Finans Politik & Ekonomik Yorumlar (672) Haziran 2025: 9-48
Araştırma Makalesi

FINANCIAL PERFORMANCE AND PORTFOLIO MODELLING IN THE BIST TEXTILE, APPAREL AND LEATHER SECTOR WITH MPSI AND RAPS MCDM METHODS

Onur ŞEYRANLIOĞLU[1], Arif ÇİLEK[2], Cennet KONUŞ[3]

Gönderim tarihi: 09.10.2024 *Kabul tarihi: 29.03.2025*

Abstract

In this study, the financial performance of 22 companies operating in the textile, apparel, and leather sectors on the Borsa Istanbul (BIST) between 2019 and 2023 was analysed using the MPSI (Modified Preference Selection Index) and RAPS (Ranking the Alternatives by Perimeter Similarity) methods. The weights of the evaluation criteria were determined using the MPSI method, while the financial performance rankings were established using the RAPS method. According to the MPSI criterion importance results, the most significant criteria were net profit margin, debt/equity ratio, and net operating profit margin, whereas the least significant criteria were current ratio, acid-test ratio, cash ratio, and inventory turnover. According to the RAPS method, BLYCT, RUBNS, ARSAN and SNPAM were the best performing companies, while SKTAS, BRKO, MNDRS, RODRG, DAGI, KORDS and ATEKS were the worst performers. As part of the study, two portfolios were created for each year, and their stock returns were analysed. According to the portfolio analysis results determined by the RAPS method, Portfolio A outperformed Portfolio B. In addition, sensitivity analysis was also performed to check the robustness of the MCDM hybrid model.

Keywords: BIST Textile, Apparel and Leather Sector Index, Financial Performance, Portfolio Modelling, MCDM, MPSI, RAPS.
JEL Classification: G11, G20, C44

MPSI VE RAPS ÇKKV YÖNTEMLERİ İLE BİST TEKSTİL, HAZIR GİYİM VE DERİ SEKTÖRÜNDE FİNANSAL PERFORMANS VE PORTFÖY MODELLEMESİ

Özet

Bu çalışmada, Borsa İstanbul'da (BIST) tekstil, hazır giyim ve deri sektörlerinde faaliyet gösteren 22 şirketin 2019-2023 yılları arasındaki finansal performansları MPSI (Modified Preference Selection Index) ve RAPS (Ranking the Alternatives by Perimeter Similarity) yöntemleri kullanılarak analiz edilmiştir. Değerlendirme kriterlerinin ağırlıkları MPSI yöntemi kullanılarak belirlenirken, finansal performans sıralamaları RAPS yöntemi kullanılarak oluşturulmuştur. MPSI kriter önem sonuçlarına göre, en önemli kriterler net kâr marjı, borç/özkaynak oranı ve net faaliyet kâr marjı iken, en az önemli kriterler cari oran, asit-test oranı, nakit oranı ve stok devir hızıdır. RAPS yöntemine göre BLYCT, RUBNS, ARSAN ve SNPAM şirketleri en iyi performans gösteren şirketler olurken; SKTAS, BRKO, MNDRS, RODRG, DAGI, KORDS ve ATEKS kodlu şirketler ise kötü performans göstermişlerdir. Çalışma kapsamında her yıl için iki portföy oluşturularak hisse senedi getirileri analiz edilmiştir. RAPS yöntemi ile belirlenen portföy analizi sonuçlarına göre Portföy A, Portföy B'den daha iyi performans göstermiştir. Ayrıca, ÇKKV hibrit modelinin sağlamlığını kontrol amacı ile duyarlılık analizi de yapılmıştır.

Anahtar Kelimeler: BİST Tekstil, Hazır Giyim ve Deri Sektör Endeksi, Finansal Performans, Portföy Modellemesi, ÇKKV, MPSI, RAPS.
JEL Classification: G11, G20, C44

[1] Asst. Prof. Dr., Giresun University, Faculty of Economics and Administrative Sciences, Department of Business Administration, onurseyranlioglu@gmail.com, ORCID ID: 0000-0002-1105-4034.

[2] Assoc. Prof. Dr., Giresun University, Bulancak Kadir Karabaş School of Applied Sciences, Department of International Trade and Finance, arif.cilek@giresun.edu.tr, ORCID ID: 0000-0002-9277-3953.

[3] Master's Student, Giresun University, Institute of Social Sciences, Department of Business Administration, cennetkonus1998@gmail.com, ORCID ID: 0009-0006-0504-2877.

1. Introduction

The textile industry has a wide range of production within the supply chain of the ready-to-wear sector. It includes fibers, yarn, knitted/woven fabrics, nonwoven surfaces such as felt and tufted surfaces, home textile products, carpets, as well as technical textiles for specific applications, including nets, ropes, textile cables, conveyor belts, tarpaulins, protective fabrics, filters, parachutes, and brake fabrics. All clothing products made from knitted and woven fabrics are produced in the ready-to-wear sector. The ready-to-wear sector is labor-intensive, where intermediate products produced in the textile industry are transformed for the fashion industry. Animal hides and furs, luggage, bags, trunks, gloves, belts, harnesses, clothing items, and shoes made from leather, fur, synthetic leather, and textile surfaces fall under the category of leather products. Additionally, these sectors are technically linked with many industries, including agriculture, livestock, chemical and petrochemical industries, automotive, construction, heavy industry, and medicine (Republic of Türkiye Ministry of Industry and Technology, 2023). For this reason, both in Türkiye and worldwide, the textile and leather industries are influenced by and simultaneously affect other sectors. With the advancement of technology, the range of products, production methods, and areas of use have diversified considerably. In this sense, the importance of these sectors is increasing day by day (Arman et al., 2022).

The current level of development in the textile and ready-to-wear sectors has been achieved primarily through export-oriented production to the United States (USA) and European Union (EU) markets. With the signing of the Customs Union Agreement with the EU in 1996, the opportunity to export to this market without quotas was gained. After 2007, in the face of China’s ability to export textile and ready-to-wear products to the EU market without quotas, Türkiye chose not to compete by lowering prices at the expense of quality. Instead, it opted to focus on producing fashion/brand-oriented, high value-added products to maintain its presence (Republic of Türkiye Ministry of Industry and Technology, 2023). Türkiye's total export revenue in 2023 amounted to approximately 222.7 billion U.S. dollars. When examining the sectoral distribution of this export revenue, the automotive industry ranks first with 35 billion dollars, followed by the chemical industry with 30.6 billion dollars, and the ready-to-wear and apparel industry in third place with 19.3 billion dollars. The shares of the automotive, chemical, and ready-to-wear and apparel industries in total export volume were 15.8%, 13.8%, and 8.7%, respectively. On the other hand, the textile and raw materials industry generated 9.6 billion dollars, the carpet industry 2.8 billion dollars, and the leather and leather products industry 1.9 billion dollars in export revenue. In total, the ready-to-wear and apparel, textile and raw materials, carpet, and leather and leather products industries generated approximately 33.4 billion dollars in export revenue, accounting for 15% of the total export volume (Türkiye Exporters Assembly, 2023). In 2023, approximately 59.9% of Türkiye's ready-to-wear and apparel exports were made to EU countries. The top countries importing ready-to-wear and apparel from Türkiye were Germany, Spain, the Netherlands, the United Kingdom, and France (Istanbul Apparel Exporters' Association, 2023). According to the sectoral manufacturing industry capacity utilization rate data, the general capacity utilization rate in the manufacturing sector for 2023 was 76.30%. When examining the capacity utilization rates of sectors related to textiles, the figures were 70.2% for textile product manufacturing, 77.23% for clothing manufacturing, and 67.29% for leather and leather products manufacturing. The capacity utilization rate for clothing manufacturing was higher than the overall manufacturing industry rate (Central Bank of the Republic of Türkiye, 2024). Textile and related sectors make a major contribution to the number of workplaces and registered employment in the country. According to 2023 data, 19,794 enterprises operating in the textile products manufacturing sector employ 397,524 insured persons, 41,558 enterprises operating in the clothing manufacturing sector employ 627,452 insured persons, and 7,750 enterprises operating in the leather and related products manufacturing sector employ 68,956 insured persons, creating employment for more than one million people in total (Republic of Türkiye Social Security Institution, 2023). According to 2022 data, the value added produced in the manufacturing industry constitutes approximately 40.44% of the total value added produced in the country (Turkish Statistical Institute, 2024). Table 1 presents the value added of manufacturing industry sub-sectors in Türkiye. The total value added produced by the textile products, clothing and leather and related products manufacturing sectors corresponds to 14.51% of the manufacturing industry value added. When the textile products, clothing and leather and related products manufacturing sectors are evaluated together, they are the sectors that create the highest value added in Türkiye. In the light of this numerical information, it is seen that the textile, clothing and leather sectors, which operate under the manufacturing industry and are at the forefront in terms of production, employment, exports and contribution to value added, are the sectors that create dynamism in the Turkish economy.

Table 1. Value Added of Manufacturing Industry Sub-Sectors in Türkiye-2022

Sector	Share
Manufacturing industry	100%
Manufacture of food products	10.15%
Beverage manufacturing	0.50%
Manufacture of textile products	9.08%
Manufacture of wearing apparel	4.84%
Manufacture of leather and related products	0.59%
Manufacture of wood etc. products	1.26%
Manufacture of paper and paper products	3.05%
Printing and reproduction of recorded media	0.54%
Manufacture of chemicals and chemical products	6.65%
Manufacture of basic pharmaceutical products	1.77%
Manufacture of rubber and plastic products	5.28%
Manufacture of other non-metallic mineral products	6.15%
Basic metal industry	9.53%
Manufacture of fabricated metal products, except machinery and equipment	6.65%
Manufacture of computer, electronic and optical products	2.45%
Manufacture of electrical equipment	4.93%
Manufacture of machinery and equipment n.e.c.	6.05%
Motor vehicle industry	7.17%
Manufacture of other transport equipment	2.91%
Furniture manufacturing	1.80%
Other manufacturing	1.02%
Repair and installation of machinery and equipment	1.84%

Source: (Turkish Statistical Institute, 2024).

Companies operating in the textile sector, as in other sectors, need to be in a structure that is open to competition and constantly developing according to changing market conditions to create, maintain and at the same time develop their market share. Especially in recent years, businesses must manage their financial performance effectively and efficiently to be protected from the negative effects of global crises (Ezin, 2022). Today, the process of measuring financial performance is of great importance not only for company managers or investors but also for all companies in the same sector. Since financial performance has various meanings such as profitability, productivity, economic growth, financial analysis is an appropriate measurement to measure financial performance for both companies and related sectors. In addition, companies now attach importance to knowing their ranking among their competitors in the same industry to be able to implement appropriate strategies. Therefore, the ranking of companies is of great importance in the business world (Abdel-Basset et al., 2020). The diversification of investment options in today's rapidly increasing competition has increased the importance of the criteria affecting the decisions of investors. Before making an investment decision, financial ratios calculated based on the financial statements of companies and the evaluation of the performance of companies according to these ratios are frequently used by investors and analysts. However, due to the diversity of financial ratios and their interaction with each other, analyses made by determining a single criterion may cause misinterpretation (Yıldırım & Çiftci, 2020). In today's data-rich environment, the abundance of corporate and financial data allows for unprecedented insights into the potential of investments. Given the volume of data, conflicting criteria and demands for superior performance, the evaluation of investment options requires support in making investment decisions. Currently available MCDM tools are well suited to help select potential investments by structuring complex problems so that multiple criteria can be considered (Papathanasiou & Ploskas, 2018). For this reason, MCDM methods, which provide a single output by evaluating multiple criteria together, do not contain assumptions that must be met in investment processes, can handle multiple criteria as input, and can obtain output ranking by weighting the inputs according to their importance, increase the usefulness of these methods' day by day (Temizel & Bayçelebi, 2016).

In the context of this information, the main objective of this study is to evaluate the 5-year (2019-2023) financial performances of 22 companies operating in the Borsa Istanbul (BIST) textile, apparel and leather sector with MPSI (Modified Preference Selection Index) and RAPS (Ranking the Alternatives by Perimeter Similarity) methods. In addition, within the scope of the study, two portfolios were created for each year according to the financial performance rankings obtained by the RAPS method and it was aimed to support the results obtained by evaluating the 5-year returns of these portfolios. The following comments can be made for the contributions of this research to the literature. Considering the strategic contribution of the textile, apparel and leather sectors to the national economy in terms of production, employment, exports and value added, it is thought that it is of great importance to update the financial performance of the companies in these sectors as new financial data are published. In addition, enabling companies in this sector to see their current financial performance and to compare them with good companies will guide sector stakeholders in their investments and make competition sustainable. With this research, the MPSI-RAPS hybrid MCDM model has been applied for the first time in financial performance measurement and an attempt has been made to contribute to the literature with the use of these rare methods.

The following stages of the research are organized as follows. After the introduction, the literature review, the methods used in the research and the implementation process were detailed. The research is completed with the conclusion and evaluation phase.

2. Literature Review

There are many studies in the literature that measure the financial performance of companies using various MCDM methods. These studies examine the financial performance of companies in different sectors with different MCDM methods. In the literature phase of this research, firstly, summaries of the research examining the financial performance of companies operating in the textile sector are presented. Then, the MPSI and RAPS methods used in this research and research summaries from different application areas are completed.

In financial performance research in the textile sector in Türkiye, Temizel and Bayçelebi (2016) conducted an analysis using the TOPSIS method on the data from 15 companies operating in the BIST textile, apparel, and leather sectors for the period 2011-2014. The study utilized eight financial ratios: current ratio, liquidity ratio, inventory turnover, fixed asset turnover, total asset turnover, debt/total assets ratio, net profit margin, and return on equity. According to the research findings, the companies DERIM, BLCYT, and YUNSA were ranked among the top three in terms of performance.

Arslan et al. (2017) examined the financial performance of 14 leading textile companies in Türkiye for the period 1991-2011 using the Analytic Hierarchy Process (AHP) and Grey Relational Analysis (GRA) methods. The study utilized a total of 14 financial ratios, including liquidity, financial structure, and profitability ratios. The criteria were weighted equally and then ranked separately using the GRA method with weights assigned by the AHP method. In the rankings without weighting, SKTAS, KORDS, and BOSSA were in the top three, while in the rankings based on weighted criteria, SKTAS, KORDS, and KRTEK were in the top three.

Konak et al. (2018) measured the financial performance of 23 companies operating in the BIST textile, apparel, and leather sectors using the TOPSIS and MOORA methods with data from the period 2010-2015. The study utilized a total of 10 financial ratios, including liquidity, operational efficiency, financial structure, and profitability ratios. Although the rankings based on TOPSIS and MOORA methods generally showed similarity, during the relevant period, ESEMS, BLCYT, and SNPAM exhibited good performance, while DMISH and MEMSA showed poor performance.

Ekizler (2020) examined the financial performance of 19 companies operating in the BIST textile, apparel, and leather sectors using the VIKOR and TOPSIS methods with data from the period 2011-2018. The study utilized 6 financial ratios: liquidity, financial structure, profitability, growth, and size. In the performance ranking, SNPAM and YATAS were identified as the best-performing companies, while DIRIT and BRMEN were the worst-performing companies.

Işıldak (2020) examined the financial performance of 20 companies operating in the BIST textile, apparel, and leather sectors using the AHP and VIKOR methods with data from the period 2014-2017. The study utilized a total of 18 financial ratios, including liquidity, operational efficiency, financial structure, profitability, and stock market performance. In the AHP method for criterion weighting, the sales profitability ratio was ranked first, while the inventory dependency ratio was ranked last. According to the VIKOR method's performance measurement, SNPAM was ranked first.

Yıldırım and Çiftçi (2020) analyzed the financial performance of 21 companies listed in the BIST textile, apparel, and leather sectors using the dynamic intuitive fuzzy WASPAS method with data from the period 2015-2019. The study employed 16 financial ratios. In the research, where the importance of criteria was considered equal and simple evaluations based on the decision-maker's perspective were used to determine the period weights, YATAS was found to be the company with the highest financial performance.

Elden Ürgüp (2021) assessed the financial performance of 21 companies operating in the BIST textile, apparel, and leather sectors using the SWARA and MARCOS methods with data from the period 2015-2020. The study employed 10 financial ratios based on literature review. According to the SWARA method, the most important criterion weight was the market value/book value ratio, while the least important was the total asset turnover ratio. The MARCOS method's performance ranking identified SNPAM as the most successful company in the sector for the years 2015, 2016, 2017, and 2018. Additionally, the correlation analysis between performance scores obtained from the performance evaluation model and stock returns revealed that a significant relationship could not be confirmed, except for the year 2020.

Ezin (2022) used the Entropy and TOPSIS methods to evaluate the financial performance of 13 companies in the BIST textile, apparel, and leather sectors for the period 2019-2021. The study employed a total of 17 financial ratios, including liquidity, financial structure, operational efficiency, and profitability ratios. The Entropy method revealed that financial structure and profitability ratios were the most important criteria. According to the TOPSIS performance ranking, BOSSA exhibited the highest performance over the years, while HATEK and KORDS showed the lowest performance.

Arman et al. (2022) assessed the financial performance of 17 companies operating in the BIST textile, apparel, and leather sectors using data from 2016-2020. They utilized the Fuzzy PIPRECIA method for criterion weighting and the MARCOS method for ranking. The study employed a total of 12 financial ratios across four areas: liquidity, financial structure, operational efficiency, and profitability. According to the MARCOS method's ranking, ARSAN, BLCYT, MEGAP, and YATAS were consistently in the top positions over the five years, while DERIM and SKTAS were in the lower positions. Additionally, the study involved creating two portfolios for each year, which were analyzed using five performance measurement criteria. It was found that Portfolio A exhibited higher performance compared to Portfolio B for the years 2017, 2018, and 2019 based on the MARCOS method.

Aksoylu et al. (2024) assessed the financial failure risks and financial performance of 22 companies operating in the BIST textile, apparel, and leather sectors using data from 2017-2022. They employed the Altman Z-Score model and the VIKOR method for their analysis. The research findings indicate that while there were fluctuations in the financial failure risks and financial performance of the companies over the years, the overall results were consistent. Generally, the best-performing companies were BLCYT, DAGI, MEGAP, and SNPAM, whereas the worst-performing companies were BRMEN, DIRIT, and SKTAS.

In the literature, there are very few financial performance studies focusing on the textile and related sectors outside of Türkiye. Among these, Deng et al. (2000) used the TOPSIS approach in a case study comparing the financial performance of seven companies in the textile industry located in Wuhan, China. The evaluation criteria for this industry included four financial ratios: profitability, efficiency, market position, and debt ratio. Another study, by Yen et al. (2023), investigated the financial performance of 11 textile and apparel companies during the period 2016-2018 using the Entropy and TOPSIS methods, with Vietnam, one of the world's largest textile and apparel exporters, as the sample. This study utilized 7 financial ratios/data points.

One of the current MCDM methods, the MPSI method, was introduced by Gligorić et al. in 2022 as a modified version of the Preference Selection Index (PSI) method in criterion weighting. Since it is a new method, its use in the literature is very limited. Among the research examples conducted with the MPSI method, Gligorić et al. (2022) in the selection of underground mine development support system; Zhang et al. (2022) in the design application of heavy tractor chassis; Yılmaz (2023) in the measurement of financial performance of multi-branch banks in Türkiye; Güçlü (2023) in the robot vacuum cleaner selection problem; Çelebi Demirarslan et al. (2024) in the ranking of quality of life indices in Asian countries by year; Torres et al. (2024) in the selection of unmanned aerial vehicle systems and Kara et al. (2024) in the comparison of supply chain performance of countries. The RAPS method, introduced by Urošević et al. in 2021, is very limited in performance ranking since it is a new method. Among these research examples, Urošević et al. (2021) is used in decision-making processes in the mining sector; Bafail et al. (2022) in the evaluation of the efficiency of engineering departments at a state university; Alamoudi and Bafail (2022) in the ranking of banking sector companies according to their financial indicators in the Saudi Stock Market; Saleh et al. (2024) in the selection of the best model in skin cancer classification. The study by Şahin Macit (2024) is one of the rare studies that examines the development levels of information and communication technologies of 14 selected countries in Europe and Central Asia using the MPSI-RAPS hybrid MCDM method.

It has been observed that in the financial performance assessment of companies in the textile sector, criteria weighting is generally determined using methods such as AHP, SWARA, Entropy, and fuzzy PIPRECIA. In this study, the MPSI method was chosen for criteria weighting due to its novelty and limited usage. Furthermore, in the financial performance ranking of companies in the textile sector, methods such as TOPSIS, GIA, MOORA, VIKOR, intuitive fuzzy WASPAS, and MARCOS are more commonly used in the literature. This study has utilized the RAPS method, which has limited usage in the literature, for financial performance measurement. Additionally, the MPSI-RAPS hybrid MCDM model has been used for the first time in financial performance measurement in the literature. In this study, it is preferred to use objective methods that can provide more systematic, rational and data-driven decisions instead of subjective evaluation based on expert opinions and experience. Therefore, it is thought that avoiding subjective comments and preferring objective methods in analyses such as financial performance and portfolio modelling may lead to more reliable results.

3. Method

3.1. Z-Score Standardization Method

In the evaluation process, it is necessary to standardize the elements of the decision matrix to enable the comparison of criteria with different dimensions and units. On the other hand, the presence of negative values in decision matrices is not commonly encountered in MCDM problems. In such cases, since negative values cannot be included in the normalized matrix, it is necessary to convert the elements of the decision matrix to positive values. In this study, the Z-score standardization method proposed by Zhang et al. (2014) is used to convert negative values in the decision matrix to positive values. The steps of the Z-score standardization method are as follows (Zhang et al., 2014; Ersoy, 2022).

Step 1: The elements of the decision matrix are transformed using Equation (1).

$$x_{ij}=\frac{X_{ij}-\bar{X}_i}{S_i} \tag{1}$$

X_{ij}, denotes the standardized data for index i in region j, X_{ij}, denotes the original data, $\bar{X}_i$ and S_i denote the arithmetic mean and standard deviation values, respectively.

Step 2: The elements of the decision matrix are made positive using Equation (2).

$$x'_{ij} = x_{ij} + A \qquad A > |minx_{ij}| \tag{2}$$

X'_{ij} represents the standardized value after transformation. It should be x'_{ij}>0.

3.2. MPSI Method

The Modified Preference Selection Index (MPSI) method relies on the degree of fluctuation, the change in preference values for each criterion. This variation essentially presents the distance between the normalized value and the average value per criterion and is expressed using Euclidean distance. The MPSI method is considered a straightforward and easy-to-understand approach for defining the objective weights of criteria. Moreover, this newly developed method does not take much time in calculating the weight coefficients. This makes the MPSI method a highly flexible and applicable approach for solving various MCDM problems. This new method consists of the following steps (Gligorić et al., 2022):

Step 1: The initial decision-making matrix is created.

$$(A/C) = [r_{ij}]_{mxn}=\begin{bmatrix} A/C & C_1 & C_2 & \cdots & C_n \\ A_1 & r_{11} & r_{12} & \cdots & r_{1n} \\ A_2 & r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ A_m & A_{m1} & A_{m2} & \cdots & A_{mn} \end{bmatrix} \tag{3}$$

Here, $A_1, A_2,\dots, A_m$ represents the vector of corresponding alternatives, $C_1, C_2,\dots, C_n$ represents the vector of corresponding criteria, x_{ij} denotes the value corresponding to the i. alternative for the j. criterion, m represents the number of alternatives, and j. represents the number of criteria.

Step 2: The normalized decision matrix R is created. Depending on the criterion trend, a simple linear normalization technique transforms different input data values to a consistent scale, specifically to the unit interval [0, 1].

For benefit-oriented criteria:

$$r_{ij} = \frac{x_{ij}}{max x_{ij}},\ i = 1, 2, \ldots, m \tag{4}$$

For cost-oriented (minimization) criteria:

$$r_{ij} = \frac{min x_{ij}}{x_{ij}},\ i = 1, 2, \ldots, m \tag{5}$$

The normalized decision matrix R is constructed as follows.

$$R(A/C) = [r_{ij}]_{mxn} = \begin{bmatrix} A/C & C_1 & C_2 & \cdots & C_n \\ A_1 & r_{11} & r_{12} & \cdots & r_{1n} \\ A_2 & r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ A_m & A_{m1} & A_{m2} & \cdots & A_{mn} \end{bmatrix} \tag{6}$$

Here, r_{ij} represents the normalized value of the corresponding criterion, where $0 < r_{ij} < 1$.

Step 3: The average v_j value of the normalized values for the j. criterion is calculated.

$$v_j = \frac{1}{m}\sum_{i=1}^{m} r_{ij} \tag{7}$$

Step 4: The priority variation value p_j is calculated.

$$\rho_j = \sum_{i=1}^{m} \left(r_{ij} - v_j\right)^2 \tag{8}$$

Step 5: The criterion weights w_j are determined.

$$w_j = \frac{\rho_j}{\sum_{j=1}^{n} \rho_j} \tag{9}$$

3.3. RAPS Method

The methodology of the Ranking the Alternatives by Perimeter Similarity (RAPS) technique can be explained through the following steps (Urošević et al., 2021; Bafail et al., 2022):

Step 1: The data is normalized. To make the decision space dimensionless, this step normalizes the input data, thereby making multidimensional data comparable and meaningful.

Equation (10) is used for normalization of maximum criteria, while Equation (11) is used for normalization of minimum criteria. This normalization process is employed to make the values of different criteria comparable and to transform a multidimensional decision space into a dimensionless form.

$$r_{ij} = \frac{x_{ij}}{max_i(x_{ij})}, \forall i \in \{1, 2, \dots, m\} \text{ ve } j \in S_{max} \tag{10}$$

$$r_{ij} = \frac{min_i(x_{ij})}{x_{ij}}, \forall i \in \{1, 2, \dots, m\} \text{ ve } j \in S_{min} \tag{11}$$

Step 2: The normalized decision matrix is created. The normalization process yields the normalized decision matrix as shown in Equation (12).

$$R = [r_{ij}]_{mxn} = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & \cdots & r_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \end{array} \tag{12}$$

Step 3: The weighted normalized decision matrix is created. By applying the weighted normalization process from Equation (13) to each normalized rij value, the weighted normalized matrix is formed as expressed in Equation (14).

$$u_{ij} = w_j r_{ij}, \forall i \in \{1, 2, \dots, m\}, \forall j \in \{1, 2, \dots, n\} \tag{13}$$

$$U = [u_{ij}]_{mxn} = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} u_{11} & u_{12} & \cdots & u_{1j} \\ u_{21} & u_{22} & \cdots & u_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ u_{m1} & u_{m2} & \cdots & u_{mn} \end{bmatrix} \end{array} \tag{14}$$

Step 4: The optimal alternative is determined. By using Equation (15) to identify each element of the optimal alternative set as indicated in Equation (16), the optimal alternative is identified.

$$q_j = max(u_{ij} | 1 \leq j \leq n), \forall i \in \{1, 2, \dots, m\} \tag{15}$$

$$Q = \{q_1, q_2, \dots, q_j\}, j = 1,2, \dots, n \tag{16}$$

Step 5: The optimal alternative is disaggregated. Disaggregating the optimal alternative involves dividing it into two subsets or components. The set Q can be represented as the union of two subsets, as shown in Equation (17). If k represents the total number of criteria to be maximized, then h=n−k represents the total number of criteria to be minimized. Consequently, the most suitable alternative is shown in Equation (18).

$$Q = Q^{max} \cup Q^{min} \tag{17}$$

$$Q = \{q_1, q_2, \dots, q_k\} \cup \{q_1, q_2, \dots, q_h\}; k + h = j \tag{18}$$

Step 6: Alternatives are disaggregated. Disaggregating the alternatives is like Step 5. This step involves disaggregating each alternative as shown in Equations (19) and (20).

$$U_i = U_i^{max} \cup U_i^{min}, \qquad \forall i \in \{1, 2, \dots, m\} \tag{19}$$

$$U_i = \{u_{i1}, u_{i2}, \dots, u_{ik}\} \cup \{u_{i1}, u_{i2}, \dots, u_{ih}\}, \forall i \in \{1, 2, \dots, m\} \tag{20}$$

Step 7: The size of the components of the optimal alternative and the alternatives is calculated. This step involves calculating the size of each component of the optimal alternative. Therefore, the size is determined using Equations (21), (22), (23), and (24).

$$Q_k = \sqrt{q_1^2 + q_2^2 + \cdots + q_k^2} \tag{21}$$

$$Q_h = \sqrt{q_1^2 + q_2^2 + \cdots + q_h^2} \tag{22}$$

$$U_{ik} = \sqrt{u_{i1}^2 + u_{i2}^2 + \cdots + u_{ik}^2}, \forall i \in \{1, 2, \dots, m\} \tag{23}$$

$$U_{ih} = \sqrt{u_{i1}^2 + u_{i2}^2 + \cdots + u_{ih}^2}, \forall i \in \{1, 2, \dots, m\} \tag{24}$$

Step 8: Alternatives are ranked according to the RAPS method. The optimal alternative is represented by the perimeter of a right-angled triangle. The base and perpendicular sides of this triangle, denoted as Q_k and Q_h, are expressed using Equation (25). The perimeter is calculated for each alternative using Equation (26). The ratio between the perimeter of each alternative and the optimal alternative is given by Equation (27). Alternatives are then organized and ranked in descending order of their PS_i values.

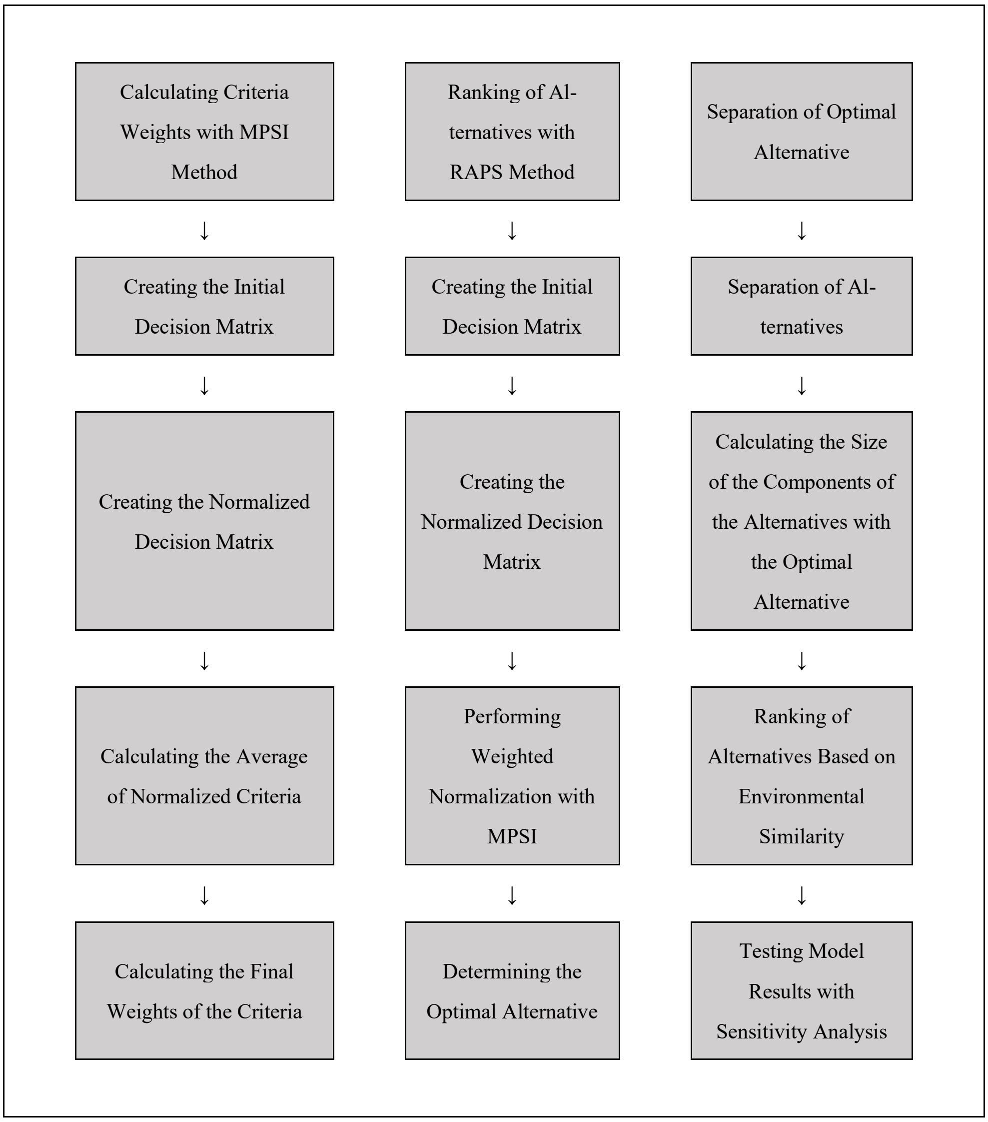
$$P = Q_k + Q_h + \sqrt{Q_k^2 + Q_h^2} \tag{25}$$

$$P_i = U_{ik} + U_{ih} + \sqrt{U_{ik}^2 + U_{ih}^2} \tag{26}$$

$$PS_i = \frac{P_i}{P}, \forall i \in \{1, 2, \dots, m\} \tag{27}$$

Figure 1 shows the detailed flow chart of the Integrated MPSI-RAPS MCDM model.

Figure 1. Schematic of the MPSI-RAPS Hybrid MCDM Model



Source: (Urošević et al., 2021; Gligorić et al., 2022; Şahin Macit, 2024).

4. Findings

The ratios chosen for this research are among the most used financial performance measurement criteria in the literature, based on the study by Arman et al. (2022). Liquidity ratios express the short-term debt payment ability of companies; financial structure ratios express the financial structure and long-term debt payment ability of companies; activity ratios express the effectiveness of the use of assets and resources of companies to continue their main activities; profitability ratios express the adequacy of the profitability of the company (Akgüç, 2013). The criteria used in the study are shown in Table 2.

Table 2. Financial Ratios Used in Performance Measurement of Companies

Main Criteria	Symbol	Sub-Criterion	Formula	Aim
Liquidity Ratios	L1	Current Ratio	Current Assets/Short Term Liabilities	Max
	L2	Acid-Test Ratio	Current Assets-Stocks/Short Term Liabilities	Max
	L3	Cash Ratio	(Liquid Assets+Securities)/Short Term Liabilities	Max
Financial Structure Ratios	F1	Leverage Ratio	Total Debt/Total Assets	Min
	F2	Financing Rate	Shareholders' Equity/Total Debt	Max
	F3	Debt/Equity Ratio	Total Debt/Shareholders' Equity	Min
Operating Efficiency Ratios	A1	Receivables Turnover Rate	Net Sales/Short Term Trade Receivables	Max
	A2	Stock Turnover Rate	Cost of Trade Goods Sold/Stocks	Max
	A3	Active Turnover Rate	Net Sales/Total Assets	Max
Profitability Ratios	P1	Return on Equity	Net Profit/ Shareholders' Equity	Max
	P2	Net Profit Margin	Net Profit/Net Sales	Max
	P3	Net Operating Margin	EBITDA/Net Sales	Max

Source: (Akgüç, 2013).

There are 27 companies operating in the BIST Textile, Apparel and Leather Sector Index. Due to the lack of data for the specified period, Artemis Halı A.Ş. (ARTMS), Birlik Mensucat Ticaret ve Sanayi İşletmesi A.Ş. (BRMEN), Diriteks Diriliş Tekstil Sanayi ve Ticaret A.Ş. (DIRIT), Hateks Hatay Tekstil İşletmeleri A.Ş. (HATEK) and Royal Halı İplik Tekstil Mobilya Sanayi ve Ticaret A.Ş. (ROYAL) were excluded from the analysis and the study consisted of 22 companies. The companies used in the study are shown in Table 3.

Table 3. List of Companies Included in the Study

Rank	Company Name	Code
1	Akın Tekstil A.Ş.	ATEKS
2	Arsan Tekstil Ticaret ve Sanayi A.Ş.	ARSAN
3	Bilici Yatırım Sanayi ve Ticaret A.Ş.	BLCYT
4	Birko Birleşik Koyunlulular Mensucat Ticaret ve Sanayi A.Ş.	BRKO
5	Bossa Ticaret ve Sanayi İşletmeleri T.A.Ş.	BOSSA
6	Dagi Giyim Sanayi ve Ticaret A.Ş.	DAGI
7	Derimod Konfeksiyon Ayakkabı Deri Sanayi ve Ticaret A.Ş.	DERIM
8	Desa Deri Sanayi ve Ticaret A.Ş.	DESA
9	Ensari Deri Gıda Sanayi ve Ticaret A.Ş.	ENSRI
10	İşbir Sentetik Dokuma Sanayi A.Ş.	ISSEN
11	Karsu Tekstil Sanayii ve Ticaret A.Ş.	KRTEK
12	Kordsa Teknik Tekstil A.Ş.	KORDS
13	Lüks Kadife Ticaret ve Sanayii A.Ş.	LUKSK
14	Mega Polietilen Köpük Sanayi ve Ticaret A.Ş.	MEGAP
15	Menderes Tekstil Sanayi ve Ticaret A.Ş.	MNDRS
16	Rodrigo Tekstil Sanayi ve Ticaret A.Ş.	RODRG
17	Rubenis Tekstil Sanayi Ticaret A.Ş.	RUBNS
18	Söktaş Tekstil Sanayi ve Ticaret A.Ş.	SKTAS
19	Sönmez Pamuklu Sanayii A.Ş.	SNPAM
20	Sun Tekstil Sanayi ve Ticaret A.Ş.	SUNTK
21	Yataş Yatak ve Yorgan Sanayi Ticaret A.Ş.	YATAS
22	Yünsa Yünlü Sanayi ve Ticaret A.Ş.	YUNSA

Source: (Public Disclosure Platform, 2024).

To calculate the financial ratios used in the study, the annual financial statements for the years 2019-2023 were obtained from the Public Disclosure Platform. A decision matrix was created using the selected alternatives and criteria for the study, as shown in Table 4. Data for the year 2023 is shown as an example.

Table 4. Decision Matrix for the 2023 Year

Code	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
ATEKS	0.98	0.50	4.24	39.01	156.42	63.93	4.84	4.85	0.41	-0.70	-1.00	-11.26
ARSAN	7.47	7.36	703.27	18.98	632.11	15.82	4.81	5.05	0.07	12.78	140.37	-51.85
BLCYT	9.00	7.19	459.53	28.68	1118.57	8.94	1.73	2.73	0.16	18.40	79.93	20.25
BRKO	1.46	0.96	32.52	8.25	61.65	162.21	19.58	2.03	0.78	-34.25	-12.04	-19.53
BOSSA	1.55	0.92	11.26	34.30	191.53	52.21	3.86	4.35	0.62	24.54	23.21	6.24
DAGI	1.29	0.53	11.22	49.53	101.91	98.13	5.40	1.40	0.64	9.71	7.55	-5.19
DERIM	1.36	1.22	24.04	74.36	34.48	289.99	4.82	17.21	2.70	5.03	0.47	6.27
DESA	2.04	1.65	118.64	37.30	168.12	59.48	10.96	5.26	0.92	33.38	20.25	21.18
ENSRI	1.55	0.26	2.55	34.68	188.36	53.09	3.45	0.79	0.31	29.46	58.39	18.50
ISSEN	1.81	1.11	45.34	28.76	247.65	40.38	3.59	3.54	0.58	7.72	8.63	18.16
KRTEK	1.51	0.76	16.54	40.52	146.78	68.13	5.97	3.59	0.75	12.06	8.55	10.45
KORDS	1.24	0.63	15.21	63.28	67.90	147.27	5.20	3.13	0.80	1.76	0.78	4.25
LUKSK	1.34	0.99	32.72	28.64	249.19	40.13	3.32	3.89	0.30	16.76	35.38	16.39
MEGAP	1.19	0.84	0.62	66.58	50.19	199.26	2.89	5.29	1.15	21.89	6.04	16.96
MNDRS	1.63	0.63	18.74	35.24	187.13	53.44	6.82	3.04	0.48	14.27	17.49	3.03
RODRG	1.53	0.16	14.97	53.49	86.93	115.03	32.26	0.70	0.44	13.32	12.33	7.77
RUBNS	2.44	1.25	0.57	20.58	385.80	25.92	21.34	4.98	0.81	2.57	2.30	19.58
SKTAS	0.74	0.32	8.10	56.25	85.39	117.11	7.52	3.61	0.42	-0.71	-0.68	-14.15
SNPAM	2.48	1.71	38.66	10.21	879.51	11.37	7.12	6.91	0.40	-0.13	-0.28	-1.06
SUNTK	1.63	1.07	40.94	42.93	136.78	73.11	9.19	7.16	1.37	7.26	3.06	11.22
YATAS	1.16	0.58	11.08	57.19	74.84	133.61	10.46	5.14	1.25	14.57	5.18	6.17
YUNSA	1.92	1.23	66.45	28.26	253.81	39.40	5.98	3.35	0.74	28.50	24.87	19.40

The data for the year 2023 has been analyzed in detail as an example of applying the MPSI-RAPS method, and the results obtained for other years have been presented.

4.1. Application of Z-Score Standardization Method

To apply the MPSI-RAPS method, the decision matrix with negative values was first transformed into positive values using the Z-score standardization method. The decision matrix with negative values shown in Table 4 was standardized using Equation (1). The standardized decision matrix is presented in Table 5.

Table 5. Standardized Decision Matrix (2023)

Code	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
ATEKS	-0.591	-0.503	-0.434	0.003	-0.345	-0.312	-0.476	0.122	-0.596	-0.831	-0.632	-0.947
ARSAN	2.687	3.136	3.778	-1.156	1.404	-1.027	-0.481	0.183	-1.226	0.141	3.615	-3.359
BLCYT	3.459	3.046	2.310	-0.594	3.193	-1.129	-0.913	-0.531	-1.060	0.546	1.799	0.926
BRKO	-0.349	-0.259	-0.263	-1.776	-0.694	1.149	1.593	-0.747	0.089	-3.249	-0.964	-1.438
BOSSA	-0.304	-0.280	-0.392	-0.269	-0.216	-0.486	-0.614	-0.032	-0.207	0.988	0.095	0.093
DAGI	-0.435	-0.487	-0.392	0.612	-0.545	0.197	-0.398	-0.941	-0.170	-0.081	-0.375	-0.586
DERIM	-0.399	-0.121	-0.315	2.048	-0.793	3.049	-0.479	3.928	3.647	-0.418	-0.588	0.095
DESA	-0.056	0.107	0.256	-0.096	-0.302	-0.378	0.383	0.248	0.349	1.626	0.006	0.981
ENSRI	-0.304	-0.631	-0.444	-0.247	-0.228	-0.473	-0.672	-1.129	-0.782	1.343	1.152	0.822
ISSEN	-0.172	-0.180	-0.186	-0.590	-0.009	-0.662	-0.652	-0.282	-0.281	-0.224	-0.343	0.802
KRTEK	-0.324	-0.365	-0.360	0.091	-0.380	-0.249	-0.318	-0.266	0.034	0.089	-0.345	0.343
KORDS	-0.460	-0.434	-0.368	1.407	-0.671	0.927	-0.426	-0.408	0.126	-0.654	-0.578	-0.025
LUKSK	-0.410	-0.243	-0.262	-0.597	-0.004	-0.666	-0.690	-0.174	-0.800	0.428	0.461	0.696
MEGAP	-0.485	-0.323	-0.456	1.598	-0.736	1.700	-0.750	0.257	0.775	0.797	-0.420	0.730
MNDRS	-0.263	-0.434	-0.346	-0.215	-0.232	-0.468	-0.198	-0.436	-0.467	0.248	-0.076	-0.098
RODRG	-0.314	-0.684	-0.369	0.841	-0.601	0.448	3.374	-1.156	-0.541	0.180	-0.231	0.184
RUBNS	0.146	-0.105	-0.456	-1.063	0.499	-0.877	1.841	0.162	0.145	-0.595	-0.533	0.886
SKTAS	-0.713	-0.599	-0.411	1.000	-0.606	0.479	-0.100	-0.260	-0.578	-0.832	-0.622	-1.118
SNPAM	0.166	0.139	-0.226	-1.663	2.314	-1.093	-0.156	0.756	-0.615	-0.790	-0.610	-0.341
SUNTK	-0.263	-0.201	-0.213	0.230	-0.417	-0.175	0.134	0.833	1.183	-0.257	-0.510	0.389
YATAS	-0.500	-0.461	-0.393	1.055	-0.645	0.724	0.313	0.211	0.960	0.270	-0.446	0.089
YUNSA	-0.117	-0.116	-0.059	-0.619	0.013	-0.676	-0.316	-0.340	0.015	1.274	0.145	0.875

Note: The value of A in Equation 2 has been taken as 3.399.

The standardized decision matrix in Table 5 has been converted to positive values using Equation (2) and is presented in Table 6.

Table 6. Positive Decision Matrix (2023)

	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
Code	max	max	max	min	max	min	max	max	max	max	max	max
ATEKS	2.808	2.896	2.965	3.402	3.054	3.087	2.923	3.521	2.803	2.568	2.767	2.452
ARSAN	6.086	6.535	7.177	2.243	4.803	2.372	2.918	3.582	2.173	3.540	7.014	0.040
BLCYT	6.858	6.445	5.709	2.805	6.592	2.270	2.486	2.868	2.339	3.945	5.198	4.325
BRKO	3.050	3.140	3.136	1.623	2.705	4.548	4.992	2.652	3.488	0.150	2.435	1.961
BOSSA	3.095	3.119	3.007	3.130	3.183	2.913	2.785	3.367	3.192	4.387	3.494	3.492
DAGI	2.964	2.912	3.007	4.011	2.854	3.596	3.001	2.458	3.229	3.318	3.024	2.813
DERIM	3.000	3.278	3.084	5.447	2.606	6.448	2.920	7.327	7.046	2.981	2.811	3.494
DESA	3.343	3.506	3.655	3.303	3.097	3.021	3.782	3.647	3.748	5.025	3.405	4.380
ENSRI	3.095	2.768	2.955	3.152	3.171	2.926	2.727	2.270	2.617	4.742	4.551	4.221
ISSEN	3.227	3.219	3.213	2.809	3.390	2.737	2.747	3.117	3.118	3.175	3.056	4.201
KRTEK	3.075	3.034	3.039	3.490	3.019	3.150	3.081	3.133	3.433	3.488	3.054	3.742
KORDS	2.939	2.965	3.031	4.806	2.728	4.326	2.973	2.991	3.525	2.745	2.821	3.374
LUKSK	2.989	3.156	3.137	2.802	3.395	2.733	2.709	3.225	2.599	3.827	3.860	4.095
MEGAP	2.914	3.076	2.943	4.997	2.663	5.099	2.649	3.656	4.174	4.196	2.979	4.129
MNDRS	3.136	2.965	3.053	3.184	3.167	2.931	3.201	2.963	2.932	3.647	3.323	3.301
RODRG	3.085	2.715	3.030	4.240	2.798	3.847	6.773	2.243	2.858	3.579	3.168	3.583
RUBNS	3.545	3.294	2.943	2.336	3.898	2.522	5.240	3.561	3.544	2.804	2.866	4.285
SKTAS	2.686	2.800	2.988	4.399	2.793	3.878	3.299	3.139	2.821	2.567	2.777	2.281
SNPAM	3.565	3.538	3.173	1.736	5.713	2.306	3.243	4.155	2.784	2.609	2.789	3.058
SUNTK	3.136	3.198	3.186	3.629	2.982	3.224	3.533	4.232	4.582	3.142	2.889	3.788
YATAS	2.899	2.938	3.006	4.454	2.754	4.123	3.712	3.610	4.359	3.669	2.953	3.488
YUNSA	3.282	3.283	3.340	2.780	3.412	2.723	3.083	3.059	3.414	4.673	3.544	4.274

4.2. MPSI Method Findings

To calculate the weight values of the criteria included in the study using the MPSI method, the initial decision matrix was created as expressed in Equation (3) and presented in Table 6. Using Equations (4) and (5), normalization was performed for the benefit and cost-oriented criteria in Table 6, resulting in the normalized decision matrix as shown in Equation (6). This matrix was then presented in Table 7.

Table 7. Normalized Decision Matrix (2023)

	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
Code	max	max	max	min	max	min	max	max	max	max	max	max
ATEKS	0.409	0.443	0.413	0.477	0.463	0.735	0.432	0.481	0.398	0.511	0.395	0.560
ARSAN	0.887	1.000	1.000	0.723	0.729	0.957	0.431	0.489	0.308	0.704	1.000	0.009
BLCYT	1.000	0.986	0.795	0.579	1.000	1.000	0.367	0.391	0.332	0.785	0.741	0.987
BRKO	0.445	0.480	0.437	1.000	0.410	0.499	0.737	0.362	0.495	0.030	0.347	0.448
BOSSA	0.451	0.477	0.419	0.518	0.483	0.779	0.411	0.459	0.453	0.873	0.498	0.797
DAGI	0.432	0.446	0.419	0.405	0.433	0.631	0.443	0.336	0.458	0.660	0.431	0.642
DERIM	0.437	0.502	0.430	0.298	0.395	0.352	0.431	1.000	1.000	0.593	0.401	0.798
DESA	0.487	0.536	0.509	0.491	0.470	0.751	0.558	0.498	0.532	1.000	0.486	1.000
ENSRI	0.451	0.424	0.412	0.515	0.481	0.776	0.403	0.310	0.371	0.944	0.649	0.964
ISSEN	0.470	0.493	0.448	0.578	0.514	0.829	0.406	0.425	0.442	0.632	0.436	0.959
KRTEK	0.448	0.464	0.423	0.465	0.458	0.721	0.455	0.428	0.487	0.694	0.435	0.854
KORDS	0.429	0.454	0.422	0.338	0.414	0.525	0.439	0.408	0.500	0.546	0.402	0.770
LUKSK	0.436	0.483	0.437	0.579	0.515	0.830	0.400	0.440	0.369	0.762	0.550	0.935
MEGAP	0.425	0.471	0.410	0.325	0.404	0.445	0.391	0.499	0.592	0.835	0.425	0.943
MNDRS	0.457	0.454	0.425	0.510	0.480	0.774	0.473	0.404	0.416	0.726	0.474	0.754
RODRG	0.450	0.416	0.422	0.383	0.424	0.590	1.000	0.306	0.406	0.712	0.452	0.818
RUBNS	0.517	0.504	0.410	0.695	0.591	0.900	0.774	0.486	0.503	0.558	0.409	0.978
SKTAS	0.392	0.429	0.416	0.369	0.424	0.585	0.487	0.428	0.400	0.511	0.396	0.521
SNPAM	0.520	0.541	0.442	0.935	0.867	0.984	0.479	0.567	0.395	0.519	0.398	0.698
SUNTK	0.457	0.489	0.444	0.447	0.452	0.704	0.522	0.578	0.650	0.625	0.412	0.865
YATAS	0.423	0.450	0.419	0.364	0.418	0.551	0.548	0.493	0.619	0.730	0.421	0.796
YUNSA	0.479	0.502	0.465	0.584	0.518	0.834	0.455	0.417	0.485	0.930	0.505	0.976

Using Table 7 and Equations (7), (8), and (9), the weight coefficients for each criterion were calculated, and the computed criterion weights are shown in Table 8.

Table 8. Criterion Weights According to the MPSI Method (2019-2023)

	Period	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
W_j	2023	0.066	0.073	0.060	0.099	0.072	0.093	0.068	0.058	0.063	0.123	0.063	0.162
	2022	0.050	0.051	0.050	0.106	0.059	0.155	0.054	0.054	0.078	0.123	0.092	0.128
	2021	0.053	0.053	0.055	0.108	0.085	0.081	0.067	0.076	0.091	0.097	0.120	0.113
	2020	0.058	0.062	0.075	0.107	0.062	0.076	0.072	0.065	0.065	0.120	0.140	0.099
	2019	0.063	0.069	0.077	0.094	0.063	0.081	0.079	0.077	0.075	0.108	0.137	0.078

According to Table 8, the most important criterion in 2019 was the net profit margin (P2) with a weight of 0.137, while the least important criterion was the current ratio (L1) with a weight of 0.063. In 2020, the most important criterion was again the net profit margin (P2) with a weight of 0.140, and the least important criterion was the current ratio (L1) with a weight of 0.058. For 2021, the most important criterion was the net profit margin (P2) with a weight of 0.120, while the least important criterion was the acid-test ratio (L2) with a weight of 0.053. In 2022, the most important criterion was the debt/equity ratio (F3) with a weight of 0.155, and the least important criterion was the cash ratio (L3) with a weight of 0.050. In 2023, the most important criterion was the net operating profit margin (P3) with a weight of 0.162, and the least important criterion was the inventory turnover ratio (A2) with a weight of 0.058.

4.3. RAPS Method Findings

Since the first two steps of the MPSI and RAPS methods involve similar procedures, the calculations were performed using the initial decision matrix provided in Table 6. Normalization of the benefit and cost criteria in this matrix was carried out using Equations (10) and (11), like the MPSI method, resulting in the normalized decision matrix as shown in Table 7. Using this decision matrix and Equation (13), the weighted normalized decision matrix was obtained as described in Equation (14) and is presented in Table 9.

Table 9. Weighted Normalized Decision Matrix (2023)

	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
Code	max	max	max	min	max	min	max	max	max	max	max	max
ATEKS	0.027	0.032	0.025	0.047	0.033	0.068	0.029	0.028	0.025	0.063	0.025	0.091
ARSAN	0.059	0.073	0.060	0.072	0.052	0.089	0.029	0.028	0.019	0.087	0.063	0.001
BLCYT	0.066	0.072	0.048	0.057	0.072	0.093	0.025	0.023	0.021	0.097	0.047	0.160
BRKO	0.029	0.035	0.026	0.099	0.029	0.046	0.050	0.021	0.031	0.004	0.022	0.073
BOSSA	0.030	0.035	0.025	0.051	0.035	0.072	0.028	0.027	0.028	0.108	0.032	0.129
DAGI	0.029	0.032	0.025	0.040	0.031	0.058	0.030	0.019	0.029	0.081	0.027	0.104
DERIM	0.029	0.037	0.026	0.029	0.028	0.033	0.029	0.058	0.063	0.073	0.025	0.129
DESA	0.032	0.039	0.031	0.049	0.034	0.070	0.038	0.029	0.033	0.123	0.031	0.162
ENSRI	0.030	0.031	0.025	0.051	0.034	0.072	0.027	0.018	0.023	0.116	0.041	0.156
ISSEN	0.031	0.036	0.027	0.057	0.037	0.077	0.028	0.025	0.028	0.078	0.028	0.156
KRTEK	0.030	0.034	0.026	0.046	0.033	0.067	0.031	0.025	0.031	0.086	0.028	0.139
KORDS	0.028	0.033	0.026	0.033	0.030	0.049	0.030	0.024	0.031	0.067	0.025	0.125
LUKSK	0.029	0.035	0.026	0.057	0.037	0.077	0.027	0.026	0.023	0.094	0.035	0.152
MEGAP	0.028	0.034	0.025	0.032	0.029	0.041	0.027	0.029	0.037	0.103	0.027	0.153
MNDRS	0.030	0.033	0.026	0.050	0.034	0.072	0.032	0.023	0.026	0.090	0.030	0.122
RODRG	0.030	0.030	0.026	0.038	0.030	0.055	0.068	0.018	0.025	0.088	0.029	0.133
RUBNS	0.034	0.037	0.025	0.069	0.042	0.083	0.053	0.028	0.032	0.069	0.026	0.159
SKTAS	0.026	0.031	0.025	0.036	0.030	0.054	0.033	0.025	0.025	0.063	0.025	0.084
SNPAM	0.034	0.039	0.027	0.092	0.062	0.091	0.032	0.033	0.025	0.064	0.025	0.113
SUNTK	0.030	0.036	0.027	0.044	0.032	0.065	0.035	0.033	0.041	0.077	0.026	0.140
YATAS	0.028	0.033	0.025	0.036	0.030	0.051	0.037	0.029	0.039	0.090	0.027	0.129
YUNSA	0.032	0.037	0.028	0.058	0.037	0.077	0.031	0.024	0.030	0.115	0.032	0.158

Using Equations (15) and (16) along with Table 9, each element of the optimal alternative was determined, and the optimal alternative formed by combining these elements is presented in Table 10.

Table 10. Optimal Alternative (2023)

Optimal Alternative/ Criteria	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
	max	max	max	min	max	min	max	max	max	max	max	max
	q_1	q_2	q_3	q_4	q_5	q_6	q_7	q_8	q_9	q_{10}	q_{11}	q_{12}
Q	0.066	0.073	0.060	0.099	0.072	0.093	0.068	0.058	0.063	0.123	0.063	0.162

By applying Equations (17) and (19) to the data in Table 10, the benefit and cost criteria of the optimal alternative were separated, and the resulting separated optimal alternative is presented in Table 11.

Table 11. Decomposition of Optimal Alternatives (2023)

Optimal Alternative/ Criteria	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
	max	max	max	min	max	min	max	max	max	max	max	max
	q_1	q_2	q_3	q_4	q_5	q_6	q_7	q_8	q_9	q_{10}	q_{11}	q_{12}
Qmax	0.066	0.073	0.060	-	0.072	-	0.068	0.058	0.063	0.123	0.063	0.162
Qmin	-	-	-	0.099	-	0.093	-	-	-	-	-	-

In a manner like the separation process of the optimal alternative, Equations (19) and (20) were used to separate each alternative in the weighted normalized decision matrix from Table 9 into U_i^{max} and U_i^{min} . The separated alternatives are presented in Table 12.

Table 12. Decomposition of Alternatives (2023)

	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
	max	max	max	min	max	min	max	max	max	max	max	max
ATEKS/U_i^{max}	0.027	0.032	0.025	-	0.033	-	0.029	0.028	0.025	0.063	0.025	0.091
ATEKS/U_i^{min}	-	-	-	0.047	-	0.068	-	-	-	-	-	-
ARSAN/U_i^{max}	0.059	0.073	0.060	-	0.052	-	0.029	0.028	0.019	0.087	0.063	0.001
ARSAN/U_i^{min}	-	-	-	0.072	-	0.089	-	-	-	-	-	-
BLCYT/U_i^{max}	0.066	0.072	0.048	-	0.072	-	0.025	0.023	0.021	0.097	0.047	0.160
BLCYT/U_i^{min}	-	-	-	0.057	-	0.093	-	-	-	-	-	-
BRKO/U_i^{max}	0.029	0.035	0.026	-	0.029	-	0.050	0.021	0.031	0.004	0.022	0.073
BRKO/U_i^{min}	-	-	-	0.099	-	0.046	-	-	-	-	-	-
BOSSA/U_i^{max}	0.030	0.035	0.025	-	0.035	-	0.028	0.027	0.028	0.108	0.032	0.129
BOSSA/U_i^{min}	-	-	-	0.051	-	0.072	-	-	-	-	-	-
DAGI/U_i^{max}	0.029	0.032	0.025	-	0.031	-	0.030	0.019	0.029	0.081	0.027	0.104
DAGI/U_i^{min}	-	-	-	0.040	-	0.058	-	-	-	-	-	-
DERIM/U_i^{max}	0.029	0.037	0.026	-	0.028	-	0.029	0.058	0.063	0.073	0.025	0.129
DERIM/U_i^{min}	-	-	-	0.029	-	0.033	-	-	-	-	-	-
DESA/U_i^{max}	0.032	0.039	0.031	-	0.034	-	0.038	0.029	0.033	0.123	0.031	0.162
DESA/U_i^{min}	-	-	-	0.049	-	0.070	-	-	-	-	-	-
ENSRI/U_i^{max}	0.030	0.031	0.025	-	0.034	-	0.027	0.018	0.023	0.116	0.041	0.156
ENSRI/U_i^{min}	-	-	-	0.051	-	0.072	-	-	-	-	-	-
ISSEN/U_i^{max}	0.031	0.036	0.027	-	0.037	-	0.028	0.025	0.028	0.078	0.028	0.156
ISSEN/U_i^{min}	-	-	-	0.057	-	0.077	-	-	-	-	-	-
KRTEK/U_i^{max}	0.030	0.034	0.026		0.033		0.031	0.025	0.031	0.086	0.028	0.139
KRTEK/U_i^{min}	-	-	-	0.046	-	0.067	-	-	-	-	-	-
KORDS/U_i^{max}	0.028	0.033	0.026	-	0.030	-	0.030	0.024	0.031	0.067	0.025	0.125
KORDS/U_i^{min}	-	-	-	0.033	-	0.049	-	-	-	-	-	-
LUKSK/U_i^{max}	0.029	0.035	0.026	-	0.037	-	0.027	0.026	0.023	0.094	0.035	0.152
LUKSK/U_i^{min}	-	-	-	0.057	-	0.077	-	-	-	-	-	-
MEGAPU_i^{max}	0.028	0.034	0.025	-	0.029	-	0.027	0.029	0.037	0.103	0.027	0.153
MEGAP/U_i^{min}	-	-	-	0.032	-	0.041	-	-	-	-	-	-
MNDRS/U_i^{max}	0.030	0.033	0.026	-	0.034	-	0.032	0.023	0.026	0.090	0.030	0.122
MNDRS/U_i^{min}	-	-	-	0.050		0.072	-	-	-	-	-	-
RODRGU_i^{max}	0.030	0.030	0.026	-	0.030	-	0.068	0.018	0.025	0.088	0.029	0.133
RODRG/U_i^{min}	-	-	-	0.038	-	0.055	-	-	-	-	-	-
RUBNS/U_i^{max}	0.034	0.037	0.025	-	0.042	-	0.053	0.028	0.032	0.069	0.026	0.159
RUBNS/U_i^{min}	-	-	-	0.069	-	0.083	-	-	-	-	-	-
SKTAS/U_i^{max}	0.026	0.031	0.025	-	0.030		0.033	0.025	0.025	0.063	0.025	0.084
SKTAS/U_i^{min}	-	-	-	0.036	-	0.054	-	-	-	-	-	-
SNPAM/U_i^{max}	0.034	0.039	0.027	-	0.062	-	0.032	0.033	0.025	0.064	0.025	0.113
SNPAM/U_i^{min}	-	-	-	0.092	-	0.091	-	-	-	-	-	-
SUNTK/U_i^{max}	0.030	0.036	0.027	-	0.032		0.035	0.033	0.041	0.077	0.026	0.140

Table 12. Decomposition of Alternatives (2023) (Continue)

	L1	L2	L3	F1	F2	F3	A1	A2	A3	P1	P2	P3
	max	max	max	min	max	min	max	max	max	max	max	max
SUNTK/U_i^{min}	-	-	-	0.044	-	0.065	-	-	-	-	-	-
YATAS/ U_i^{max}	0.028	0.033	0.025	-	0.030	-	0.037	0.029	0.039	0.090	0.027	0.129
YATAS/U_i^{min}	-	-	-	0.036	-	0.051	-	-	-	-	-	-
YUNSA/ U_i^{max}	0.032	0.037	0.028	-	0.037	-	0.031	0.024	0.030	0.115	0.032	0.158
YUNSA/U_i^{min}	-	-	-	0.058	-	0.077	-	-	-	-	-	-

Based on Table 11, Table 12, and the formulas from Equations (21) to (27), the values of Q_k. Q_h. U_{ik}. U_{ih}. P. P_i and PS_i for the optimal alternative and the alternatives have been calculated sequentially. The final ranking of the alternatives according to the PS_i values has been made and is shown in Table 13.

Table 13. Environmental Similarity of Each Alternative and Ranking According to RAPS Method (2023)

Code	max Q_k 0.276 U_{ik}	min Q_h 0.135 U_{ih}	P 0.718 P_i	PS_i	Rank
ATEKS	0.136	0.083	0.379	0.528	21
ARSAN	0.169	0.114	0.487	0.679	9
BLCYT	0.236	0.109	0.605	0.843	1
BRKO	0.115	0.109	0.384	0.534	20
BOSSA	0.189	0.088	0.485	0.676	10
DAGI	0.154	0.071	0.395	0.550	19
DERIM	0.186	0.044	0.421	0.586	17
DESA	0.225	0.085	0.550	0.766	2
ENSRI	0.212	0.088	0.530	0.738	5
ISSEN	0.194	0.096	0.505	0.704	8
KRTEK	0.183	0.081	0.465	0.647	12
KORDS	0.163	0.059	0.396	0.551	18
LUKSK	0.198	0.096	0.513	0.715	6
MEGAP	0.203	0.052	0.464	0.647	13
MNDRS	0.173	0.088	0.455	0.633	14
RODRG	0.187	0.066	0.453	0.630	15
RUBNS	0.200	0.108	0.536	0.746	4
SKTAS	0.131	0.065	0.344	0.478	22
SNPAM	0.166	0.130	0.507	0.706	7
SUNTK	0.185	0.079	0.465	0.648	11
YATAS	0.181	0.062	0.434	0.605	16
YUNSA	0.215	0.096	0.547	0.762	3

Table 14 shows the environmental similarity and rankings of the companies included in the study according to the MPSI-RAPS method for the 2019-2023 period.

Table 14. Environmental Similarity of Each Alternative and Ranking According to RAPS Method (2019-2023)

	2023		2022		2021		2020		2019	
	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank
ATEKS	0.528	21	0.516	20	0.603	7	0.772	4	0.749	7
ARSAN	0.679	9	0.632	4	0.754	2	0.846	1	0.772	5
BLCYT	0.843	1	0.646	3	0.722	3	0.830	3	0.872	1
BRKO	0.534	20	0.692	1	0.501	19	0.499	22	0.528	22
BOSSA	0.676	10	0.554	13	0.628	5	0.689	14	0.713	12
DAGI	0.550	19	0.530	18	0.492	20	0.718	11	0.723	10
DERIM	0.586	17	0.548	16	0.537	17	0.656	18	0.670	16
DESA	0.766	2	0.563	9	0.554	14	0.682	16	0.716	11
ENSRI	0.738	5	0.561	10	0.591	10	0.723	10	0.675	15
ISSEN	0.704	8	0.552	14	0.581	11	0.717	12	0.728	9
KRTEK	0.647	12	0.558	11	0.559	13	0.690	13	0.648	19
KORDS	0.551	18	0.523	19	0.532	18	0.679	17	0.709	13
LUKSK	0.715	6	0.557	12	0.600	9	0.753	6	0.783	4
MEGAP	0.647	13	0.531	17	0.566	12	0.736	9	0.730	8
MNDRS	0.633	14	0.567	8	0.462	22	0.654	20	0.620	20
RODRG	0.630	15	0.443	21	0.485	21	0.655	19	0.708	14
RUBNS	0.746	4	0.681	2	0.643	4	0.749	7	0.668	18
SKTAS	0.478	22	0.434	22	0.553	15	0.618	21	0.593	21
SNPAM	0.706	7	0.625	5	0.823	1	0.837	2	0.863	2
SUNTK	0.648	11	0.583	7	0.602	8	0.742	8	0.791	3
YATAS	0.605	16	0.549	15	0.609	6	0.756	5	0.752	6
YUNSA	0.762	3	0.597	6	0.538	16	0.684	15	0.670	17

Table 14 shows that among the companies operating in the sector, the top three rankings were held by BLYCT, SNPAM, and SUNTK in 2019; ARSAN, SNPAM, and BLYCT in 2020; SNPAM, ARSAN, and BLYCT in 2021; BRKO, RUBNS, and BLYCT in 2022; and BLYCT, DESA, and YUNSA in 2023. At the bottom of the rankings were BRKO, SKTAS, and MNDRS in 2019; BRKO, SKTAS, and MNDRS in 2020; MNDRS, RODRG, and DAGI in 2021; SKTAS, RODRG, and ATEKS in 2022; and SKTAS, ATEKS, and BRKO in 2023. The financial performance rankings of the other companies showed high variability over the five-year period.

In this study, to assess the practical applicability of the financial performance rankings obtained using the MPSI and RAPS methods, portfolios were created based on the work of Uygurtürk and Korkmaz (2012), and the portfolios were analysed based on their returns. Accordingly, two portfolios were created: Portfolio A and Portfolio B. Portfolio A (1-11) consists of the top 11 companies in the ranking each year, while Portfolio B (12-22) consists of the last 11 companies in the ranking. The portfolios are assumed to be equally weighted for portfolio performance measurements, stock price data of the companies were taken from the investing.com website and used (Investing, n.d.). The comparison of the returns of the two portfolios for the analysis period is shown in Table 15.

Table 15. Portfolios Created According to PS_i Values and Annual Average Returns

	2019		2020		2021		2022		2023	
	Company	Average Return (%)	Company	Average Return (%)	Company	Average Return (%)	Company	Average Return (%)	Company	Average Return (%)
Portfolio-1	BLCYT	240.36	ARSAN	105.37	SNPAM	-42.58	BRKO	478.13	BLCYT	-25.56
	SNPAM	75.67	SNPAM	389.78	ARSAN	37.98	RUBNS	None	DESA	44.36
	SUNTK	None	BLCYT	130.03	BLCYT	154.20	BLCYT	75.56	YUNSA	81.66
	LUKSK	76.70	ATEKS	128.49	RUBNS	None	ARSAN	226.73	RUBNS	-26.65
	ARSAN	122.27	YATAS	99.00	BOSSA	107.80	SNPAM	108.33	ENSRI	177.23
	YATAS	63.10	LUKSK	234.06	YATAS	-20.92	YUNSA	594.50	LUKSK	95.07
	ATEKS	52.29	RUBNS	None	ATEKS	35.77	SUNTK	None	SNPAM	622.22
	MEGAP	9.68	SUNTK	None	SUNTK	None	MNDRS	306.54	ISSEN	-64.25
	ISSEN	None	MEGAP	779.10	LUKSK	69.06	DESA	606.36	ARSAN	-21.58
	DAGI	101.72	ENSRI	None	ENSRI	None	ENSRI	None	BOSSA	14.03
	DESA	159.09	DAGI	224.07	ISSEN	None	KRTEK	271.97	SUNTK	15.84
Mean	100.10		261.24		48.76		333.51		82.94	
Portfolio-2	BOSSA	90.82	ISSEN	None	MEGAP	-25.33	LUKSK	77.59	KRTEK	-9.07
	KORDS	38.51	KRTEK	163.89	KRTEK	-5.99	BOSSA	132.61	MEGAP	-10.68
	RODRG	-4.63	BOSSA	121.46	DESA	-14.36	ISSEN	516.56	MNDRS	-4.10
	ENSRI	None	YUNSA	43.44	SKTAS	-26.48	YATAS	214.89	RODRG	49.33
	DERIM	154.09	DESA	113.65	YUNSA	-9.80	DERIM	152.84	YATAS	-29.08
	YUNSA	141.83	KORDS	22.06	DERIM	-27.26	MEGAP	249.55	DERIM	43.27
	RUBNS	None	DERIM	36.39	KORDS	102.00	DAGI	163.12	KORDS	-19.69
	KRTEK	163.41	RODRG	653.41	BRKO	-10.81	KORDS	206.79	DAGI	5.92
	MNDRS	81.94	MNDRS	134.09	DAGI	-22.99	ATEKS	152.85	BRKO	-33.94
	SKTAS	105.29	SKTAS	196.08	RODRG	35.65	RODRG	84.99	ATEKS	-19.55
	BRKO	6.90	BRKO	258.06	MNDRS	-30.97	SKTAS	167.92	SKTAS	-27.84
Mean	86.46		174.25		-3.3		192.70		-5.40	

According to Table 15, Portfolio-1, which was expected to yield higher returns, achieved higher returns than Portfolio-2 throughout the 5-year analysis period. Specifically, Portfolio-1 achieved returns of 100.10% in 2019, 261.24% in 2020, 48.76% in 2021, 333.51% in 2022, and 82.94% in 2023, surpassing the returns of Portfolio-2 in those years. When evaluating the results overall, it can be said that the portfolio consisting of companies with high performance rank values, as recommended by the MPSI-RAPS method, provided better returns compared to the portfolio consisting of companies with lower rank values. This is also supported by the 5-year average return values of the portfolios. Accordingly, during the analysis period, Portfolio-1 provided an average return of 165.31%, while Portfolio-2 yielded an average return of 88.94%.

In the study, the statistical differences between the performance rankings suggested by the MPSI-RAPS method were also examined. Spearman's rank correlation was used as the statistical test. Spearman's rank correlation is expressed in Equation (28) (Uygurtürk & Korkmaz, 2012).

$$r_s = 1 - \frac{6\sum D^2}{N(N^2-1)} \tag{28}$$

In Equation (28), N represents the number of units in the sample, D^2 denotes the sum of the squared differences between the ranks of two variables, and r_s is the Spearman rank correlation coefficient. The analysis was performed using IBM SPSS Statistics 23, and the findings are presented in Table 16.

Table 16. Spearman Rank Correlation Coefficients of Ranks Based on *PSi* Values

Year	2019	2020	2021	2022	2023
2019	1.000	0.814**	0.648**	0.065	0.319
2020	0.814**	1.000	0.852**	0.274	0.403
2021	0.648**	0.852**	1.000	0.387	0.476*
2022	0.065	0.274	0.387	1.000	0.621**
2023	0.319	0.403	0.476*	0.621**	1.000

Note: **Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

According to the results in Table 16, there is a positive relationship at the 1% significance level between the ranking values of 2019 and those of 2020 and 2021. Similarly, there is a positive relationship at the 1% significance level between the ranking values of 2020 and those of 2019 and 2021. A positive relationship is observed at the 1% significance level between the ranking values of 2021 and those of 2019 and 2020, and at the 5% significance level with the ranking values of 2023. There is also a positive relationship at the 1% significance level between the ranking values of 2022 and those of 2023, and between the ranking values of 2023 and those of 2022 at the 1% significance level and at the 5% significance level with the ranking values of 2021.

4.4. Sensitivity Analysis

In this section, a sensitivity analysis was conducted to assess the robustness of the model, and the effect of different criterion weights on the results was tested. Accordingly, the criterion weights were recalculated using Entropy, LOPCOW, and Equal Weighting (EW) techniques, and compared with the MPSI-RAPS model. In the study, the suitability of these weighting techniques for real-world problems and the simplicity of their calculation procedures were effective factors in their selection. Tables 17-21 present the comparative results for the 2019-2023 period, showing the MPSI-RAPS, Entropy-RAPS, LOPCOW-RAPS and EW-RAPS methods.

Table 17. Comparative Results (2019)

	MPSI-RAPS		Entropy-RAPS		LOPCOW-RAPS		EW-RAPS	
	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank
ATEKS	0.749	7	0.745	7	0.773	8	0.713	7
ARSAN	0.772	5	0.767	5	0.799	5	0.729	5
BLCYT	0.872	1	0.880	1	0.933	1	0.866	1
BRKO	0.528	22	0.506	22	0.440	22	0.562	21
BOSSA	0.713	12	0.706	14	0.765	10	0.658	14
DAGI	0.723	10	0.722	10	0.762	11	0.687	10
DERIM	0.670	16	0.679	15	0.685	18	0.651	15
DESA	0.716	11	0.711	11	0.746	14	0.675	11
ENSRI	0.675	15	0.679	16	0.736	15	0.631	16
ISSEN	0.728	9	0.727	8	0.777	7	0.688	9
KRTEK	0.648	19	0.653	19	0.679	19	0.607	19
KORDS	0.709	13	0.708	13	0.753	13	0.667	12
LUKSK	0.783	4	0.787	3	0.817	3	0.763	3
MEGAP	0.730	8	0.724	9	0.756	12	0.694	8
MNDRS	0.620	20	0.628	20	0.642	20	0.578	20
RODRG	0.708	14	0.709	12	0.765	9	0.666	13
RUBNS	0.668	18	0.669	18	0.692	17	0.628	18
SKTAS	0.593	21	0.604	21	0.616	21	0.549	22
SNPAM	0.863	2	0.856	2	0.888	2	0.813	2
SUNTK	0.791	3	0.778	4	0.800	4	0.759	4
YATAS	0.752	6	0.746	6	0.793	6	0.713	6
YUNSA	0.670	17	0.672	17	0.709	16	0.629	17

Table 18. Comparative Results (2020)

	MPSI-RAPS		Entropy-RAPS		LOPCOW-RAPS		EW-RAPS	
	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank
ATEKS	0.772	4	0.748	5	0.769	10	0.691	7
ARSAN	0.846	1	0.825	2	0.832	2	0.777	2
BLCYT	0.830	3	0.832	1	0.853	1	0.809	1
BRKO	0.499	22	0.493	22	0.393	22	0.553	22
BOSSA	0.689	14	0.682	14	0.748	12	0.610	16
DAGI	0.718	11	0.704	12	0.733	14	0.642	10
DERIM	0.656	18	0.657	18	0.682	20	0.609	17
DESA	0.682	16	0.678	16	0.722	15	0.621	13
ENSRI	0.723	10	0.712	10	0.788	5	0.631	12
ISSEN	0.717	12	0.709	11	0.776	8	0.636	11
KRTEK	0.690	13	0.684	13	0.738	13	0.617	15
KORDS	0.679	17	0.674	17	0.717	17	0.609	18
LUKSK	0.753	6	0.744	6	0.788	6	0.692	6
MEGAP	0.736	9	0.735	8	0.767	11	0.693	5
MNDRS	0.654	20	0.651	19	0.690	18	0.595	19
RODRG	0.655	19	0.650	20	0.685	19	0.588	20
RUBNS	0.749	7	0.735	9	0.782	7	0.671	9
SKTAS	0.618	21	0.615	21	0.655	21	0.559	21
SNPAM	0.837	2	0.812	3	0.820	3	0.777	3
SUNTK	0.742	8	0.737	7	0.775	9	0.689	8
YATAS	0.756	5	0.750	4	0.790	4	0.702	4
YUNSA	0.684	15	0.680	15	0.722	16	0.619	14

Table 19. Comparative Results (2021)

	MPSI-RAPS		Entropy-RAPS		LOPCOW-RAPS		EW-RAPS	
	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank
ATEKS	0.603	7	0.595	6	0.647	8	0.543	11
ARSAN	0.754	2	0.742	2	0.776	2	0.691	3
BLCYT	0.722	3	0.734	3	0.742	3	0.744	2
BRKO	0.501	19	0.514	19	0.496	20	0.537	12
BOSSA	0.628	5	0.612	5	0.693	4	0.573	6
DAGI	0.492	20	0.492	20	0.499	19	0.478	21
DERIM	0.537	17	0.529	16	0.525	18	0.526	13
DESA	0.554	14	0.548	13	0.590	14	0.525	14
ENSRI	0.591	10	0.575	10	0.666	5	0.524	15
ISSEN	0.581	11	0.570	11	0.615	11	0.545	10
KRTEK	0.559	13	0.547	14	0.606	12	0.516	16
KORDS	0.532	18	0.527	18	0.570	16	0.499	19
LUKSK	0.600	9	0.592	8	0.658	7	0.555	8
MEGAP	0.566	12	0.556	12	0.558	17	0.550	9
MNDRS	0.462	22	0.455	22	0.465	22	0.446	22
RODRG	0.485	21	0.491	21	0.479	21	0.486	20
RUBNS	0.643	4	0.634	4	0.666	6	0.609	4
SKTAS	0.553	15	0.530	15	0.595	13	0.502	18
SNPAM	0.823	1	0.802	1	0.827	1	0.761	1
SUNTK	0.602	8	0.584	9	0.623	9	0.567	7
YATAS	0.609	6	0.594	7	0.615	10	0.580	5
YUNSA	0.538	16	0.527	17	0.573	15	0.502	17

Table 20. Comparative Results (2022)

	MPSI-RAPS		Entropy-RAPS		LOPCOW-RAPS		EW-RAPS	
	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank
ATEKS	0.516	20	0.527	20	0.642	19	0.511	19
ARSAN	0.632	4	0.639	3	0.761	2	0.626	4
BLCYT	0.646	3	0.685	2	0.751	4	0.735	1
BRKO	0.692	1	0.637	4	0.593	20	0.624	5
BOSSA	0.554	13	0.567	15	0.707	12	0.540	15
DAGI	0.530	18	0.544	18	0.674	17	0.517	18
DERIM	0.548	16	0.577	12	0.666	18	0.587	6
DESA	0.563	9	0.583	9	0.711	10	0.560	9
ENSRI	0.561	10	0.585	8	0.721	7	0.533	16
ISSEN	0.552	14	0.569	14	0.690	13	0.543	12
KRTEK	0.558	11	0.577	11	0.713	9	0.542	13
KORDS	0.523	19	0.542	19	0.675	16	0.508	20
LUKSK	0.557	12	0.575	13	0.709	11	0.540	14
MEGAP	0.531	17	0.552	17	0.679	15	0.525	17
MNDRS	0.567	8	0.581	10	0.727	6	0.546	11
RODRG	0.443	21	0.474	21	0.548	21	0.448	21
RUBNS	0.681	2	0.702	1	0.866	1	0.667	2
SKTAS	0.434	22	0.457	22	0.529	22	0.445	22
SNPAM	0.625	5	0.631	5	0.729	5	0.634	3
SUNTK	0.583	7	0.597	7	0.721	8	0.583	7
YATAS	0.549	15	0.566	16	0.683	14	0.554	10
YUNSA	0.597	6	0.610	6	0.761	3	0.580	8

Table 21. Comparative Results (2023)

	MPSI-RAPS		Entropy-RAPS		LOPCOW-RAPS		EW-RAPS	
	PS_i	Rank	PS_i	Rank	PS_i	Rank	PS_i	Rank
ATEKS	0.528	21	0.510	21	0.575	19	0.496	19
ARSAN	0.679	9	0.706	4	0.675	14	0.760	2
BLCYT	0.843	1	0.810	1	0.860	1	0.792	1
BRKO	0.534	20	0.528	18	0.505	22	0.541	16
BOSSA	0.676	10	0.642	10	0.748	9	0.581	10
DAGI	0.550	19	0.528	19	0.595	17	0.492	20
DERIM	0.586	17	0.588	16	0.582	18	0.569	12
DESA	0.766	2	0.722	2	0.831	3	0.638	5
ENSRI	0.738	5	0.690	6	0.810	4	0.603	7
ISSEN	0.704	8	0.652	9	0.757	7	0.589	9
KRTEK	0.647	12	0.608	13	0.697	10	0.551	15
KORDS	0.551	18	0.521	20	0.572	20	0.478	21
LUKSK	0.715	6	0.667	8	0.778	6	0.599	8
MEGAP	0.647	13	0.608	12	0.677	13	0.527	18
MNDRS	0.633	14	0.601	15	0.694	11	0.555	14
RODRG	0.630	15	0.604	14	0.652	15	0.560	13
RUBNS	0.746	4	0.698	5	0.789	5	0.650	4
SKTAS	0.478	22	0.467	22	0.509	21	0.454	22
SNPAM	0.706	7	0.678	7	0.753	8	0.666	3
SUNTK	0.648	11	0.616	11	0.687	12	0.571	11
YATAS	0.605	16	0.579	17	0.638	16	0.528	17
YUNSA	0.762	3	0.714	3	0.834	2	0.634	6

According to the results in Tables 17-21, the rankings obtained from the MPSI-RAPS model differ in some cases from those obtained with other models. Different criterion weights applied to the same data set can alter the decision-making rankings. The impact of criterion weights on decision-making rankings has been emphasized in many studies (Zavadskas & Podvezko, 2016; Paradowski et al., 2021; Bączkiewicz & Wątróbski, 2022).

According to the results obtained from the MPSI-RAPS model, SUNTK, which ranked 3rd in 2019, was ranked 4th according to the Entropy, LOPCOW, and EW weighting methods. BRKO, which ranked 22nd, was found to be ranked 21st according to the EW method, while SKTAS, which ranked 21st, was ranked 22nd according to the EW method.

In 2020, ARSAN, which ranked 1st, was ranked 2nd according to the Entropy, LOPCOW, and EW weighting methods. SNPAM, which ranked 2nd, was ranked 3rd according to the Entropy, LOPCOW, and EW methods. BLCYT, which ranked 3rd, was ranked 1st according to the Entropy, LOPCOW, and EW methods. MNDRS, which ranked 20th, was ranked 19th according to the Entropy and EW methods, and 18th according to the LOPCOW method.

In 2021, ARSAN, which ranked 2nd, was ranked 3rd according to the EW method. BLCYT, which ranked 3rd, was ranked 2nd according to the EW method. RODRG, which ranked 21st, was ranked 20th according to the EW method. DAGI, which ranked 20th, was ranked 19th according to the LOPCOW method and 21st according to the EW method.

In 2022, BRKO, which ranked 1st, was ranked 4th according to the Entropy method, 20th according to the LOPCOW method, and 5th according to the EW method. RUBNS, which ranked 2nd, was ranked 1st according to both the Entropy and LOPCOW methods. BLCYT, which ranked 3rd, was ranked 2nd according to the Entropy method, 4th according to the LOPCOW method, and 1st according to the EW method. ATEKS, which ranked 20th, was ranked 19th according to both the LOPCOW and EW methods.

In 2023, DESA, which ranked 2nd, was ranked 3rd according to the LOPCOW method and 5th according to the EW method. YUNSA, which ranked 3rd, was ranked 2nd according to the LOPCOW method and 6th according to the EW method. SKTAS, which ranked 22nd, was ranked 21st according to the LOPCOW method. ATEKS, which ranked 21st, was ranked 19th according to both the LOPCOW and EW methods. BRKO, which ranked 20th, was ranked 18th according to the Entropy method, 22nd according to the LOPCOW method, and 16th according to the EW method. In this context, it can be said that the model used is minimally sensitive to criterion weights and is robust.

5. Conclusion and Evaluation

The analysis of the financial performance of publicly traded companies plays an important role in stock selection. In Türkiye, companies operating in the textile, apparel, and leather sector have a significant impact in terms of the value they create for the country, employment, production, and exports. Stakeholders demand the examination and accurate assessment of the financial performance of companies operating in this sector. Knowing the financial performance rankings of companies not only provides valuable information to stakeholders and investors but also has the potential to drive competition among companies.

In this study, the financial performance ranking of 22 companies listed in the BIST textile, apparel, and leather sector for the 2019-2023 period was conducted using the MPSI and RAPS methods. The study used 12 sub-criteria under 4 main criteria. In the first phase of the study, the weighting of the criteria was carried out using the MPSI method, while the evaluation and measurement of alternatives based on the criteria were performed using the RAPS method. According to the results of the MPSI method, the criteria with the highest relative importance values during the 2019-2023 period were the net profit margin for the first three years, and the debt-to-equity ratio and net operating profit margin in the following years. The criteria with the lowest relative importance values were the current ratio for the first two years, the acid-test ratio for the third year, the cash ratio for the fourth year, and the inventory turnover for the fifth year. According to the results obtained using the RAPS method, BLYCT, RUBNS, ARSAN, and SNPAM companies ranked at the top over the 5-year period, while SKTAS, BRKO, MNDRS, RODRG, DAGI, KORDS, and ATEKS companies ranked at the bottom.

The findings of this study are largely like those obtained in studies by Konak et al. (2020), Ekizler (2020), Işıldak (2020), Elden Ürgüp (2021), Arman et al. (2022), and Aksoylu et al. (2024). In this context, the results obtained from this research are consistent with the findings of previous studies in the literature. Additionally, within the scope of the study, two portfolios were created for each year based on the financial performance rankings obtained through the RAPS method, and the results were supported by evaluating the 5-year returns of these portfolios. Accordingly, Portfolio-1, which was expected to perform better and consisted of the top 11 companies, performed better than Portfolio-2. Based on these results, decision-makers may consider using these methods to minimize portfolio risks, and when these methods are employed, investors may prefer to direct their capital toward the companies in Portfolio-1. In other words, investors may decide to avoid the stocks of companies in Portfolio-2 due to their lower returns.

Considering the results obtained from the sensitivity analysis conducted to assess the robustness of the model, it has been observed that the rankings obtained with different criterion weights are generally homogeneous. The rankings obtained using the MPSI technique remained the same or showed very little variation when compared to those obtained with other techniques (Entropy, LOPCOW, and EW). This indicates that the model is suitable for performance evaluation and portfolio modelling in the textile, apparel, and leather sectors, is minimally sensitive to different criterion weights, and is robust.

The originality of this study is demonstrated in two ways, both in terms of topic and methodology. Within this framework, the financial performance measurement of companies has been applied for the first time using the hybrid MPSI and RAPS multi-criteria decision-making methods. The results obtained from this study demonstrate the ease and success of applying the MPSI and RAPS methods in measuring the financial performance of businesses, and it is expected to contribute to sector stakeholders.

This study has certain key limitations. The evaluation was conducted over a 5-year period (2019-2023). The research utilized 4 main and 12 sub-financial criteria. However, the financial performance rankings should not be perceived as a direct measure of success or failure for the companies. While Portfolio-1 exhibited higher performance compared to Portfolio-2, this result cannot be generalized to years outside the research period. In this context, it is crucial to continuously update such sectoral financial performance studies and evaluate them using different multi-criteria decision-making methods to contribute significantly to the literature.

References

Abdel-Basset, M., Ding, W., Mohamed, R., & Metawa, N. (2020). An integrated plithogenic MCDM approach for financial performance evaluation of manufacturing industries. Risk Management, 22(3), pp.192-218. https://doi.org/10.1057/s41283-020-00061-4

Akgüç, Ö. (2013). Finansal yönetim (9. Baskı). Avcıol Yayınları.

Aksoylu, S., Altınışık, F., & Taşdemir, B. (2024). BİST Tekstil Endeksi'nde yer alan işletmelerin finansal risklerinin ve performanslarının Altman Z-Skor ve VIKOR yöntemleriyle analizi. Muhasebe ve Finansman Dergisi, 103, ss.93-112. https://doi.org/10.25095/mufad.1439649

Alamoudi, M. H., & Bafail, O. A. (2022). BWM-RAPS approach for evaluating and ranking banking sector companies based on their financial indicators in the Saudi stock market. Journal of Risk and Financial Management, 15(10), pp.467. https://doi.org/10.3390/jrfm15100467

Arman, K., Cıbır, M., & Kundakcı, N. (2022). İşletmelerin finansal performansının bulanık PIPRECIA ve MARCOS yöntemleri ile analizi: BİST tekstil, deri endeksinde bir uygulama. Muhasebe Bilim Dünyası Dergisi, 24(4), ss.800-826. https://doi.org/10.31460/mbdd.985476

Arslan, R., Bircan, H., & Arslan, Ö. (2017). Tekstil firmalarında finansal performansın Analitik Hiyerarşi Prosesi ile ağırlıklandırılmış Gri İlişkisel Analiz yöntemiyle değerlendirilmesi. Kahramanmaraş Sütçü İmam Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 7(2), ss.19-36.

Bączkiewicz, A., & Wątróbski, J. (2022). Crispyn-a python library for determining criteria significance with objective weighting methods. SoftwareX, 19, pp.101166. https://doi.org/10.1016/j.softx.2022.101166

Bafail, O. A., Abdulaal, R. M., & Kabli, M. R. (2022). AHP-RAPS approach for evaluating the productivity of engineering departments at a public university. Systems, 10(4), pp.107. https://doi.org/10.3390/systems10040107

Çelebi Demirarslan, P., Sönmez Çakır, F., & Akansel, I. (2024). Ranking the quality of life indexes by years in Asian countries using multi-criteria decision-making methods. Asia-Pacific Journal of Regional Science, 8, pp.911-942. https://doi.org/10.1007/s41685-024-00350-w

Central Bank of the Republic of Türkiye, (2024). Manufacturing Industry Capacity Utilisation Rate. https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket

Deng, H., Yeh, C.-H., & Willis, R. J. (2000). Inter-company comparison using modified TOPSIS with objective weights. Computers & Operations Research, 27(10), pp.963-973. https://doi.org/10.1016/S0305-0548(99)00069-6

Ekizler, H. (2020). Dokuma, giyim eşyası ve deri sanayi sektöründeki işletmelerin performanslarının değerlendirilmesi: VIKOR ve TOPSIS yöntemleri. Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 13(1), ss.24-39. https://doi.org/10.25287/ohuiibf.556233

Elden Ürgüp, S. (2021). Firma performansı ile pay senedi getirisi arasındaki ilişkinin SWARA-MARCOS modeliyle analizi: BİST tekstil, giyim eşyası ve deri sektörünün örneği. Ekonomi ve Finansal Araştırmalar Dergisi, 3(2), ss.91-109.

Ersoy, N. (2022). Türk inşaat firmalarının finansal performansının SECA yöntemi ile değerlendirilmesi. İzmir İktisat Dergisi, 37(4), ss.1003-1021. https://doi.org/10.24988 /ije.1065282

Ezin, Y. (2022). Tekstil sektörünün oran analizi ve TOPSİS yöntemi ile değerlendirilmesi. Kafkas Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 13(25), ss.213-243. https://doi.org/10.36543/kauiibfd.2022.010

Gligorić. M., Gligorić. Z., Lutovac. S., Negovanovic, M., & Langovic, Z. (2022). Novel hybrid MPSI-MARA decision-making model for support system selection in an underground mine. Systems, 10(6), pp.248. https://doi.org/10.3390/systems10060248

Güçlü, P. (2024). Comparative analysis of the MCDM methods with multiple normalization techniques: Three hybrid models combine MPSI with DNMARCOS, AROMAN, and MACONT method. Business and Economics Research Journal, 15(2), pp.129-154. https://doi.org/10.20409/berj.2024.436

Investing. (n.d.). Share prices. Retrieved June 7, 2024, from https://tr.investing.com

Işıldak, M. S. (2020). AHP ve VIKOR yöntemleri kullanılarak BİST'te işlem gören dokuma, giyim eşyası ve deri işletmelerinin finansal performans analizi. Anemon Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi, 8(5), ss.1435-1446. https://doi.org/10.18506/anemon.668761

Istanbul Apparel Exporters' Association, (2023). January-December Clothing and Apparel Sector Export Performance Evaluation. https://www.ihkib.org.tr/content/files/ uploads/49/hazir-giyim-ve-konfeksiyon-sektoru-ocak-aralik-2022.pdf

Kara, K., Yalçın, G. C., Simic, V., Baysal, Z., & Pamucar, D. (2024). The alternative ranking using two-step logarithmic normalization method for benchmarking the supply chain performance of countries. Socio-Economic Planning Sciences, 92, pp.101822. https:// doi.org/10.1016/j.seps.2024.101822

Konak, T., Elbir, G., Yılmaz, S., Karataş, B., Durman, Y., & Düzakın, H. (2018). Borsa İstanbul'da işlem gören tekstil firmalarının TOPSIS ve MOORA yöntemi ile analizi. Çukurova Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 22(1), ss.11-44.

Papathanasiou, J., & Ploskas, N. (2018). Multiple criteria decision aid methods, examples and python implementations. Springer International Publishing.

Paradowski, B., Shekhovtsov, A., Bączkiewicz, A., Kizielewicz, B., & Sałabun, W. (2021). Similarity analysis of methods for objective determination of weights in multi-criteria decision support systems. Symmetry, 13(10), pp.1874. https://doi.org/10.3390/sym13101874

Public Disclosure Platform, (2024). Sectors. https://www.kap.org.tr/tr/Sektorler

Republic of Türkiye Ministry of Industry and Technology, (2023). Textile, Clothing and Leather Products Sector Report. https://www.sanayi.gov.tr/plan-program-raporlar-ve-yayinlar/sektor-raporlari

Republic of Türkiye Social Security Institution, (2023). Monthly Statistical Bulletins. https://www.sgk.gov.tr/Istatistik/Aylik/42919466-593f-4600-937d-1f95c9e252e6/

Şahin Macit, N. (2024). Avrupa ve Orta Asya ülkelerinde BİT gelişmişlik düzeyinin entegre MPSI-RAPS yöntemi ile ölçülmesi. Kafkas Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 15(29), ss.24-53. https://doi.org/10.36543/kauiibfd.2024.002

Saleh, N., Hassan, M. A., & Salaheldin, A. M. (2024). Skin cancer classification based on an optimized convolutional neural network and multicriteria decision-making. Scientific Reports, 14, pp.17323. https://doi.org/10.1038/s41598-024-67424-9

Temizel, F., & Bayçelebi, B. E. (2016). Finansal oranların TOPSIS sıralaması ile yıllık getiriler arasındaki ilişki: Tekstil imalatı sektörü üzerine bir uygulama. Anadolu Üniversitesi Sosyal Bilimler Dergisi, 16(2), ss.159-170. https://doi.org/10.18037/ausbd.389248

Torres, P. S., Gomes, C. F. S., & Dos Santos, M. (2024). Selection of unmanned aerial vehicle systems for border monitoring using the MPSI-SPOTIS method. Journal of Defense Analytics and Logistics, 8(1), pp.80-104. https://doi.org/10.1108/JDAL-12-2023-0016

Turkish Statistical Institute, (2024). Basic Indicators by Economic Activities. https://data.tuik.gov.tr/Kategori/GetKategori?p=sanayi-114&dil=1

Türkiye Exporters Assembly, (2023). Export Statistics 2023. https://tim.org.tr/tr/ihracat-rakamlari

Urošević, K., Gligorić, Z., Miljanović, I., Beljić, Č., & Gligorić, M. (2021). Novel methods in multiple criteria decision-making process (MCRAT and RAPS) Application in the mining industry. Mathematics, 9(16), pp.1980. https://doi.org/10.3390/math9161980

Uygurtürk, H., & Korkmaz, T. (2012). Finansal performansın TOPSIS çok kriterli karar verme yöntemi ile belirlenmesi: Ana metal sanayi işletmeleri üzerine bir uygulama. Eskişehir Osmangazi Üniversitesi İİBF Dergisi, 7(2), ss.95-115.

Yen, P. T. H., Tien-Chin, W., Hoa, N. T. H., & Anh, N. T. N. (2023). An evaluation of financial performance of Vietnam textile and apparel industry using the Entropy-TOPSIS method. Journal of International Economics and Management, 23(1), pp.14-27. https://doi.org/10.38203/jiem.023.1.0058

Yıldırım, B. F., & Çiftci, H. N. (2020). BİST'te işlem gören tekstil firmalarının finansal performanslarının dinamik sezgisel bulanık WASPAS yöntemi ile değerlendirilmesi. İzmir İktisat Dergisi, 35(4), ss.777-791. https://doi.org/10.24988/ije.202035408

Yılmaz, N. (2023). Financial performance analysis of multi-branch banks with integrated MPSI-MARA Model: The case of Türkiye. Ekonomi ve Finansal Araştırmalar Dergisi, 5(2), pp.168-188. https://doi.org/10.56668/jefr.1384058

Zavadskas, E. K., & Podvezko, V. (2016). Integrated determination of objective criteria weights in MCDM. International Journal of Information Technology & Decision Making, 15(02), pp.267-283. https://doi.org/10.1142/S0219622016500036

Zhang, X., Wang, D., Kong, D., Huang, B., Zhang, Z., & He, Y. (2022). The anti-fatigue lightweight design of heavy tractor frame based on a modified decision method. Structural and Multidisciplinary Optimization, 65(10), pp.280. https://doi.org/10.1007/s00158-022-03385-9

Zhang. X., Wang. C., Li. E., & Xu, C. (2014). Assessment model of ecoenvironmental vulnerability based on improved entropy weight method. The Scientific World Journal, 2014(1), pp.797814. https://doi.org/10.1155/2014/797814