Hacettepe Journal of Health Administration, 2026; 29(1), 39-52
https://doi.org/10.61859/hacettepesid.1697093

RESEARCH ARTICLE

FINANCIAL ASSESSMENT OF TURKISH PHARMACEUTICAL AND BIOPHARMACEUTICAL FIRMS QUOTED ON THE STOCK EXCHANGE EMPLOYING MSD-BASED WEDBA METHODOLOGY

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ABSTRACT

This study aims to conduct a financial analysis of selected pharmaceutical and biopharmaceutical companies operating in Türkiye, employing the Weighted Euclidean Distance Based Approach (WEDBA). The financial data of the eight firms traded on the stock exchange, including the period from December 2023 to December 2024, are examined. The weights of the criteria are determined through the application of the Modified Standard Deviation (MSD) technique. Index scores and financial performance ranking of the pharmaceutical entities were performed utilizing the WEDBA multi-criteria decision-analysis methodology. The MSD findings reveal that the most important performance indicator is "Cash Ratio," which got the highest value of 0,1687 in 2024, whereas 0,1616 in 2023. The WEDBA outcomes reveal that ANGEN achieved the highest ranking both in 2024 and 2023, whilst TRILC received the lowest rating in 2024, and GENIL in 2023. This study is among the initial investigations on the financial performance of pharmaceutical organizations utilizing the MSD-based WEDBA technique. The findings of the study underscored the significance of adopting MCDA methods in assessing the financial performance of pharmaceutical companies.

Keywords: *Financial performance, pharmaceutical companies, MCDA, WEDBA*

ARTICLE INFO

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Recieved: 11.05.2025
Accepted: 28.01.2026

Cite This Paper:

Karadağ, M. M. (2026). Financial assessment of Turkish pharmaceutical and biopharmaceutical firms quoted on the stock exchange employing MSD-based WEDBA methodology. Hacettepe Journal of Health Administration, 29(1), 39-52. https://doi.org/10.61859/hacettepesid.1697093

ARAŞTIRMA MAKALESİ

BORSA'DA İŞLEM GÖREN TÜRK FARMASÖTİK VE BİYOFARMASÖTİK ŞİRKETLERİNİN MSD-TABANLI WEDBA YÖNTEMİ UYGULANARAK FİNANSAL AÇIDAN İNCELENMESİ

Mehmet Mete KARADAĞ [†]

ÖZ

Çalışmanın amacı, Türkiye'de faaliyet gösteren ilaç ve biyofarmasötik şirketlerinin finansal analizinini Ağırlıklı Öklidyen Mesafe Tabanlı Yaklaşım (WEDBA) yaklaşımı aracılığıyla yapmaktır. Borsada işlem gören sekiz farmasötik ve biyofarmasötik şirketinin Aralık 2023-Aralık 2024 dönemini kapsayan finansal verileri incelendiği çalışmada kriterlerin ağırlıkları Modifiye Edilmiş Standart Sapma (MSD) yöntemi ile belirlenmiştir. Şirketlerinin endeks puanları ve finansal performans sıralaması Ağırlıklı Öklidyen Mesafe Tabanlı Yaklaşım (WEDBA) çok-kriterli karar analizi (MCDA) metodolojisi kullanılarak gerçekleştirilmiştir. MSD bulguları, en önemli performans göstergesinin 2023 yılında 0,1616 iken, 2024 yılında 0,1687 ile en yüksek değeri alan "Nakit Oranı" olduğunu ortaya koymaktadır. WEDBA sonuçları, ANGEN'in hem 2024 hem de 2023'te en yüksek sıralamayı elde ettiğini, TRILC'in 2024'te ve GENIL'in 2023'te en düşük değerleri aldığını göstermektedir. MSD-tabanlı WEDBA tekniğini kullanarak ilaç kuruluşlarının finansal performansı üzerine yapılan ilk araştırmalardan biri olan bu çalışma, ilaç şirketlerinin finansal performans analizinde MCDA yöntemlerinin kullanılmasının, performans değerlendirme sürecine önemli ölçüde katkıda bulunacağının bir örneğini teşkil etmektedir.

Anahtar Kelimeler: *Finansal analiz, ilaç firmaları, MCDA, WEDBA*

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Gönderim Tarihi: 11.05.2025
Kabul Tarihi: 28.01.2026

Atıfta Bulunmak İçin:

Karadağ, M. M. (2026). Financial assessment of Turkish pharmaceutical and biopharmaceutical firms quoted on the stock exchange employing MSD-based WEDBA methodology. Hacettepe Sağlık İdaresi Dergisi, 29(1), 39-52. https://doi.org/10.61859/hacettepesid.1697093

I. INTRODUCTION

The pharmaceutical industry is described as a business sector dedicated to the design, development, and production of chemical products utilized in the diagnosis and treatment of diseases, disabilities, or other dysfunctions, as well as in enhancing functionality (National Institutes of Health, 2025), profoundly impacts the national healthcare system. The Biopharmaceutical industry is "the segment of business that uses biotechnology (biotech) to develop and manufacture medical therapies (biopharmaceuticals) and in vivo diagnostic processes." The primary distinction between pharmaceutical companies and biopharmaceutical companies lies in the fact that pharmaceutical companies produce their goods by chemical and synthetic methods, while biopharmaceutical companies utilize biotechnology for manufacturing. Nonetheless, the phrases are occasionally utilized interchangeably (NIH, 2025). In this context, the financial evaluation of pharmaceutical and biopharmaceutical firms will be conducted collectively under the umbrella of pharmaceutical companies, rather than as separate organizations.

The pharmaceutical sector, characterized by substantial expenses and prolonged research and development timelines, possesses distinct characteristics and is crucial for national economies due to its strategic significance. Türkiye's pharmaceutical industry is significant, possessing a production capacity that aligns with worldwide standards and generates high added value (Republic of Türkiye Ministry of Industry and Technology, 2023). Conversely, specific medications cannot be produced in Türkiye due to requirements for advanced technology or restricted domestic demand. According to TÜİK data, the production value of the "Manufacture of Basic Pharmaceutical Products and Pharmaceutical Materials" sector climbed to 181 billion TL in 2023 (IQVIA, 2024).

In 2023, the Manufacturing of Basic Pharmaceutical Products and Pharmaceutical Materials sector comprises 782 firms, as reported by TurkStat Annual Industry and Service Statistics. As of July 2024, Türkiye has 99 pharmaceutical production facilities, 10 radiopharmaceutical production facilities, 13 raw material production facilities, 3 herbal supplement production facilities, and 4 special medical purpose dietary food production facilities approved by the Turkish Medicines and Medical Devices Agency (IQVIA, 2024).

Decision-making is an essential part of our daily lives, and decision-making that involves many, often conflicting criteria is referred to as multi-criteria decision-making (MCDM). Multi-criteria decision analysis (MCDA) is a methodology employed to assess decision alternatives with various competing criteria and to identify the most effective solution. MCDM and MCDA are both used for describing a similar notion. These approaches are commonly employed in performance evaluation processes.

A corporation's performance assessment is associated with its efficiency in utilizing assets, shareholder equity, liabilities, income, and expenses (Alimohammadlou and Bonyani, 2017), and the key aspect of a company's performance is its financial performance (Jacková, 2020). Analyzing financial performance is crucial for corporations, as it assists in the enhancement of financial structures and evaluating vulnerabilities and strengths, thus providing a competitive advantage over other businesses. The application of MCDA approaches in assessing financial performance will benefit pharmaceutical firms and other stakeholders.

Each MCDA problem encompasses multiple attributes that signify the decision criterion. An attribute may be advantageous or disadvantageous to an alternative. Every attribute possesses a corresponding weight that denotes its significance (Erwig and Kumar, 2025). In this context, this study addresses the selection of the optimal pharmaceutical firm based on financial performance, considering the ranking of companies as an MCDM problem with various conflicting variables.

WEDBA methodology allows the decision maker to integrate both objective and subjective weights, either separately or in conjunction, to facilitate a more balanced and thorough decision-making process (Rao and Singh, 2011). The methodology can simultaneously consider any number of

quantitative and qualitative selection attributes and helps to obtain the preference index, which evaluates and ranks alternatives for a given selection problem (Rao et al., 2012).

Criteria weights may be determined by subjective, objective, or a hybrid of both weighting methodologies. As stated by Wu and Wang (2022), subjective weighting approaches are constrained by two factors: the existence of individual subjective assessments that heighten uncertainty, and the requirement for multiple comparisons, which complicates model implementation. Therefore, the Modified Standart Deviation (MSD) method, which is an objective approach, was favoured for determining criterion weights. It has also been preferred due to its simplicity in calculation.

This study intends to conduct a financial analysis of specific pharmaceutical and biopharmaceutical firms in Türkiye, utilizing the Modified Standart Deviation (MSD) and the Weighted Euclidean Distance Based Approach (WEDBA) methodologies to investigate the application of MCDA techniques in the financial assessment of pharmaceutical companies and provide a systematic framework and practical guidance for implementing MCDA methods across various pharmaceutical enterprises. This study is one of the first examinations of the financial performance of pharmaceutical companies employing the MSD-integrated WEDBA methodology.

In the study, first, the criteria weights are established using the MSD technique. Subsequently, the WEDBA methodology was employed for performance evaluation and ranking.

II. LITERATURE REVIEW

Lobo and Bhat (2024) assessed the financial performance of ten Indian pharmaceutical firms listed in the S&P BSE Healthcare Index across two separate intervals: before COVID-19 and during the pandemic. A hybrid multicriteria decision-making MCDM methodology, combining the Fuzzy Analytic Hierarchy Process (FAHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), is utilised to evaluate organisations according to five principal financial aspects and many performance metrics.

Baltes and Minculete (2016) assessed the financial performance of pharmaceutical companies in Romania from 2009 to 2014, employing multiple linear regression as the research methodology and utilizing the financial return ratio as an indicator. The research indicated that the financial returns of pharmaceutical firms were positively influenced by economic profitability, equity multiplier, and inflation; however, they were adversely impacted by the net profit margin.

Azam et al. (2023) analyzed the financial performance of selected Indian pharmaceutical companies. In the study, Altman's Z-Score model was employed, focusing on liquidity, profitability, leverage, payment capacity, and market value to evaluate the risk of bankruptcy.

Estiasih and Putra (2021) examined the influence of net profit margin, debt-to-equity ratio, return on assets, return on equity, and firm size on the financial performance of publicly traded pharmaceutical businesses in Indonesia. The study employed robust standard error and a fixed effect model (FEM) to examine the correlations among the variables. The findings demonstrate that net profit margin, debt-to-equity ratio, return on assets, return on equity, and firm size positively correlate with the financial performance of publicly traded pharmaceutical businesses in Indonesia.

Vijayakumar (2020) assessed the performance of Indian pharmaceutical businesses via Simple Additive Weighting (SAW) and Additive Ratio Assessment (ARAS) MCDM techniques. The financial ratios utilized in the study were identified for their power to convey insights regarding earning potential, resource utilization, financial soundness, payment capability, debt coverage, management efficacy, and investment valuation metrics of the company.

Research analyzing the financial performance of Turkish pharmaceutical businesses through MCDA methodologies is relatively few, and the TOPSIS method is mostly employed in recent studies. The following studies are particularly noteworthy.

Gülençer and Hazar (2020) studied four pharmaceutical businesses listed on BIST. The Altman Z-score method was utilized to evaluate the probability of financial insolvency among the organizations. The TOPSIS method was employed to assess financial performance.

Çalış et al. (2021) investigated the impact of the COVID-19 epidemic on the financial structure of the pharmaceutical sector in Turkey. The financial statements of EIS Eczacıbaşı İlaç, Sınai ve Finansal Yatırımlar Sanayi ve Ticaret A.Ş. have been examined using financial analysis tools for the 2019-2020 period and compared with those of other companies.

Akgün and Ahmadzada (2022) examined the financial performance of pharmaceutical companies listed on Borsa Istanbul during the COVID-19 pandemic using the TOPSIS method.

Şenol (2023) analyzed the impact of COVID-19 on the financial performance of firms within the health sector listed on BIST using the TOPSIS method.

Şenol et al. (2023) examined the impact of COVID-19 on the pharmaceutical business by analyzing the seven pharmaceutical companies listed on Borsa Istanbul A.Ş. for the periods of September 2019, September 2020, September 2021, and September 2022. The TOPSIS approach was utilized to analyze the effect of the chosen companies' financial performance over the COVID-19 era.

Gülençer et al. (2024) analyzed the financial performance and risks of firms in the pharmaceutical and healthcare industries listed on Borsa Istanbul. The TOPSIS approach was implemented to evaluate financial performance, whereas the Altman Z score was utilized to analyze financial risk.

III. METHODOLOGY

The study implemented the WEDBA methodology to ascertain the companies' performance and rank the financial performance outcomes. The MSD methodology was utilized to compute the criteria weights.

The study utilizes data sourced from the financial statements and reports available on the https://www.isyatirim.com.tr, and the Public Disclosure Platform's website (https://www.kap.org.tr). The analysis spans two years, from 2023 to 2024. The study sample comprises eight publicly listed pharmaceutical firms.

As Şenol (2023) indicated, there is no healthcare-focused index that exists on the BIST. The BIST's sectoral classification does not expressly include an index for pharmaceutical enterprises. Companies were determined by conducting an examination of the companies' trade names and the operating sectors in which they operate.

Pharmaceutical manufacturing is categorized within the broader chemical industry based on BIST's sector classification. The majority of pharmaceutical companies are listed in the BIST Chemicals, Petroleum, Rubber, and Plastic Products (XKMYA) Index. ANGEN, DEVA, RTLAB, and TRILC were determined from this index. These companies are also included in the BIST Industrials (XUSIN) Index. GENIL, LKMNH, and SELEC are listed in the BIST Services (XUHIZ) Index. ECILC is listed in the BIST Financials (XUMAL) and BIST Holding and Investment (XHOLD) Index. In general, all of the companies selected for the study were included in the BIST All Shares (XUTUM) index. The list of companies selected for the analysis is presented in Table 1.

Table 1. Selected Publicly Traded Pharmaceutical Companies

Code	Company Name
ANGEN	Anatolia Tanı ve Biyoteknoloji Ürünleri Araştırma Geliştirme Sanayi ve Ticaret A.Ş.
DEVA	Deva Holding A.Ş.
ECILC	EİS Eczacıbaşı İlaç, Sınai ve Finansal Yatırımlar Sanayi ve Ticaret Anonim Şirketi
GENIL	Gen İlaç ve Sağlık Ürünleri Sanayi ve Ticaret A.Ş.
LKMNH	Lokman Hekim Engürüsağ Sağlık, Turizm, Eğitim Hizmetleri ve İnşaat Taahhüt A.Ş.
RTALB	RTA Laboratuvarları Biyolojik Ürünler İlaç ve Makina Sanayi Ticaret A.Ş.
SELEC	Selçuk Ecza Deposu Ticaret ve Sanayi A.Ş.
TRILC	Türk İlaç ve Serum Sanayi A.Ş.

Source: Borsa Istanbul (2025). BIST Stock Indices https://borsaistanbul.com/en/indices/bist-stock-indices

Financial performance evaluations involve a comprehensive method, considering a wide range of factors such as capital adequacy, liquidity, indebtedness, market value, profitability, and operating efficiency. Thus, within the framework of the study, a criterion set comprising thirteen ratios categorized into capital adequacy, return and profitability, liquidity, indebtedness, market value, and operational performance was established as the criteria for evaluating financial performance. These ratios utilized in forming the decision matrix and computing the criteria weights were determined based on studies including Vijayakumar (2020), Akgün and Ahmadzada (2022), and Şenol (2023) from the relevant literature.

The criteria, codes, and impact directions used as the evaluation criteria are displayed in Table 2.

Table 2. Determined Performance Criterion

Primary Criteria	Subordinate Criteria	Code	Impact Direction
Capital Adequacy	Total Shareholders' Equity / Total Assets	C_1	max.
Returns and Profitability	Net Income / Total Assets	C_2	max.
	Net Income / Total Shareholders' Equity	C_3	max.
	Net Income / Revenue	C_4	max.
Liquidity	Current Ratio	C_5	max.
	Quick Ratio (Acid-Test Ratio)	C_6	max.
	Cash Ratio	C_7	max.
Indebtedness	Total Liabilities / Total Assets	C_8	min.
	Total Shareholders' Equity / Total Liabilities	C_9	max.
Market Value	Price-to-Book (P/B)	C_{10}	min.
	P/S (Price to Sales)	C_{11}	min.
Operating	Inventory Turnover	C_{12}	max.
	Assets Turnover	C_{13}	max.

The Total Shareholders' Equity to Total Assets ratio reflects the proportion of a firm's total assets financed by shareholders' equity. It indicates the company's financial stability and capital structure, with elevated values suggesting reduced financial leverage and enhanced solvency.

The Net Income to Total Assets (ROA) ratio assesses a company's overall profitability in relation to its total assets. It denotes the efficiency with which a company employs its assets to produce net income.

The Net Income to Total Shareholders' Equity (ROE) ratio evaluates a firm's profitability from the viewpoint of its shareholders. This indicates the efficiency with which a company utilizes invested equity capital to produce profits.

Liquidity ratios reflect a firm's capacity to fulfill its short-term obligations. A higher ratio is preferred.

The Total Liabilities to Total Assets ratio quantifies the extent to which a company's assets are financed by liabilities. This metric illustrates the company's financial leverage.

The Total Shareholders' Equity to Total Liabilities ratio assesses the relationship between shareholders' equity and total liabilities, reflecting the degree to which owners' funds support the company's obligations. This ratio is utilized for assessing financial stability and long-term solvency.

Price-to-Book ratio (Market Capitalization to Total Shareholders' Equity) assesses a stock's price in relation to its book value.

Price-to-Sales ratio (Market Capitalization to Revenue) indicates the valuation of a stock in relation to its revenue.

The Inventory Turnover ratio (Cost of Goods Sold to Average Inventory) measures the frequency of inventory replacement over a designated timeframe.

The Asset Turnover ratio (Revenue to Total Assets) measures the efficiency of asset utilization within the company. A low asset turnover ratio suggests that the company is not effectively utilizing its assets. This indicates the operational efficiency of the firm.

3.1. MSD Methodology

The MSD approach, a modified version of the standard deviation (SD) method, was introduced by Puška et al. (2022). There are two more phases in comparison to the SD approach.

Step 1: Constructing the decision matrix

First, a decision matrix *x* is constructed, comprising x_{ij} values and including *m* alternatives and *n* criteria (Equation (1)).

$$x = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \dots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad ; \quad i = 1, 2, \ldots, m \text{ and } j = 1, 2, \ldots, n \tag{1}$$

x_{mn}, denotes a component of the decision matrix for the *m.* alternative in the *n.* criterion.

After establishing the initial decision matrix, which comprises "n" criteria and "m" alternatives, this method encompasses the subsequent steps:

Step 2. Normalizing the decision matrix

In the study, the "min-max" normalization method was considered. Using Equations (i) and (ii), normalization is implemented, and the normalized value r_{ij} is determined.

$$r_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)} \text{ for beneficial criteria} \tag{i}$$

$$r_{ij} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)} \text{ for non-beneficial criteria} \tag{ii}$$

Step 3. Computation of the standard deviation (σ).

Step 4. Computing the sum of the sum of the columns $\sum_j^m x_{ij}$.

Step 5. Compute the adjusted value of the standard deviation via Eq. (2).

$$\sigma' = \frac{\sigma}{\sum_j^m x_{ij}} \quad (2)$$

Step 6. Determination of the final weights of the criterion utilizing Eq. (3).

$$w_j = \frac{\sigma_j'}{\sum_{j=1}^m \sigma_j'} \quad (3)$$

3.2. WEDBA Methodology

The Weighted Euclidean Distance Based Approach (WEDBA), proposed by Rao and Singh (2012), relies on the weighted distances of alternatives from both the most and least favorable scenarios. The related steps of the WEDBA method are outlined below (Rao and Singh, 2011; Rao and Singh, 2012):

Step 1. Constructing a decision matrix

Step 2. Standardization:

Computing the Z_{ij} which is the standardized value of x_{ij} via Eq (4), Eq (5), and Eq (6).

$Z_{ij} = \frac{x_{ij} - \mu_j}{\sigma_j}$; which μ_j denotes the mean value of the j^{th} attribute, and σ_j denotes the standard deviation of the attribute j (4)

$x_{ij} = \frac{y_{ij}}{max_j\,(y_{ij})}$; for beneficial attributes (5)

$x_{ij} = \frac{min_j(y_{ij})}{y_{ij}}$; for non-beneficial attributes (6)

Step 3. Ideal and anti-ideal points

Ideal points and anti-ideal points represent the sets of maximum and minimum attribute values, respectively, derived from the standardized decision matrix.

Step 4. Determining Weighted Euclidean Distance

Weighted Euclidean distance (WED) between an alternative 'i' and ideal point a^* is denoted by WED_i^+ and between an alternative i and anti-ideal point b^* is denoted by WED_i^- calculated by using Eq. (7) and Eq. (8).

The Weighted Euclidean Distance (WED) between an alternative 'i' and the ideal point a*, together with between the alternative 'i' and the anti-ideal point b*, is estimated using Eq (7) and Eq (8).

Which w_j represents the criteria weights.

$$WED_i^+ = \left[\sum_{j=1}^n \{w_j * (Z_{ij} - a_j^*)\}^2\right]^{1/2} \quad (i = 1,2,\dots,m) \quad (7)$$

$$WED_i^- = \left[\sum_{j=1}^n \{w_j * (Z_{ij} - b_j^*)\}^2\right]^{1/2} \quad (i = 1,2,\dots,m) \quad (8)$$

Step 5. Calculating the index score using Eq. (9), and ranking

$$Index\ Score = \frac{WED_i^-}{WED_i^+ - WED_i^-} \quad (9)$$

The index score reflects the closeness of a particular alternative to the ideal solution. A higher index value for a certain alternative signifies its closeness to the best solution. The alternative with the highest index score is the optimal selection for the decision-making problem.

IV. FINDINGS

4.1. Determination of Weights by Using the MSD Methodology

Financial ratios were employed to construct the decision matrices utilized in the WEDBA approach. First, the initial decision matrix was constructed utilizing Equation (1). The 13-criterion decision matrix for eight pharmaceutical entities is displayed in Tables 3 and 4. Considering the similarity in implementation methods for 2024 and 2023, the following section of the study will mostly focus on the measures to be executed for 2024.

Table 3. 2024 Initial Decision Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
ANGEN	0.868	-0.123	-0.141	-0.413	8.661	4.537	2.342	0.132	6.591	1.750	5.130	0.541	0.297
DEVA	0.700	0.002	0.003	0.004	1.608	0.989	0.126	0.300	2.334	0.750	1.010	1.965	0.520
ECILC	0.799	0.018	0.023	0.117	2.019	1.492	0.635	0.201	3.968	0.730	3.720	2.921	0.156
GENIL	0.594	0.012	0.020	0.010	1.382	1.126	0.129	0.406	1.461	4.930	2.440	11.088	1.197
LKMNH	0.544	0.071	0.130	0.092	0.998	0.842	0.076	0.456	1.192	2.040	1.320	12.021	0.771
RTALB	0.869	0.027	0.031	0.329	0.721	0.531	0.030	0.131	6.619	0.870	9.150	2.850	0.083
SELEC	0.339	0.030	0.088	0.016	1.330	1.052	0.085	0.661	0.512	2.110	0.390	9.219	1.853
TRILC	0.482	0.018	0.038	0.028	1.950	1.546	0.007	0.518	0.929	1.410	1.060	4.092	0.643

Table 4. 2023 Initial Decision Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
ANGEN	0.897	-0.101	-0.113	-0.574	15.698	10.834	6.491	0.103	8.673	1.560	7.970	0.213	0.176
DEVA	0.659	0.151	0.229	0.299	1.665	1.072	0.219	0.341	1.930	0.710	0.920	1.606	0.505
ECILC	0.801	0.063	0.079	0.423	1.605	1.138	0.588	0.199	4.028	0.600	3.220	2.688	0.149
GENIL	0.630	0.059	0.093	0.055	1.457	0.985	0.025	0.370	1.703	2.010	1.190	4.967	1.057
LKMNH	0.558	0.140	0.250	0.175	0.926	0.790	0.051	0.442	1.261	1.300	0.850	16.159	0.796
RTALB	0.896	-0.057	-0.064	-0.745	2.805	2.278	0.368	0.104	8.611	0.890	10.350	1.667	0.077
SELEC	0.336	0.005	0.015	0.002	1.327	1.049	0.172	0.664	0.507	1.760	0.270	11.084	2.182
TRILC	0.630	0.054	0.086	0.055	1.267	1.200	0.009	0.370	1.700	1.040	0.670	32.997	0.984

After the establishment of the initial decision matrix, normalization was conducted. The “min-max” normalization method was employed in this procedure, utilizing Equations (i) and (ii). The standard deviation (σ) was subsequently calculated. In the following phase, the modified standard deviation (σ') was computed using Equation (2). In the last phase, the final weights of the criterion (w_j) were determined using Equation (3). The final weights of the criterion are presented in Tables 5 and 6.

Table 5. 2024 Criteria Weights (w_j)

C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
0.0553	0.0386	0.0424	0.0422	0.1434	0.1146	0.1687	0.0553	0.0911	0.0394	0.0428	0.0791	0.0870

Table 6. 2023 Criteria Weights (w_j)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
0.0393	0.0445	0.0489	0.0413	0.1476	0.1497	0.1616	0.0393	0.0770	0.0467	0.0381	0.0912	0.0747

The results derived from the weights computed by the MSD technique indicate that the most important criteria for both 2024 and 2023 are C7, identified as "Cash Ratio."

4.2. WEDBA Application

The decision matrix, as previously established and presented in Table 3, was utilized in this study. After this procedure, standardization was conducted utilizing Eq (4), Eq (5), and Eq (6). Following that, the values of $WED_i^+$and WED_i^- were calculated utilizing Equations (7) and (8). In the last phase, the Index Score was calculated via Eq. (9), and rankings were established. Index Score and Ranking are displayed in Table 7.

Table 7. Outcomes of the WEDBA Methodology

2024				
WED_i^+	WED_i^-	INDEX SCORE	RANK	Alternatives
0.450	0.869	0.659	1	ANGEN
0.827	0.261	0.240	7	DEVA
0.728	0.357	0.329	3	ECILC
0.810	0.333	0.292	6	GENIL
0.846	0.352	0.294	5	LKMNH
0.880	0.404	0.314	4	RTALB
0.826	0.409	0.331	2	SELEC
0.825	0.255	0.236	8	TRILC
2023				
WED_i^+	WED_i^-	INDEX SCORE	RANK	Alternatives
0.466	0.870	0.651	1	ANGEN
0.893	0.273	0.234	7	DEVA
0.879	0.271	0.235	6	ECILC
0.904	0.207	0.186	8	GENIL
0.894	0.284	0.241	5	LKMNH
0.864	0.288	0.250	4	RTALB
0.890	0.310	0.258	3	SELEC
0.862	0.354	0.291	2	TRILC

In the WEDBA methodology, the index score indicates the proximity of a specific alternative to the ideal solution. Higher index scores for a specific alternative indicate a proximity to the ideal solution. (Rao and Singh, 2012). A higher index score corresponds to the best rank for that alternative. Table 7 indicates that, according to the WEDBA methodology results for 2024, ANGEN, with the highest index score of 0.659, is the optimal alternative, whereas TRILC, with the 0.236 lowest score, is the least favorable alternative. 2023 The WEDBA approach results demonstrate that ANGEN, with the highest index score of 0,651, is the best alternative, whilst GENIL, with the 0,186 lowest score is the least favorable alternative.

V. DISCUSSION

The motive of the study was to develop a detailed assessment of financial performance schemes for the pharmaceutical companies implementing the MSD technique to measure the weights and the WEDBA methodology to rank the alternatives.

Regarding the criteria, the Cash Ratio, denoted as C7, emerged as a crucial indicator, signifying its importance in evaluating financial performance. The analysis of the WEDBA methodology rankings reveals that in 2024, ANGEN achieved the top ranking, and TRILC received the lowest ranking. In 2023, ANGEN attained the highest ranking, while GENIL obtained the lowest ranking. The findings align with Şenol (2023), demonstrating that ANGEN achieved the highest financial performance in the post-pandemic period, and with Gülençer et al. (2024), which established that ANGEN reached optimal performance in 2019.

The outcomes indicated that the implementation of MCDA approaches significantly benefited the assessment of the financial performance of pharmaceutical enterprises.

The limitation of the study is that it evaluated only eight pharmaceutical enterprises. This mostly results from the accessibility of both regular and disaggregated financial data from publicly traded corporations. Access to comprehensive financial data could enhance future analyses of financial performance by incorporating additional enterprises.

VI. CONCLUSION

Analyzing financial performance enables pharmaceutical companies to assess their financial status relative to competitors, identify essential financial vulnerabilities and strengths, and contribute to making rational financial decisions.

This study analyses the financial performance of some particular Turkish pharmaceutical and biopharmaceutical businesses listed on the stock exchange employing the MSD-based WEDBA methodology and intends to improve the current literature by providing an additional perspective on performance measurement for pharmaceutical and biopharmaceutical enterprises. The justification for employing the WEDBA methodology is based on the scarcity of research that has performed thorough financial evaluations of pharmaceutical entities utilizing the WEDBA methodology. The assessment of pharmaceutical and biopharmaceutical firms was consolidated within the framework of pharmaceutical companies, rather than treating them as separate entities.

This study is among the initial investigations on the financial performance of pharmaceutical organizations utilizing the MSD-integrated WEDBA technique. In 2024 and 2023, the implemented MSD methodology indicated that the primary performance indicator among evaluated pharmaceutical businesses is the "Cash Ratio". The WEDBA results suggest that ANGEN attained the highest score in both 2024 and 2023, whilst TRILC obtained the lowest rating in 2024 and GENIL in 2023.

Future academic research on the financial performance analysis of pharmaceutical companies may incorporate various MCDM methodologies, providing a comprehensive comparison through the integration of multiple MCDM models into the financial performance ranking.

Ethics Committee Approval: This study does not require ethics committee approval.

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