.083	0.083	0.095	0.070	0.095
K3	0.071	0.064	0.056	0.091	0.078	0.071	0.079	0.071	0.065	0.065	0.071
K4	0.079	0.133	0.064	0.051	0.072	0.083	0.092	0.081	0.080	0.070	0.081

In the study, first the TOPSIS Method is presented, followed by the ELECTRE Method.

3.5.1. TOPSIS Method

The TOPSIS method is a multi-criteria decision-making approach that is based on the idea that the best solution is not only the closest to the positive ideal solution but also the farthest from the negative ideal solution (Jollyta, 2018; Kaplan, Odabaş & Bozdoğan, 2023).

The TOPSIS method was applied a total of 11 times, once for each year from 2013 to 2022, and an additional time for the average data of these years, to analyze the financial performance of cement companies. The intermediate steps of the TOPSIS method were based on the average performance of the 10-year period from 2013 to 2022.

The first step in the implementation of the TOPSIS method is the decision matrix, which is presented in Table 9.

Table 9: Decision Matrix for the Average of 2022-2013 Years

Comp.	L1	L2	M1	M2	F1	F2	F3	K1	K2	K3	K4
AFYON	1.487	65.962	47.794	1.662	0.576	5.050	7.857	7.127	10.806	10.040	10.835
AKCNS	1.244	16.905	42.308	1.602	0.940	4.385	7.369	12.228	16.122	12.729	21.503
BASCM	1.622	36.460	33.837	2.696	0.831	3.707	6.290	5.202	9.253	6.587	7.058
BTCIM	1.041	26.627	60.748	0.792	0.555	5.149	7.091	-2.651	9.928	-5.976	-16.955
BSOKE	1.397	66.415	67.012	0.929	0.356	5.922	4.404	-10.096	3.445	-30.812	329.535
BUCIM	3.241	59.318	26.724	2.469	1.207	4.365	4.550	12.413	12.110	9.744	21.203
CMBTN	1.110	15.823	65.174	0.717	2.040	3.563	98.427	1.401	-0.729	0.402	7.201
CMEN	1.450	23.847	30.008	2.226	0.654	4.006	5.676	4.281	2.276	4.662	8.490
CIMSA	1.097	24.120	45.949	1.511	0.623	4.079	6.562	13.526	17.801	19.214	26.428
GOLTS	1.390	8.943	57.257	0.854	0.670	3.136	5.161	4.931	14.014	5.994	11.586
KONYA	3.165	130.275	26.493	3.784	0.878	4.202	4.949	8.303	9.455	9.804	11.992
NIBAS	1.444	42.975	29.539	3.400	0.384	6.364	4.948	3.943	-6.916	15.991	3.723
NUHCM	2.025	53.298	32.359	2.285	0.781	4.887	6.790	15.718	19.978	18.926	23.413
OYAKC	2.648	64.119	25.490	3.594	1.371	7.546	7.466	20.703	19.042	22.211	29.040
YBTAS	2.348	2.098	28.750	3.371	0.754	7.003	5.867	7.333	8.169	7.274	10.119

Table 10 presents the normalized decision matrix created for the standardization of data ranges.

Table 10: Average of 2022-2013 Years Normalized Decision Matrix

Comp.	L1	L2	M1	M2	F1	F2	F3	K1	K2	K3	K4
AFYON	0.200	0.322	0.282	0.181	0.159	0.258	0.078	0.182	0.230	0.181	0.032
AKCNS	0.168	0.083	0.250	0.175	0.259	0.224	0.073	0.312	0.343	0.230	0.064
BASCM	0.218	0.178	0.200	0.294	0.229	0.190	0.062	0.133	0.197	0.119	0.021
BTCIM	0.140	0.130	0.358	0.086	0.153	0.263	0.070	-0.068	0.211	-0.108	-0.051
BSOKE	0.188	0.325	0.395	0.101	0.098	0.303	0.044	-0.258	0.073	-0.556	0.982
BUCIM	0.437	0.290	0.158	0.269	0.332	0.223	0.045	0.317	0.258	0.176	0.063
CMBTN	0.149	0.077	0.384	0.078	0.561	0.182	0.974	0.036	-0.016	0.007	0.021
CMEN	0.195	0.117	0.177	0.243	0.180	0.205	0.056	0.109	0.048	0.084	0.025
CIMSA	0.148	0.118	0.271	0.165	0.171	0.209	0.065	0.346	0.379	0.347	0.079
GOLTS	0.187	0.044	0.338	0.093	0.184	0.160	0.051	0.126	0.299	0.108	0.035
KONYA	0.426	0.637	0.156	0.413	0.242	0.215	0.049	0.212	0.201	0.177	0.036
NIBAS	0.194	0.210	0.174	0.371	0.106	0.325	0.049	0.101	-0.147	0.289	0.011
NUHCM	0.273	0.261	0.191	0.249	0.215	0.250	0.067	0.402	0.426	0.342	0.070
OYAKC	0.357	0.313	0.150	0.392	0.377	0.386	0.074	0.529	0.406	0.401	0.087
YBTAS	0.316	0.010	0.170	0.368	0.208	0.358	0.058	0.187	0.174	0.131	0.030

The weighted normalized decision matrix, considering the criterion weights, is presented in Table 11.

Table 11: Weighted Normalized Decision Matrix for the Average of 2022-2013 Years

Comp.	L1	L2	M1	M2	F1	F2	F3	K1	K2	K3	K4
AFYON	0.016	0.029	0.026	0.017	0.015	0.030	0.009	0.012	0.022	0.013	0.003
AKCNS	0.014	0.008	0.023	0.016	0.024	0.026	0.009	0.021	0.033	0.016	0.005
BASCM	0.018	0.016	0.018	0.027	0.021	0.022	0.007	0.009	0.019	0.008	0.002
BTCIM	0.011	0.012	0.033	0.008	0.014	0.031	0.008	-0.005	0.020	-0.008	-0.004
BSOKE	0.015	0.030	0.037	0.009	0.009	0.035	0.005	-0.017	0.007	-0.040	0.079
BUCIM	0.035	0.026	0.015	0.025	0.031	0.026	0.005	0.021	0.025	0.013	0.005
CMBTN	0.012	0.007	0.036	0.007	0.052	0.021	0.116	0.002	-0.001	0.001	0.002
CMEN	0.016	0.011	0.016	0.022	0.017	0.024	0.007	0.007	0.005	0.006	0.002
CIMSA	0.012	0.011	0.025	0.015	0.016	0.024	0.008	0.023	0.036	0.025	0.006
GOLTS	0.015	0.004	0.031	0.008	0.017	0.019	0.006	0.009	0.028	0.008	0.003
KONYA	0.035	0.058	0.014	0.038	0.023	0.025	0.006	0.014	0.019	0.013	0.003
NIBAS	0.016	0.019	0.016	0.034	0.010	0.038	0.006	0.007	-0.014	0.021	0.001
NUHCM	0.022	0.024	0.018	0.023	0.020	0.029	0.008	0.027	0.040	0.024	0.006
OYAKC	0.029	0.029	0.014	0.036	0.035	0.045	0.009	0.036	0.039	0.029	0.007
YBTAS	0.026	0.001	0.016	0.034	0.019	0.042	0.007	0.013	0.017	0.009	0.002

The ideal solution vector, both positive and negative, is presented in Table 12.

Table 12: Positive and Negative Ideal Solution Vectors for the Average of 2022-2013 Years

Vectors	L1	L2	M1	M2	F1	F2	F3	K1	K2	K3	K4
Positive Ideal	0.035	0.058	0.014	0.038	0.052	0.045	0.116	0.036	0.040	0.029	0.079
Negative Ideal	0.011	0.001	0.037	0.007	0.009	0.019	0.005	-0.017	-0.014	-0.040	-0.004

The relative closeness values were obtained by applying TOPSIS 11 times, taking into account both the proximity to the positive ideal vector and the distance from the negative ideal vector, using the ideal solution vectors given in Table 13 for each separate option.

Table 13: Proximity Values According to Years and 10-Year Averages

Comp.	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	Avg.
AFYON	0.428	0.383	0.486	0.225	0.381	0.423	0.224	0.388	0.330	0.280	0.347
AKCNS	0.391	0.353	0.515	0.387	0.489	0.361	0.385	0.326	0.260	0.337	0.367
BASCM	0.366	0.273	0.413	0.364	0.419	0.357	0.348	0.287	0.288	0.378	0.323
BTCIM	0.334	0.234	0.350	0.246	0.382	0.223	0.213	0.231	0.211	0.296	0.237
BSOKE	0.086	0.302	0.162	0.056	0.250	0.074	0.157	0.300	0.324	0.384	0.366
BUCIM	0.486	0.509	0.548	0.394	0.524	0.394	0.370	0.240	0.245	0.287	0.390
CMBTN	0.531	0.500	0.565	0.446	0.658	0.502	0.509	0.540	0.536	0.577	0.513
CMENT	0.380	0.334	0.424	0.291	0.356	0.292	0.245	0.206	0.190	0.231	0.283
CIMSA	0.414	0.393	0.500	0.361	0.442	0.386	0.349	0.307	0.261	0.433	0.385
GOLTS	0.381	0.309	0.467	0.395	0.381	0.240	0.192	0.149	0.176	0.306	0.303
KONYA	0.361	0.339	0.500	0.397	0.527	0.500	0.462	0.388	0.434	0.410	0.416
NIBAS	0.528	0.423	0.382	0.364	0.293	0.141	0.198	0.184	0.289	0.141	0.326
NUHCM	0.454	0.458	0.624	0.434	0.495	0.394	0.392	0.321	0.251	0.299	0.421
OYAKC	0.455	0.417	0.528	0.767	0.474	0.520	0.437	0.340	0.333	0.430	0.470
YBTAS	0.346	0.302	0.366	0.337	0.408	0.386	0.463	0.379	0.342	0.423	0.339

The findings obtained from the analysis conducted using the TOPSIS method are presented as a whole in Figure 1 and Figure 2 below.

Figure 1: TOPSIS Results

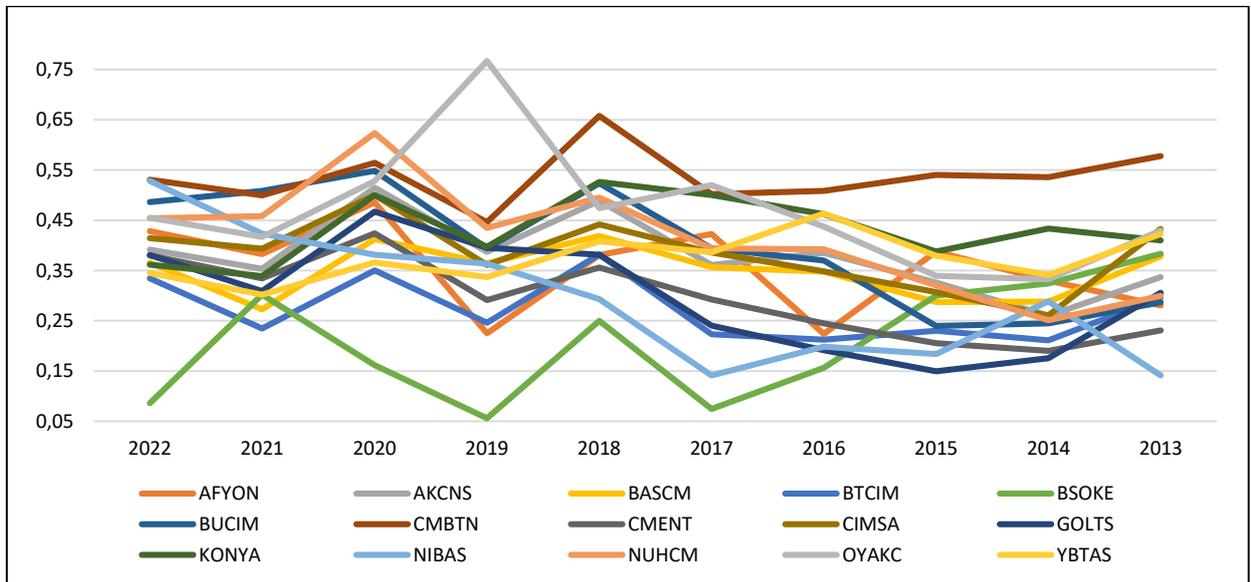
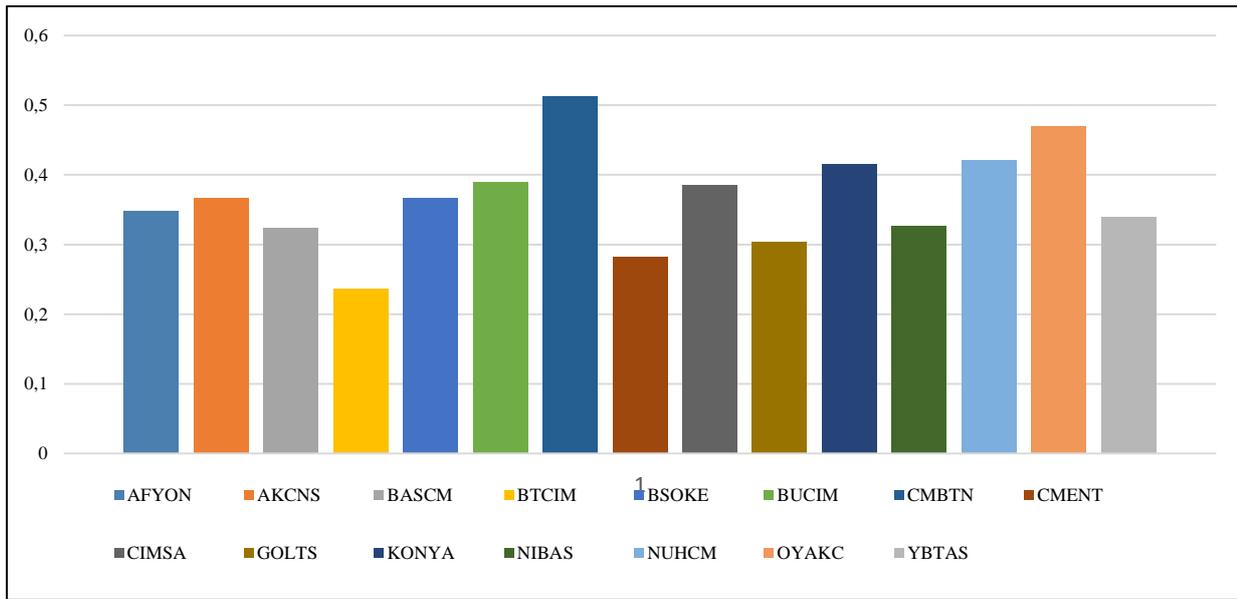


Figure 2: 10-Year TOPSIS Results.



3.5.2. ELECTRE Method

The ELECTRE method, which was first introduced by Bernard Roy in a conference in 1965 and later published in his work, made its way into the literature (Şahin, 2018, p. 155). ELECTRE, as one of the Multiple Criteria Decision Making (MCDM) methods, also started to be recognized in the literature with Beneyoun's usage in 1966. This method is still considered one of the MCDM methods used today (Arslan, 2018, p. 341). ELECTRE is a method that allows decision-makers to compare alternatives based on pairwise comparisons of criteria and helps them identify and evaluate the most suitable option among the available alternatives. Different sets of criteria and varying weightings can lead to different results in the analysis (Odabaş & Bozdoğan, 2020, p. 202).

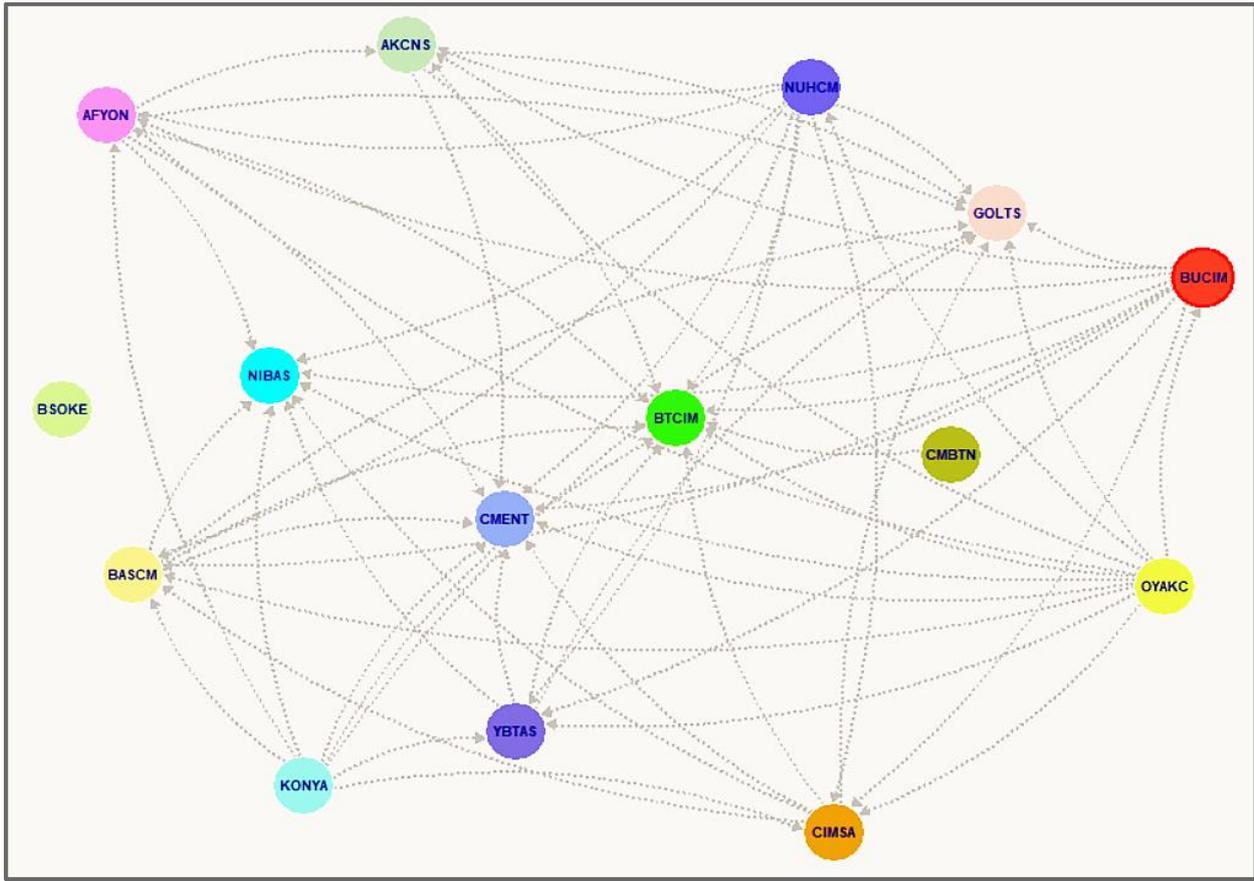
A pairwise dominance comparison among the firms was conducted using the ELECTRE method for the 10-year average values. The findings related to the total dominance matrix are presented in Table 14.

Table 14: Total Dominance Matrix

Comp.	AFYON	AKCNS	BASCM	BTCIM	BSOKE	BUCIM	CMBTN	CMENT	CIMSA	GOLTS	KONYA	NIBAS	NUHCM	OYAKC	YBTAS
AFYON	0	1	0	1	0	0	0	1	0	1	0	1	0	0	0
AKCNS	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0
BASCM	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0
BTCIM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSOKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUCIM	1	1	1	1	0	0	0	1	1	1	0	1	0	0	1
CMBTN	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
CMENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CIMSA	0	0	1	1	0	0	0	1	0	1	0	1	0	0	0
GOLTS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KONYA	1	0	1	1	0	0	0	1	1	1	0	1	0	0	1
NIBAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NUHCM	1	1	1	1	0	0	0	1	1	1	0	1	0	0	1
OYAKC	1	1	1	1	0	1	0	1	1	1	0	1	1	0	1
YBTAS	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0

The visualization of the total dominance matrix is provided in the figure below. An arrow from one company to another indicates superiority in the comparison.

Figure 3: ELECTRE Results



In the ELECTRE method, unlike the total dominance matrix, alternatives can also be ranked based on concordance dominance and discordance dominance values. Accordingly, the ranking of companies in terms of dominance superiority is given in Table 15.

Table 15: Net Dominance Ranking

Comp.	Net Compatibility Dominance	Net Incompatibility Dominance	Compatibility Rank	Incompatibility Rank	Average Rank
AFYON	1.807608045	0.2720135	6	7	5
AKCNS	1.846595281	1.3593063	5	9	6
BASCM	-1.532080787	3.4354174	9	11	11
BTCIM	-5.641607104	8.8919995	13	15	15
BSOKE	-4.864598782	-3.5497521	12	6	10
BUCIM	3.481894478	-3.7966954	4	5	4
CMBTN	-5.714900077	-9.6420806	14	1	7
CMENT	-4.374385184	8.4763617	11	14	13
CIMSAs	0.007915322	0.7228953	8	8	8
GOLTS	-5.901957476	7.2025719	15	12	14
KONYA	4.15805306	-7.7630226	3	3	2.5
NIBAS	-1.922692536	7.6182571	10	13	12
NUHCM	5.61566542	-5.547916	2	4	2.5
OYAKC	11.93011855	-9.5479016	1	2	1
YBTAS	1.104371788	1.8685456	7	10	9

3.6. Research Findings

In Table 16 below, the success rankings are presented for both methods in a mutually exclusive manner. Accordingly, three success groups, namely Good, Medium, and Poor, have been formed, each consisting of 5 companies.

Table 16: *Success Groups According to Two Methods*

Success Group	Companies	TOPSIS Success Order	Companies	ELECTRE Success Order
High	CMBTN	1	OYAKC	1
	OYAKC	2	NUHCM	2,5
	NUHCM	3	KONYA	2,5
	KONYA	4	BUCIM	4
	BUCIM	5	AFYON	5
Medium	CIMSA	6	AKCNS	6
	AKCNS	7	CMBTN	7
	BSOKE	8	CIMSA	8
	AFYON	9	YBTAS	9
	YBTAS	10	BSOKE	10
Low	NIBAS	11	BASCM	11
	BASCM	12	NIBAS	12
	GOLTS	13	CMEN	13
	CMEN	14	GOLTS	14
	BTCIM	15	BTCIM	15

When the success groups are examined, it is observed that except for AFYON and CMBTN, the companies in all other success groups are the same for both TOPSIS and ELECTRE. CMBTN ranks first in the good success group according to the TOPSIS method, while it ranks 5th in the medium success group according to the ELECTRE method. AFYON, on the other hand, ranks 9th in the medium success group according to the TOPSIS method, while it ranks 5th in the good success group according to the ELECTRE method.

Except for the two companies mentioned above, the companies in the good success group for both methods are OYAKC, NUHCM, KONYA, and BUCIM, respectively. NUHCM and KONYA companies rank 3rd and 4th in the TOPSIS method, while in the ELECTRE method, they both share the 2nd and 3rd positions jointly.

According to the findings related to the measurement of companies' financial performance, OYAKC, NUHCM, KONYA, and BUCIM companies from the good success group rank equally in both the TOPSIS and ELECTRE methods, while BTCIM ranks last in the findings obtained from both methods. NIBAS and BASCM, among themselves, and GOLTS and CMEN, among themselves, have changed their positions in the bad success group in the findings obtained from both methods.

According to the findings obtained from both methods, among the companies with the best financial performance, OYAKC, NUHCM, and KONYA companies, when their 10-year financial ratios were examined, generally had lower financial leverage ratios compared to other companies and higher current ratios. Additionally, when looking at the 10-year period, OYAK and NUHCM companies generally had higher return on equity ratios than other companies. For KONYA company, it was observed that its cash ratio was significantly higher than other companies in most years. These findings can be cited as reasons for OYAK, NUHCM, and KONYA companies being the ones with the best financial performance according to the findings obtained from both methods.

When the reasons for BTCIM company being the worst in terms of financial performance in both methods are examined, the following observations can be made. BTCIM has almost consistently had a negative return on equity ratio when the data for the past 10 years is examined. In order to improve its financial performance, BTCIM company should minimize fluctuations in revenues from sales. It should also take the necessary measures to ensure that its debt structure is strong and its capital structure is resilient. The financial leverage ratio, which has a minimum target value, has also been consistently one of the highest among the companies when looking at the 10-year period. In terms of the net profit margin ratio, it has also had negative values for several years within the past 10 years.

5. Conclusion

While the global cement sector has seen significant development in the last two decades, the Turkish cement sector has also made strides and become one of the most prominent countries in the cement industry. As of 2021, Turkey ranks 5th in cement production worldwide and 2nd in cement exports. It is anticipated that the Turkish cement sector will continue to grow in importance over the next 30 years, with both production volume and exports expected to increase. Therefore, every analysis conducted regarding the sector is crucial for its better preparation for the future and the development of accurate strategies.

In light of this information, the study aimed to measure the financial performance of 15 companies listed on Borsa Istanbul (BIST) with available financial data from 2013 to 2022. The study utilized CRITIC-based TOPSIS and ELECTRE methods, and the findings were compared between the two methods and presented separately. Three different success groups, namely good, moderate, and poor, were established, with five companies in each group. According to the results obtained from the TOPSIS method, CMBTN ranked first in the financial performance success ranking, followed by OYAK, NUHCM, and KONYA as the other top-performing companies. The findings from the ELECTRE method also indicated that OYAK, NUHCM, and KONYA were the most successful companies in terms of financial performance. Since CMBTN ranked first in the TOPSIS method but fell into the moderate success group in the ELECTRE method, it can be concluded that, according to the findings from both methods, OYAK, NUHCM, and KONYA were the top-performing companies in terms of financial performance. In both methods, BTCIM emerged as the least successful company in terms of financial performance.

Especially after the earthquake disaster that occurred in February 2023, the dynamics in the cement sector and the importance of all components of the sector will continue to increase. Continuously analyzing the financial performance of companies in the sector on a regular basis is crucial, both for individuals and parties investing in the sector and for public institutions to work in an integrated manner with companies in the sector. The cement sector, which is essential for various aspects such as earthquakes, floods, landslides, health investments, transportation infrastructure, and the effective provision of public services, is an extremely important sector for the development of our country. The sector contributes to employment, supports our country's exports, and enhances the quality of public services, bringing many benefits. Therefore, determining the financial position of the cement sector, predicting its future position, and promoting the institutionalization of companies continuing their activities in the sector are of great importance. Inspired by this study, conducting various financial analyses and measuring financial performance in the sector by selecting different data periods, using different financial ratios, and applying different methods can contribute to the literature.

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