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BIST100'DE İŞLEM GÖREN OTOMOTİV İMALAT ŞİRKETLERİNİN FİNANSAL PERFORMANSININ ENTROPİ TABANLI TOPSIS YÖNTEMİYLE BELİRLENMESİ*

DETERMINATION OF FINANCIAL PERFORMANCES OF AUTOMOTIVE MANUFACTURING COMPANIES TRADE ON BIST 100 VIA ENTROPY BASED TOPSIS METHOD

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Öz

Bu yazıda Borsa İstanbul ilk 100'de (BİST100) işlem gören 9 ana metal sanayi şirketinin 2017-2021 dönemine ait mali tabloları kullanılarak şirketlerin finansal performansları TOPSIS yöntemi ile analiz edilmiştir. Değerlendirme kriteri olarak kullanılan finansal oranların ağırlıklarının belirlenmesinde sübjektiflikten kaçınmak için geliştirilen Entropy yöntemi kullanılmıştır. TOPSIS yöntemi ile şirket performansını gösteren tek puana dönüştürülür. İşletmelerin sıralaması bu performans puanına göre yapılmıştır. Araştırma sonuçlarına göre finansal performans sıralaması KARSN, FMZIP, BFREN, DİTAŞ, OTKAR, TOASO, EGEEN ve ASUZU'dur.

Anahtar Kelimeler: Otomotiv Sektörü, Borsa İstanbul 100 (BİST100), TOPSİS, İyileştirilmiş Entropi, Finansal Performans Analizi

JEL Codes:C02 , G00 , G10

Abstract

In this article, the financial performances of the companies are analyzed using the TOPSIS method, using the financial statements of 9 main metal industry companies traded in Borsa Istanbul 100 (BIST100) for the period 2017-2021. The Entropy method, which was developed to avoid subjectivity, was used in determining the weights of financial ratios used as evaluation criteria. It is converted into a single score showing company performance with the TOPSIS method. The ranking of the enterprises was made according to this performance score. According to the results of the research, the financial performance rankings are KARSN, FMZIP, BFREN, DİTAŞ, OTKAR, TOASO, EGEEN and ASUZU.

Keywords: Automotive Sector, Borsa Istanbul 100 (BIST100), TOPSIS, Improved Entropy, Financial Performance Analysis

GEL Codes:C02 , G00 , G10

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Introduction

Today, in the business world, which has a high level of integration and is in continuous development, the automotive industry, which is the pioneer of this development, is at a key point in terms of its importance. The automotive industry is the leading buyer in sectors as petrochemical, plastic, textile, iron electronics and glass. In this case, it is also the pioneer of technological changes in many sectors. The importance of the sector is not only due to the added value of its own production, but also because it contributes to the development of many other sectors due to its very strong forward and backward links. It can be said that this has increased even more in the 21st century.

The automotive sector is a very valuable field of activity in terms of both the world economy, Turkey and the unity of the employees. In these days when mergers, business integrity, bankruptcies and acquisitions between companies are intense, production is taking place on a global scale, especially with the effect of new technology.

While the decision-makers in the enterprises determine the successful use and control of the important functions and tools of the enterprise such as profit, cost, production, labor force, with performance measurements and evaluations, they may have to find the most suitable option among the alternatives that fulfill different objectives and sometimes contradict each other. In cases where there are multiple and often incompatible criteria, the multi-criteria analysis method is used to find a solution to a problem. (Bülbül ve Köse, 2009:72).

TOPSIS(Technique for Order by Similarity to Ideal Solution) analysis, which is one of the multi-criteria decision-making methods, was first introduced to the literature by Hwang and Yoon in 1981 to solve their problems and is frequently used in many fields. It is based on the rule that the alternative chosen with this method is the farthest from the negative ideal solution and the closest to the positive ideal solution. This practice is based on decision-making that provides as much profit as possible and yet is the most risk-free. (Lai vd, 1994:487).

Since multi-criteria decision making methods increase reliability in financial analysis (Esbouei, Ghadikolaei, Antucheviciene,2014:288), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method was used to evaluate the financial performance of the enterprises that are the scope of the study. In the TOPSIS method, the developed Entropy method was used to determine the weights of the financial ratios used in the evaluation of the financial performance of the enterprises.

1. Literature Review

In the measurement of financial performance, it is frequently used in financial analysis in terms of the convenience and convenience it provides to individuals and businesses in the decision-making part, since it has application areas in different sectors. Some of the studies carried out with the TOPSIS method, both at home and abroad, are briefly described below.

Feng and Wang (2000) evaluated the performance of five airlines in Taiwan using the TOPSIS method. As a result of the study, which was carried out using twenty-two variables, it was determined that the use of financial indicators is more meaningful in determining the performance of airline companies.

This study conducted by Wu and Olson (2006), was analyzed according to the TOPSIS method, using 12 financial ratios, taking into account the financial performance of banks in Canada. The results were compared with the TOPSIS method.

Yanik and Eren (2007) analyzed the financial performances of automotive manufacturing companies traded in Borsa Istanbul with the AHP, TOPSIS, ELECTRE and VICOR methods, and the performances of the businesses were evaluated. In the light of the data found, a ranking was made according to financial performances and performances.

Yörük and Erdem (2008) measured the relationship between the efficiency of added value, which is the main component of the companies in the automotive sector, and the ratio of the book value of the companies to the market value, which is among the criteria of the financial performance of the companies. The financial statements

of 12 automotive companies were examined and in the light of these data, conclusions were drawn about the relationship between capital and business performance by using the VAIC method.

In Demireli's (2010) study, the financial statements of three banks and the ratios published by the TBB were examined by using the TOPSIS method. In the light of this information, he evaluated the performances of the banks and made a ranking.

2. Methodology

2.1. The Purpose, Scope and Data Set of the Study

In this study, 9 companies that are traded in the ISE (Istanbul Stock Exchange) and covering the basic metal industry index are included. The purpose of this study is to evaluate and rank the financial performance of the basic metal industry enterprises. In the study, analyzes were carried out using the financial ratios obtained from the financial statement data of enterprises between the years 2017-2021. The data used to calculate the financial statements of the Public Disclosure Platform (KAP) and official websites. (KAP, 2021).

The enterprises included in the study are shown in Table 1.

Table 1: Businesses Included in the Study

BİST Code	**Business**
EGEEN	EGE ENDÜSTRİ VE TİCARET A.Ş.
ASUZU	ANADOLU ISUZU OTOMOTİV SANAYİ VE TİCARET A.Ş.
DITAS	DİTAS DOĞAN YEDEK PARÇA İMALAT VE TEKNİK A.Ş.
BFREN	BOSCH FREN SİSTEMLERİ SANAYİ VE TİCARET A.Ş.
FMZIP	FEDERAL-MOGUL İZMİT PİSTON VE PİM ÜRETİM TESİSLERİ A.Ş.
FROTO	FORD OTOMOTİV SANAYİ A.Ş.
KARSN	KARSAN OTOMOTİV SANAYİ VE TİCARET A.Ş.
OTKAR	OTOKAR OTOMOTİV VE SAVUNMA SANAYİ A.Ş.
TOASO	TOFAŞ TÜRK OTOMOBİL FABRİKASI A.Ş.

2.2 Financial Ratios Used in the Study

In the study, the ratios have been determined in the light of information that will support the use of business assets, profitability status, financial structure, and liquidity situation. Calculation techniques and financial ratios used in this analysis are shown in Table 2.

With the information obtained in Table 2, the liquidity ratio and current ratio were used to determine the short-term solvency of the companies. Inventory turnover, total asset turnover, fixed asset turnover ratios, and leverage ratios were used to determine the active use of business assets. Finally, net profit margin and return on equity were analyzed in the analysis to determine the profitability of the business.

Table 2: Financial Ratios Used in Analysis

Current Ratio (CO)	Current Assets / Short Term Liabilities
Liquidity Ratio (or Quick Ratio) (LO)	Current Assets – Inventories/ Short Term Liabilities
Stock Turnover Ratio (SDH)	Cost of Sales / Average İnventory

Fixed Asset Turnover Ratio (SADH)	Net Sales / Capital Assets
Total Asset Turnover Ratio (TADH)	Net Sales / Net Assets
Debt-Total Assets Ratio (BO/TA)	Liabilities / Total Assets
Net Profit Margin (NKM)	Net Profit for the year/ Net Sales
Return on Equity (ÖK)	Net Profit / Equity

2.3 Methodology of Study

In the study, TOPSIS method was used to evaluate the financial performances of the enterprises and to make their rankings. TOPSIS method provides the opportunity to evaluate different financial performance indicators together in order to evaluate and compare the financial performances of enterprises. The importance weights of the financial ratios used as evaluation criteria in the TOPSIS method were determined by using the developed Entropy method. In this part of the study, the TOPSIS method and the stages of the developed Entropy weight determination method are examined.

2.3.1 Improved Entropy

The entropy method is a method that allows the weights of the criteria used in the creation of the decision matrix to be determined objectively. Entropy has gained importance in social sciences as well as physical science. (Hwang and Yoon, 1981:52). In the entropy method, the natural logarithm function is used while calculating the entropy values for the criteria.

Step 1: The decision matrix X which shows the performance of different alternatives with respect to various criteria is formed.

$$D = \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} X_{11} & \cdots & X_{1n} \\ X_{21} & \cdots & X_{2n} \\ \vdots & \cdots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix}$$

Step 2: Normalization of desicion matrix

$$pij = \frac{X_{ij}}{\sum_{i=n}^{m} \forall\, i,j} \quad \forall \text{ i,j}$$

Step 3: Finding entropy values for criteria

$$eij = -k.\sum_{j=1}^{n} pij.ln(pij)$$

i=1,2 ,…,m ve j= 1,2 ,…,n

$$k = (ln(m)^{-1}) \;\; eij = 0 \leq ej \leq 1$$

Step 4: Finding degrees of differentiation

dj=1-cj j=1,2 ,…,n

Step 5: Calculation of Entropy criterion weights

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}$$

Step 6: Making corrections if negative data are available

2.3.2 TOPSIS Method

TOPSIS method is one of the most frequently used methods. The main basis of the method is to determine the Negative Ideal Solution (NIS) and Positive Ideal Solution (PIS) points, and there is the idea that the most preferred alternative is not only the closest to the positive ideal solution but also the farthest distance from the negative ideal solution. The TOPSIS method is a 6-step process. The steps are listed below. (Dumanoğlu ve Ergül , 2010 : 105-107; Mahmoodzadeh vd., 2007: 336-337).

Step 1: Creating the Decision Matrix (A)

In the rows of the decision matrix, there are the decision points whose advantages are to be listed, and in the columns, there are the evaluation factors to be used in decision making. Matrix A is the initial matrix created by the decision-maker. The decision matrix is shown as below.

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

In the Aij matrix, m gives the number of decision points, n the number of evaluation factors.

Step 2: Creating the Normalized Decision Matrix (R)

The Normalized Decision Matrix is calculated by using the elements of the A matrix in the TOPSIS method and with the help of the following formula.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \qquad i = 1, \dots, m \qquad j = 1, \dots, n$$

Step 3: Creating the Weighted Decision Matrix (V)

The weight values (wi) of the evaluation factors are determined.

$$(\sum_{i=1}^{n} w_i = 1)$$

Then, the elements in each column of the R matrix are multiplied by the corresponding (wi) value to form the V matrix. The V matrix is shown below:

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ \vdots & & & \vdots \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_n r_{mn} \end{bmatrix}$$

Step 4: Determining the Ideal (V+) and Negative Ideal (V-) Solution

At this stage, the maximum and minimum values in each column of the weighted matrix are determined.

$V^+ = \{v^+, v^+, ..., v^+\}$ (maximum values) topsıs kısmındaki formül gelicek buraya a olan

$V^- = \{v^-, v^-, ..., v^-\}$ (minimum values)

Step 5: Calculating Distance Measures Between Alternatives

After the completion of the ideal points, the distance values to the maximum and minimum ideal points are calculated with the help of the following formulas in the 5th step. (Mahmoodzadeh vd., 2007: 337).

$$s_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \quad \text{i= 1,2……m}$$

$$s_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad \text{i=1,2……,m}$$

Step 6: Calculating the Relative Closeness to the Ideal Solution

Ideal and negative ideal separation measures are used to calculate the relative closeness (C+) of each decision point to the ideal solution. The criterion used here is the share of the negative ideal discrimination measure in the total discrimination measure. Calculation of its relative value to the ideal solution is carried out with the help of the following formula. (Ballı ve Korukoğlu, 2009: 125).

$$C_i^+ = \frac{s_i^-}{s_i^- + s_i^+} \quad \text{i=1,2,…,m}$$

The C + value in the formula takes values in the range of $0 \leq C + \leq 1$. $C^+ = 1$ of the relevant decision point to the ideal solution, C+ =0 shows the absolute closeness of the relevant decision point to the negative ideal solution. Finally, the obtained values are arranged in order of magnitude and the order of importance of the decision points is determined.

Step 1: Creating the Decision Matrix (A)

There are 9 decision points (businesses) and 8 evaluation factors (financial ratios) in this study. First, the Standard Decision Matrix (9x8) was created for the TOPSIS method. The 2021 decision matrix of the businesses that are the subject of this study is shown in Table 3. As an example, only the data for 2021 are shown in the table.

Table 3: Decision Matrix of Criteria for 2021 (A)

2021	**CRITERIA**							
BUSINESSES	CO	LO	SDH	SADH	TADH	BO/TA	NKM	ÖK
EGEEN	4,202	3,006	-3,166	5,009	1,201	0,197	0,575	0,540
ASUZU	1,343	1,043	-4,913	3,183	1,328	0,614	0,079	0,152
DİTAS	1,139	2,249	1,621	0,317	0,432	13,274	0,356	0,730
BFREN	1,961	2,222	1,310	0,834	0,174	4,210	0,458	8,643
FMZIP	5,168	1,041	1,219	0,619	0,198	1,705	0,716	32,834
FROTO	1,579	3,944	1,365	0,387	0,233	4,862	0,867	0,856
KARSN	0,901	6,803	1,277	0,136	0,485	37,791	0,100	1,640
TOASO	1,175	5,783	1,219	0,267	0,311	7,154	0,571	1,446
OTKAR	1,388	2,000	1,033	0,681	0,339	5,751	0,696	0,912

Step 2: Creating the Normalized Decision Matrix (R)

The normalized decision matrix in Table 4 was calculated using the elements of matrix A in Table 3 and with the help of equation.

Table 4: Normalized Decision Matrix for 2021 (R)

2021	**CRITERIA**							
BUSINESSES	CO	LO	SDH	SADH	TADH	BO/TA	NKM	OK
EGEEN	0,552	0,274	-0,467	0,822	0,603	0,005	0,346	0,016
ASUZU	0,176	0,095	-0,724	0,523	0,667	0,015	0,048	0,004
DİTAS	0,150	0,205	0,239	0,052	0,217	0,319	0,214	0,021
BFREN	0,258	0,202	0,193	0,137	0,087	0,101	0,276	0,254
FMZIP	0,679	0,095	0,180	0,102	0,099	0,041	0,431	0,964
FROTO	0,207	0,359	0,201	0,063	0,117	0,117	0,522	0,025
KARSN	0,118	0,620	0,188	0,022	0,244	0,908	0,060	0,048
TOASO	0,154	0,527	0,180	0,044	0,156	0,172	0,344	0,042
OTKAR	0,182	0,182	0,152	0,112	0,170	0,138	0,419	0,027

Step 3: Criteria Weights Calculated with Entropy

By applying the entropy method, criterion weights will be calculated, and in the second stage of the application, automotive enterprises will be evaluated with the Topsıs method. In this direction, the weights of the criteria were created. Table 5 shows the weights of the criteria.

Table 5: Weights of Criteria Calculated by Entropy Method

	CO	**LO**	**SDH**	**SADH**	**TADH**	**BO/TA**	**NKM**	**OK**
Weight	-0,841	-0,929	0,966	0,653	-0,556	0,770	-0,992	1,929

After the weights were calculated, the weighted standard decision matrix was created as in table 6 bu multiplying the weights of each criterion with the values in the normalized decision matrix.

2021	**CRITERIA**							
BUSINESSES	CO	LO	SDH	SADH	TADH	BO/TA	NKM	OK
EGEEN	-0,464	-0,255	-0,451	0,537	-0,335	0,004	-0,343	0,031
ASUZU	-0,148	-0,088	-0,699	0,341	-0,371	0,011	-0,047	0,009
DİTAS	-0,126	-0,190	0,231	0,034	-0,120	0,246	-0,213	0,041
BFREN	-0,217	-0,188	0,186	0,089	-0,048	0,078	-0,274	0,490
FMZIP	-0,571	-0,088	0,173	0,066	-0,055	0,032	-0,427	1,860
FROTO	-0,175	-0,334	0,194	0,041	-0,065	0,090	-0,518	0,048
KARSN	-0,100	-0,576	0,182	0,015	-0,135	0,699	-0,059	0,093
TOASO	-0,130	-0,490	0,174	0,029	-0,087	0,132	-0,341	0,082
OTKAR	-0,153	-0,169	0,147	0,073	-0,095	0,106	-0,416	0,052

Step 4: Determining the Ideal (V+) and Negative Ideal (V-) Solution

In step 4, ideal (V+) and negative ideal (V-) solution sets are determined. Clusters were formed by choosing the largest value in the column of the V matrix for (V+) and the smallest value in the column of the V matrix for (V-).

V^{+} = { -0,100 ; -0,089 ; 0,231 ; 0,538 ; -0,049 ; 0,700 ; -0,048 ; 1,860 }

V^{-} = { -0,572 ; -0,577 ; -0,700 ; 0,015 ; -0,371 ; 0,004 ; -0,518 ; 0,009 }

Step 5: Determining Distance Measures Between Alternatives

In this step, positive ideal solution distance (S+) and negative ideal solution distance (S-) were calculated and shown below.

S^{+} = { 2,151 ; 2,216 ; 1,952 ; 1,594 ; 1,019 ; 2,047 ; 1,909 ; 1,999 ; 1,998 }

S^{-} = { 0,695 ; 0,864 ; 1,195 ; 1,212 ; 2,131 ; 1,058 ; 1,325 ; 1,048 ; 1,077 }

Step 6: Determining the Relative Closeness to the Ideal Solution

The closeness of the found decision points to the ideal solution (C) was calculated with the formulation specified in Equation 4.

Table 6: Closeness Values to the Ideal Solution in 2021 (C)

BUSINESSES	2021 YEAR C VALUE	RANKİNG
EGEEN	0,244	9
ASUZU	0,281	8
DİTAS	0,380	4
BFREN	0,432	2
FMZIP	0,677	1
FROTO	0,341	7
KARSN	0,410	3
TOASO	0,344	6
OTKAR	0,350	5

In this case, the "C" values are arranged in order of magnitude and the performance sequence is made. In Table 7, the scores of the basic automotive industry enterprises traded in BIST100 for the period of 2017-2021 and the performance sequence corresponding to these scores are given.

Table 7: "C" Values and Rankings of the Businesses Included in the Study

BUSINESSES	2017 YEAR C VALUE	RANKİNG	2018 YEAR C VALUE	RANKİNG	2019 YEAR C VALUE	RANKİNG	2020 YEAR C VALUE	RANKİNG	2021 YEAR C VALUE	RANKİNG
EGEEN	0,201	7	0,264	7	0,096	9	0,144	9	0,244	9
ASUZU	0,183	9	0,241	8	0,130	8	0,180	8	0,281	8
DİTAS	0,245	4	0,144	9	0,419	2	0,309	3	0,380	4
BFREN	0,268	3	0,341	5	0,217	4	0,283	4	0,432	2
FMZIP	0,375	2	0,407	2	0,352	3	0,400	2	0,677	1
FROTO	0,202	6	0,344	4	0,215	5	0,269	7	0,341	7
KARSN	0,608	1	0,637	1	0,529	1	0,658	1	0,410	3
TOASO	0,197	8	0,318	6	0,209	7	0,278	6	0,344	6
OTKAR	0,227	5	0,371	3	0,214	6	0,279	5	0,350	5

3. Results and Discussion

The automotive sector has a great role in the economic development level of the countries due to its constantly developing technology, its large share in world trade, the abundance of employment, and its central location for other sectors.

In this study, it is aimed to evaluate and compare the financial performances of nine companies operating in the Automotive sector and traded in the BIST between 2017 and 2021 with the TOPSIS method. The TOPSIS method brings together different evaluation criteria on a common denominator and provides an objective evaluation opportunity to the decision makers. In the study, eight different financial ratios (current ratio, liquidity ratio, stock turnover ratio, fixed asset turnover ratio, total asset turnover ratio, debt-to-total assets ratio, net profit margin and return on equity) reflecting the financial performance of the enterprises were examined. The weights of the

financial ratios used in the evaluation of the financial performance of the enterprises were calculated by using the improved Entropy method calculated by using the developed Entropy method. The rankings of the supplier companies within the scope of the application were obtained. The result obtained as a result of the Integrated Entropy-Topsıs method, the weighting of the criteria with Entropy and then the evaluation of financial performances with the Topsıs method has been presented.

4. Conclusion

The automotive industry is important for economies not only because of its contribution to development itself, but also because it is a buyer of other sectors such as petrochemical, plastic, textile, iron electronics and glass. In this case, it is also the pioneer of technological changes in many sectors.

In this study, it is aimed to evaluate and compare the financial performances of nine companies operating in the Automotive sector and traded in the BIST between 2017 and 2021 with the TOPSIS method.

The result obtained according to Integrated Entropy-Topsıs method, the weighting of the criteria with Entropy and then the evaluation of financial performances with the Topsıs method has been presented.

According to the findings of the study, when the ‘‘C’’ values calculated according to the TOPSIS method are examined, it is seen that the KARSN coded enterprise did not take the first place in the analysis period only in 2021. In the same way, we see that the company with the code FMZIP is in the second place steadily and placed in the first place in 2021. While the company with the code DİTAS was the last unsuccessful company in 2018, it managed to rank first by increasing its performance in other years. When we examine other businesses, it is determined that there is no general variation, accordingly, the most successful companies from 2017 to 2021 were KARSN, FMZIP, BFREN, DİTAS, OTKAR, TOASO, EGEEN and ASUZU respectively.

As a result, the TOPSIS method brings together different evaluation options on a common denominator and provides an objective evaluation opportunity to the decision makers. Therefore, the results obtained in this study will not only provide information to business managers operating in the basic metal industry sector about the performance rankings of the enterprises to position themselves among the enterprises. In addition, since the information obtained can be compared with the results of the same or different performance evaluation methods to be made in the future regarding the enterprises operating in the basic metal industry sector, the changes in the financial performances of the enterprises over time and the rankings that will be revealed by different methods can be put forward comparatively.

Based on the results obtained from this study, it is a fact that the automotive sector is an important locomotive in terms of Turkey’s economic growth. Investments to be made in this sector, together with its sub-sectors, will positively affect Turkey’s production, export, and national income.

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