Evaluating Financial Performance With Grey Relational Analysis: An Application Of Manufacturing Companies Listed On Borsa İstanbul

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ABSTRACT

This study aims at evaluating financial performance of manufacturing companies listed on Borsa Istanbul with a recent methodology: Grey Relational Analysis. The analysis is conducted with financial ratios related to liquidity, debt, activity and profitability. Eleven ratios of ninety eight companies for the year 2015 are employed in the analysis. According to the results; although a stationery company shows the highest performance, cement and fertilizer companies predominate, and additionally there is one textile and one ceramic company in top ten companies.

Keywords: *Grey Relational Analysis, performance evaluation, BIST, manufacturing industry.*

Jel Classification*: G10, G30.*

Finansal Performansın Gri İlişkisel Analiz Yöntemiyle Değerlendirilmesi: Borsa İstanbul'da İşlem Gören İmalat Şirketleri Üzerine Bir Uygulama

ÖZET

Bu çalışma, Borsa İstanbul'da işlem gören imalat şirketlerinin finansal performanslarını en son yöntemlerden birisi olan Gri İlişkisel Analiz ile değerlendirmeyi amaçlamaktadır. Bu analiz; likidite, borç yapısı, faaliyet ve karlılık ile ilgili finansal oranlar ile gerçekleştirilmiştir. Doksan sekiz firmanın 2015 yılına ait onbir finansal oranı analizde kullanılmıştır. Sonuçlara göre, bir kırtasiye firması en yüksek performansı göstermesine rağmen, çimento ve gübre şirketleri büyük çoğunluğu oluşturmaktadır, ve ayrıca bir tekstil ve seramik firması da ilk on şirket içerisinde yer almaktadır.

Anahtar Kelimeler: *Gri İlişkisel Analiz, performans değerlendirme, BİST, imalat sektörü.*

JEL Sınıflandırması: *G10, G30.*

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1. INTRODUCTION

Performance measurement is important for the companies by reason of monitoring whether they achieved their foregone objectives successfully. The history shows that companies have used different performance measurement methods in order to correctly evaluate the financial position of themselves. The most commonly used method is financial ratio analysis which focuses on financial statements and comprises four main categories: liquidity, activity, debt structure and profitability[1].

Evaluating firm performance is as much as important measuring performance, since evaluating performance provides comparing companies by considering not only one financial indicator but also many different financial indicators simultaneously[2].

The objective of this paper is evaluating financial performance of the listed manufacturing companies with a new method, Grey Relational Analysis. This study contributes to the literature in two ways. First of all, it employs almost all ratios which are directly or indirectly related with profitability in order to measure and evaluate the performance exactly. Using a wide range of ratios provides more actual performance measurement and evaluation. Additionally, the company's exact performance is examined in all its parts. As a matter of fact, this contribution is the result of using Grey analysis[3] which enables bearing more than one indicator in mind. Secondly, it covers all manufacturing industry companies. Previous studies generally comprise limited number of companies. This study will be the one which investigates all manufacturing industry companies listed on Borsa İstanbul and employs a great number of ratios for Grey analysis.

The paper is organized as follows: first of all the theoretical background is explained, then methodology and results are given, and final section concludes.

2. THEORETICAL BACKGROUND

2.1. Grey Relational Analysis (GRA)

Deng (1989) indicates that the Grey System Theory was initiated in 1982 (as it refers to Deng, 1982), by concerning the incompleteness, uncertainty, and poverty in information. Grey relations, grey elements, grey numbers have been developed to explain the behavior of a mechanism, economy, even a human body. Deng (1989) also emphasizes that the goal of such as system is to build a bridge between social science and natural science by generating a mathematical modeling framework in order to perform quantitative analysis by considering uncertainty in information.

[1] There is a fifth category especially for listed companies and this category includes market-related ratios.
[2] Which is called as multicriteria decision making.
[3] Grey analysis and GRA are used in the text interchangeably.

The grey relational analysis is a component of Grey System Theory that has been developed to solve multi-criteria decision making problems in which the decision maker should consider interrelationships among multiple variables and factors. The major role of GRA is to evaluate the performance of all alternatives by comparatively ordering them with respect to the factors or criteria (Kuo et al., 2008; Wang et al., 2016) .The grey relational analysis method depends upon the concept of grey relational space. GRA is a useful method for capturing the correlations between the reference factor and other factors which can be compared within a system (Wu et al., 2010: 975).

There exist several variations in terms of executing the procedure of GRA (Wang, 2016; Liou et al., 2011), but the conventional one (Kuo et al. 2008) is adopted for the problem in this paper as defined in section 3. GRA method can be explained step by step as follows (Kuo et al., 2008: 82-83):

Step 1. Decision matrix construction: Evaluation values of the variables in the multi-criteria decision making (MCDM) problem constructs the decision matrix. In the decision matrix, there exist *n* alternative and *m* selection criteria. The decision matrix is shown as given in the equation (1).

i: selection criteria; i: 1,2,3, … , m

j: alternative; j: 1,2,3, … , n

$$\begin{bmatrix} X_1(1) & X_1(2) & \dots & X_1(m) \\ X_2(1) & X_2(2) & \dots & X_2(m) \\ \vdots & \vdots & \vdots & \vdots \\ X_n(1) & X_n(2) & \dots & X_n(m) \end{bmatrix} \quad (1)$$

Step 2. Standard series construction: Standard series are the target values of the selection criteria in the decision making model. Standard series determine the reference point of the MCDM problem. Standard series can be constructed using the equation (2):

$$X_0 = (X_0(1), X_0(2), \dots, X_0(m) \; or \; [X_0(1) \quad X_0(2) \quad \dots \quad X_0(m)] \quad (2)$$

where

m: total number of selection criteria

X_0: target value of the selection criteria

Step 3. Normalization of the decision matrix: Normalization should be performed for constructing comparable series. The values in the normalized series are in $[0,1]$ interval. The Normalization can be applied via three different methods depending on the selection policy.

- The normalization procedure is performed using the equation (3), if higher is better for a selection criteria in the multi criteria decision making problem:

$$X_i^*(k) = \frac{X_i(k) - min_k X_i(k)}{max_k X_i(k) - min_k X_i(k)} \quad (3)$$

where

$\min_k X_i(k)$: *minimum value in the decision matrix from the viewpoint of selection criteria i*

$\max_k X_i(k)$: *maximum value in the decision matrix from the viewpoint of selection criteria i*

- Normalization procedure is performed using the equation (4), if lower is better for a selection criteria in the multi criteria decision making problem:

$$X_i^*(k) = \frac{max_k X_i(k) - X_i(k)}{max_k X_i(k) - min_k X_i(k)} \quad (4)$$

- Normalization procedure is performed via the equation (5), if there is a desired value for a selection criteria in the MCDM problem:

$$X_i^*(k) = 1 - \frac{|X_i(k) - X_0(k)|}{max\{max_k X_i(k) - X_0(k); X_0(k) - min_k X_i(k)\}} \quad (5)$$

where

k: *alternative*; j: $1,2,3,\dots,n$

$X_0(k)$: *desired value of alternative k*

Step 4. Construction of the difference series: The absolute differences between the normalized decision matrix values and the standard series values. Calculation procedure for finding the absolute differences between the entries of the normalized decision matrix and the standard series values can be found through the equation (6) and the concluding matrix after finding the differences is represented as given in the equation (7):

$$\Delta_{0i}(k) = |X_i^*(k) - X_0^*(k)| \quad (6)$$

$$\begin{bmatrix} \Delta_{01}(1) & \Delta_{01}(2) & \dots & \Delta_{01}(m) \\ \Delta_{02}(1) & \Delta_{02}(2) & \dots & \Delta_{02}(m) \\ \vdots & \vdots & \vdots & \vdots \\ \Delta_{0n}(1) & \Delta_{0n}(2) & \dots & \Delta_{0n}(m) \end{bmatrix} \quad (7)$$

Step 5. Calculation of grey relational coefficients and construction of grey factor matrix: First of all, the highest and the lowest values in the difference series should be determined for obtaining grey relational coefficients. Grey relational coefficients calculation process can be applied using the equation (8):

$$\gamma(X_0(k), X_i(k)) = \frac{\Delta_{min} + \varsigma \times \Delta_{max}}{\Delta_{0j} + \varsigma \times \Delta_{max}} \quad (8)$$

where

Δ_{max}: *the highest value in the difference series*

Δ_{min}: *the lowest value in the difference series*

γ: *grey relational coefficient*

ς: *adjustment coefficient between* Δ_{0j} *and* Δ_{max} ; $\varsigma \in [0,1]$

Grey factor matrix is then constructed based on the values of the grey relational coefficients. The grey factor matrix includes all grey relational coefficients as seen in the equation (9):

$$\begin{bmatrix} \gamma_{01}(1) & \gamma_{01}(2) & \dots & \gamma_{01}(m) \\ \gamma_{02}(1) & \gamma_{02}(2) & \dots & \gamma_{02}(m) \\ \vdots & \vdots & \vdots & \vdots \\ \gamma_{0n}(1) & \gamma_{0n}(2) & \dots & \gamma_{0n}(m) \end{bmatrix} \quad (9)$$

Step 6. Determination of grey relational grades: Grey relational grade exhibits the similarity between the normalized decision matrix and the standard series. Similarity increases as the grey relational grade increases. The highest similarity gives the best alternative in the MCDM problem. If the importance levels of the selection criteria in the MCDM problem are equal, the grey relational grade is calculated as $\tau: grey\ relational\ grade$ through the equation (10):

$$\tau\ (X_0, X_i) = \frac{1}{m}\sum_{k=1}^{m} \gamma(X_0(k), X_i(k)1) \quad (10)$$

If the importance levels of the selection criteria in the MCDM problem are different, grey relational grade is calculated using the equation (11):

$$\tau\ (X_0, X_i) = \sum_{k=1}^{m} \gamma(X_0(k), X_i(k)) \cdot W_i(k) \quad (11)$$

where

$W_i(k): weight\ value\ of\ the\ selection\ criteria\ i.$

The GRA method ends up with finding the weights $W_i(k)$ for each alternative defined in the problem and show their importance in terms of the selection criteria. In this paper, those importance values are considered as the performance of the firms in the dataset with respect to the selected ratios, i.e. selection criteria.

The GRA method has been successfully applied for many multi-criteria decision making problems from various disciplines, e.g., selecting call center site location (Birgün & Güngör, 2014); machine selection (Topoyan et al., 2015); Monitoring chip fatigue (Zhou et al., 2016) and integrated with other methods and algorithms to develop hybrid models in order to obtain better solutions (Jin et al., 2016; Wang, 2016). The method can also be used to optimize process parameters (Abhang & Hameedullah, 2012).

In this study, the GRA method is used for a multi-criteria decision making problem arising in finance in which the method is recently preferred for similar purpose. Therefore, financial applications comprising this method are analyzed in more details in the further section.

2.2. GRA in Finance

Although GRA method has been widely used in the literature, there have been limited studies about the application of GRA method in financial decision making process.

GRA is a common evaluation method in financial research especially in Taiwan. Huang & Jane (2009) integrate grey systems theory with rough set theory and the moving average autoregressive exogenous prediction model for constructing forecasting and portfolio selection mechanism in a stock market over the electronic stock data of The New Taiwan Economy database. Hsu et al. (2009) combine GRA method with Fourier series and Markov state transition, i.e. Markov–Fourier grey model for increasing the forecast accuracy in Taiwan weighted stock index. The mean residual error values are calculated for analyzing the accuracy of forecasting model in the study. Ho (2006) uses the GRA method to evaluate the relative performance of three investment Taiwanese trust firms. Lin et al. (2009) propose a hybrid business failure prediction model by integrating rough set theory, case based reasoning and the GRA. Sample companies in the study have been announced as failed according to the ‘‘Securities and Exchange Laws” during the period from 1999 to 2006. Their approach has been applied on the dataset collected from Taiwan Stock Exchange Corporation and Taiwan Economic Journal database over return on assets, return on equity, net income except disposed, gross margin, net income, current ratio, acid test ratio, liabilities ratio, TCRI credit ranking, cash flow operation to current liabilities, total equity growth ratio, return on total assets growth ratio, days account receivable turnover, inventory turnover, earning per share, added value per person, manager-director, director and supervisor shareholding, inflation rate, business cycle and rediscount rate. Kung & Wen (2007) utilize the GRA method to analyze the financial performance of venture capital enterprises in Taiwan. In the study, the top five financial ratios among twenty financial ratios are found that they have affected the financial performance of the venture capital enterprises. According to the results of the study, these top five financial ratios are operating revenues to long term investment ratio, operating revenues to net value ratio, operating revenues to total assets ratio, income before taxes to total assets ratio and operating income to total assets ratio.

A financial crisis warning system for banking industry has been constructed by using the grey relational analysis method. The results have been compared with logistic regression and back-propagation neural network. According to the study, the proposed method based upon grey relational analysis method could find a signal about the financial crisis. Thus, early warning system could be constructed.

Hamzacebi & Pekkaya (2011) apply the GRA method for ordering some financial firms’ stocks in Istanbul Stock Exchange. Their study applies a heuristic, analytic hierarchy process, and learning via sample approaches to find the importance levels of the criteria in that multi criteria decision making problem through the criteria based on price earnings ratio, market book ratio, return on total assets, profit margin on sales, quick (acid test) ratio and total debt ratio. These ratios are have been calculated from the consolidated balance sheet and income statements of finance sector stocks and then used as input to obtain the importance weights of these financial ratios for each method defined in the study. According to the compared results, heuristic approach has not been given satisfactory results for investors and learning via sample approach has been better than the others.

Wu et al. (2010) analyze the performances of the four wealth management bank alternative with the GRA method. The study uses four main criteria, i.e. financial perspective, customer perspective, internal business process perspective and learning and growth perspective. The sub criteria of financial perspective are handling charge/revenue, customers market share ratio, capacity for profitability and assets management. The sub-criteria of customer perspective are customer acquisition, VIP-Certified financial, customer profitability, customer confidence and customer retention. The sub-criteria of internal business process perspective are lead in innovation system programming, certified financial integration platform for professionals, operational quality for a group of customers, internal customer satisfaction and management stratum support. The sub-criteria of learning and growth perspective are wealth managers' professional knowledge and growth, education and training of wealth managers, wealth manager's scale of team, wealth manager's complaint system and appropriateness of performance policy rewards and punishments. Analytic hierarchy process pair wise comparison matrices are used for finding the importance levels of the main criteria and the sub-criteria.

Zhang (2012) applies the GRA method in order to evaluate venture capital investment projects. The primary assessment criteria in the study are management ability, operation ability, market ability, exit obtain and cost. Each primary criterion is then divided into several sub criteria. Management ability covers quality of management and key staff, planning and accountability, compensation and information management and reporting; operation ability covers revenue/profitability plan, expense management, operational plans, process quality and efficiency; market ability covers market trends, competitive position, and growth strategy and customer management; exit obtain covers value realization, accretive add-on acquisitions, and exit (timing envisaged); and finally the cost criterion covers financing cost, input-output ratio, and asset structure. Zhang performs the GRA method in his study to evaluate three candidate venture capital firms through the opinions of five investment experts from the viewpoint of these criteria.

In Turkey, the literature indicates that most of the studies employed Data Envelopment Analysis and TOPSIS methods for measuring performance of the companies. One of the DEA related studies calculated efficiency scores of the companies from cement industry (Cengel, 2011). Similarly Gerek, Erdiş and Yakut (2011) measured efficiency of cement industry companies and Kayalıdere and Kargın (2004) computed efficiency scores of cement and textile companies.

One of the latest studies using TOPSIS focused on 32 companies from manufacturing industry for the period 2010-2012. Liquidity, activity and profitability ratios were wielded. Additionally the relation between financial performance and market value/book value indicator was analyzed, but no significant relationship was captured (Akbulut ve Rençber, 2015). Similarly, Yurdakul and İç (2005) investigated the relationship between performance

score and market price. Kaya, Coşkun and Ekşi (2013) used the same method to compare financial performance of a company before and after the acquisition/takeover. Uyguntürk and Korkmaz (2012) reckoned financial performances of 13 companies from metal industry with 8 ratios for the period 2006-2010 and compared annual performances.

On the other hand studies using GRA, comperatively new method of performance measurement, is limited. One of the recent studies, Bektaş and Tuna (2013), focused on companies from Borsa İstanbul the Emerging Companies Market by using profitability related ratios of one year. Peker and Baki (2011) ranked the financial performance of companies from insurance industry with liquidity, leverage and profitability ratios.

3. METHODOLOGY AND RESULTS

As a part of the reflection of industrial performance of the country, this paper evaluates the financial performance of all listed manufacturing companies (ninety eight firms-all companies listed on Borsa İstanbul) in Turkey by applying the GRA with eleven financial ratios. In order to determine the latest financial performance, the year 2015 (the latest year) is chosen for the analysis and related year's financial tables are used[4].

The GRA method (as explained in the section 2) is adopted to find the financial performance for each alternative defined in the problem to obtain their importance in terms of the selection criteria (financial ratios). In this paper, those importance values are considered as the performance indicators of the above-mentioned firms in the dataset with respect to the selected ratios. The main reason to choose GRA is its flexibility in calculations. By the help of this method, various number of criteria set can be analyzed without loosing the power of the method, and normalizations can be performed with respect to different ideal values of the criteria. For instance, the first three ratios in Table 1 have different ideal values and it is difficult to normalize and evaluate with other similar methods of MCDM. Besides, GRA can consider uncertainty even if the datasets are collected through crisp numbers as frequently observed in financial datasets.

For the purpose of determining financial performance of the manufacturing companies, fundamental liquidity, debt, activity and profitability ratios are selected. The ratios are explained in Table 1.

[4] Data is collected from Finnet database.

Table 1. Ratio Explanations

Ratio Number	Ratio explanation	Ideal value
Ratio 1	Current Ratio = Current Assets / Short-Term Liabilities	1,5 - 2
Ratio 2	Acid Test Ratio = (Current Assets - Inventories) / Short-Term Liabilities	1
Ratio 3	Financial Leverage Ratio = (Short-Term Liabilities+Long-Term Liabilities) / Total Liabilities And Stockholders' Equity	0,5
Ratio 4	Inventory Turnover Ratio = Cost of Sales (-) / Inventories	maximum
Ratio 5	Gross Profit Margin = Gross Profit (Loss) / Revenue	maximum
Ratio 6	Operating Profit Margin = Operating Profit (Loss) / Revenue	maximum
Ratio 7	Ordinary Income Ratio = Profit Before Extraordinary Items and Tax / Revenue	maximum
Ratio 8	Profit Margin = Profit Before Tax (Loss) / Revenue	maximum
Ratio 9	Net Income Ratio = Net Income / Revenue	maximum
Ratio 10	Return on Equity = Net Income / Stockholders' Equity	maximum
Ratio 11	Economic Profitability Ratio = Profit Before Tax (Loss) / Total Liabilities	maximum

GRA analysis is conducted by following 6 steps as explained before:

1. Decision matrix construction
2. Standard series construction[5]
3. Normalization of the decision matrix
4. Construction of the difference series
5. Calculation of grey relational coefficients and construction of grey factor matrix
6. Determination of grey relational grades

The first step is decision matrix construction. Decision matrix infers the values of financial ratios for selected companies. Thus, ratios are calculated for each company and they are shown on Table 2.

Table 2. Decision Matrix[6]

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
ACSEL	11,65	4,82	0,10	1,72	0,18	0,02	0,05	0,03	0,03	0,02	0,03	Firm 1
ADEL	1,57	0,85	0,46	1,12	0,47	0,19	0,17	0,31	0,28	0,35	0,21	Firm 2
AFYON	4,86	4,69	0,56	7,14	0,23	0,17	0,16	0,25	0,22	0,09	0,04	Firm 3
ALCAR	5,88	4,58	0,19	3,87	0,25	0,04	0,10	0,10	0,08	0,11	0,10	Firm 4
ALKA	2,77	2,13	0,33	5,09	0,14	0,08	0,04	0,07	0,07	0,10	0,08	Firm 5
ATPET	1,53	1,22	0,50	4,15	0,20	0,01	0,06	0,00	0,00	0,00	0,00	Firm 6
BAGFS	1,08	0,42	0,55	2,11	0,18	0,11	0,07	0,09	0,51	0,45	0,03	Firm 7
BFREN	3,40	3,11	0,27	14,93	0,17	0,12	0,15	0,17	0,15	0,25	0,21	Firm 8
BNTAS	3,64	2,99	0,35	4,37	0,16	0,08	0,12	0,11	0,10	0,07	0,05	Firm 9
BOLUC	1,67	1,33	0,33	6,51	0,38	0,31	0,33	0,32	0,26	0,26	0,21	Firm 10
BRISA	1,35	0,98	0,70	3,47	0,31	0,13	0,16	0,11	0,11	0,30	0,09	Firm 11

[5] Second step is standard series construction and the standard series are the ideal values in the column 3 of Table 1.

[6] Calculations are conducted with 6-digit analysis, due to page limitations tables are prepared with 2-digit values. Hence, although it seems that some of the companies have similar grades, their 6-digit grades are different.

Table 2. Decision Matrix[6]

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
BSOKE	3,34	2,94	0,46	4,35	0,32	0,20	0,28	0,20	0,15	0,08	0,06	Firm 12
CEMTS	3,45	2,01	0,23	4,34	0,14	0,04	0,05	0,04	0,03	0,04	0,04	Firm 13
DAGI	1,72	1,41	0,49	3,55	0,34	0,07	0,11	0,06	0,04	0,06	0,05	Firm 14
DENCM	1,66	0,67	0,27	3,61	0,19	0,02	0,03	0,03	0,03	0,03	0,03	Firm 15
DERIM	1,57	1,49	0,82	19,72	0,09	0,05	0,07	0,03	0,03	0,14	0,03	Firm 16
DGZTE	7,11	7,09	0,10	163,20	0,43	0,12	0,26	0,40	0,32	0,15	0,17	Firm 17
DMSAS	1,36	0,84	0,58	4,81	0,10	0,02	0,03	0,04	0,03	0,07	0,04	Firm 18
EGGUB	0,63	0,27	0,57	3,47	0,21	0,13	0,10	0,01	0,01	0,02	0,01	Firm 19
EGSER	1,94	1,37	0,41	3,46	0,31	0,17	0,17	0,16	0,16	0,24	0,14	Firm 20
ERBOS	2,78	1,64	0,31	3,48	0,13	0,07	0,07	0,09	0,07	0,13	0,11	Firm 21
FMIZP	9,20	8,51	0,10	16,86	0,27	0,22	0,25	0,31	0,27	0,38	0,39	Firm 22
FROTO	1,05	0,79	0,64	14,88	0,11	0,06	0,06	0,05	0,05	0,28	0,10	Firm 23
GOODY	1,86	1,32	0,41	6,58	0,14	0,04	0,07	0,07	0,06	0,15	0,11	Firm 24
HEKTS	2,29	1,20	0,38	1,44	0,37	0,20	0,23	0,19	0,15	0,21	0,16	Firm 25
IHEVA	4,02	3,07	0,23	1,56	0,20	0,06	0,04	0,11	0,13	0,06	0,04	Firm 26
IHGZT	4,31	4,07	0,17	12,24	0,02	-0,23	-0,19	-0,12	-0,03	-0,01	-0,03	Firm 27
IZOCM	1,83	1,42	0,38	8,25	0,24	0,09	0,11	0,09	0,07	0,18	0,14	Firm 28
JANTS	1,54	0,86	0,36	3,15	0,22	0,11	0,15	0,10	0,08	0,11	0,09	Firm 29
KENT	1,70	1,45	0,32	8,21	0,36	0,06	0,07	0,10	0,09	0,13	0,09	Firm 30
KLMSN	2,62	2,24	0,77	4,28	0,21	0,10	0,14	0,09	0,08	0,24	0,06	Firm 31
KNFRT	8,65	2,63	0,12	1,06	0,20	0,13	0,16	0,16	0,13	0,11	0,12	Firm 32
KUTPO	2,78	1,37	0,27	1,75	0,35	0,09	0,12	0,12	0,09	0,12	0,11	Firm 33
MERKO	1,34	0,42	0,68	1,28	0,19	0,05	0,05	0,01	0,01	0,02	0,01	Firm 34
MRDIN	2,63	1,77	0,18	2,64	0,37	0,24	0,29	0,34	0,29	0,18	0,18	Firm 35
OTKAR	1,30	0,75	0,85	2,48	0,26	0,07	0,10	0,06	0,06	0,32	0,05	Firm 36
PETUN	1,65	1,01	0,22	8,76	0,17	0,08	0,08	0,13	0,11	0,16	0,14	Firm 37
PINSU	0,71	0,55	0,64	7,32	0,48	-0,04	-0,06	-0,08	-0,06	-0,17	-0,07	Firm 38
PNSUT	1,16	0,69	0,34	7,58	0,16	0,05	0,05	0,07	0,06	0,11	0,08	Firm 39
PRKME	3,43	2,82	0,18	2,93	0,19	0,00	0,15	0,21	0,18	0,07	0,06	Firm 40
PRZMA	10,03	6,65	0,06	2,33	0,11	0,05	0,06	0,07	0,06	0,03	0,03	Firm 41
SAMAT	1,61	0,63	0,69	1,88	0,14	0,09	0,09	0,01	0,01	0,02	0,01	Firm 42
TATGD	2,39	1,45	0,36	3,66	0,23	0,06	0,08	0,07	0,07	0,16	0,10	Firm 43
TTRAK	1,61	1,00	0,68	4,82	0,19	0,12	0,12	0,10	0,08	0,39	0,15	Firm 44
TUCLK	1,56	1,38	0,74	5,77	0,11	0,04	0,14	0,01	0,02	0,04	0,01	Firm 45
USAK	1,08	0,78	0,75	2,59	0,21	0,12	0,12	0,01	0,01	0,01	0,01	Firm 46
VESBE	1,72	1,38	0,59	8,23	0,15	0,10	0,11	0,07	0,06	0,23	0,10	Firm 47
ADANA	4,45	3,69	0,10	5,02	0,39	0,27	0,30	0,41	0,34	0,18	0,20	Firm 48
ADBGR	4,45	3,69	0,10	5,02	0,39	0,27	0,30	0,41	0,34	0,18	0,20	Firm 49
ADNAC	4,45	3,69	0,10	5,02	0,39	0,27	0,30	0,41	0,34	0,18	0,20	Firm 50
AEFES	1,88	1,46	0,43	5,46	0,41	0,10	0,09	-0,01	-0,01	-0,02	0,00	Firm 51
AKCNS	1,74	1,33	0,30	7,69	0,29	0,24	0,24	0,24	0,19	0,24	0,20	Firm 52
AKSA	1,43	1,19	0,45	8,83	0,19	0,14	0,17	0,13	0,10	0,16	0,11	Firm 53
ALKIM	3,04	2,04	0,24	3,68	0,25	0,13	0,12	0,14	0,12	0,17	0,13	Firm 54
ANACM	1,48	1,15	0,53	3,88	0,21	0,05	0,06	0,00	0,02	0,02	0,00	Firm 55
ARCLK	1,80	1,39	0,66	4,50	0,32	0,08	0,09	0,06	0,06	0,19	0,06	Firm 56
ASLAN	1,18	1,00	0,36	6,99	0,37	0,26	0,28	0,24	0,19	0,19	0,15	Firm 57
ASUZU	1,80	1,02	0,63	2,43	0,17	0,05	0,03	0,02	0,02	0,05	0,02	Firm 58
AYGAZ	1,21	0,99	0,33	30,87	0,11	0,04	0,04	0,07	0,07	0,16	0,12	Firm 59
BLCYT	1,86	1,44	0,38	4,45	0,25	0,18	0,26	0,26	0,25	0,25	0,12	Firm 60
BRSAN	1,00	0,56	0,60	3,31	0,11	0,04	0,05	0,03	0,01	0,02	0,02	Firm 61
BUCIM	2,81	2,06	0,32	4,82	0,21	0,10	0,12	0,11	0,09	0,15	0,11	Firm 62
CCOLA	1,75	1,34	0,54	7,07	0,35	0,10	0,09	0,03	0,02	0,04	0,02	Firm 63

Table 2. Decision Matrix[6]

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
CIMSA	1,57	1,35	0,35	8,39	0,31	0,25	0,26	0,26	0,21	0,21	0,15	Firm 64
CMBTN	1,40	1,36	0,51	93,52	0,08	0,01	0,01	0,02	0,01	0,04	0,03	Firm 65
CMENT	1,71	1,23	0,22	4,89	0,22	0,07	0,07	0,09	0,08	0,06	0,04	Firm 66
CUSAN	2,64	2,00	0,31	6,17	0,21	0,10	0,14	0,13	0,10	0,21	0,15	Firm 67
DITAS	1,62	1,09	0,64	4,46	0,19	0,00	0,00	0,00	0,00	-0,01	0,00	Firm 68
DYOBY	1,19	0,98	0,84	6,47	0,33	0,11	0,07	0,00	0,00	0,03	0,00	Firm 69
GEDZA	5,92	4,23	0,18	4,11	0,18	0,07	0,09	0,09	0,06	0,04	0,05	Firm 70
GENTS	3,69	2,36	0,25	3,22	0,09	-0,05	0,04	0,07	0,05	0,07	0,06	Firm 71
HURGZ	0,87	0,84	0,60	29,38	0,43	0,00	0,04	-0,09	-0,08	-0,13	-0,06	Firm 72
IHMAD	8,10	7,79	0,06	1,39	-0,09	-2,16	-1,39	-0,66	-0,40	-0,01	-0,01	Firm 73
IZMDC	0,67	0,45	0,87	8,44	0,05	0,04	0,02	-0,12	-0,10	-0,82	-0,12	Firm 74
KARTN	1,69	0,84	0,22	4,16	0,09	0,00	0,01	0,08	0,08	0,08	0,06	Firm 75
KONYA	4,51	3,83	0,16	6,56	0,22	0,13	0,13	0,17	0,14	0,13	0,13	Firm 76
KORDS	1,50	0,83	0,44	3,34	0,18	0,09	0,10	0,08	0,07	0,12	0,06	Firm 77
KRATL	2,10	1,28	0,60	5,14	0,04	0,02	0,06	-0,01	-0,01	-0,03	-0,02	Firm 78
KRSTL	3,49	2,84	0,21	6,82	0,08	0,01	0,02	0,03	0,02	0,03	0,03	Firm 79
MNDRS	1,16	0,69	0,61	2,88	0,08	0,03	-0,01	-0,07	-0,05	-0,10	-0,05	Firm 80
NUHCM	2,70	2,18	0,25	6,15	0,37	0,28	0,25	0,24	0,18	0,16	0,17	Firm 81
OLMIP	1,74	1,27	0,40	6,11	0,13	-0,03	-0,02	0,01	0,01	0,03	0,01	Firm 82
PARSN	1,04	0,62	0,40	3,47	0,28	0,09	0,10	0,08	0,11	0,05	0,02	Firm 83
PETKM	1,75	1,52	0,49	10,50	0,16	0,12	0,11	0,13	0,14	0,23	0,11	Firm 84
PIMAS	1,41	1,18	0,55	7,27	0,14	-0,02	-0,02	-0,02	-0,04	-0,08	-0,01	Firm 85
PRKAB	1,29	1,05	0,77	7,87	0,12	0,04	0,02	0,02	0,01	0,09	0,03	Firm 86
RTALB	3,78	2,88	0,25	2,00	0,45	0,21	0,29	0,28	0,23	0,17	0,16	Firm 87
SASA	1,69	0,98	0,44	4,76	0,13	0,07	0,10	0,06	0,06	0,18	0,10	Firm 88
SODA	3,90	3,41	0,22	7,23	0,27	0,18	0,20	0,29	0,25	0,20	0,18	Firm 89
TMPOL	1,40	1,08	0,66	3,58	0,21	0,15	0,13	0,06	0,05	0,13	0,05	Firm 90
TOASO	1,15	1,03	0,74	16,02	0,12	0,07	0,07	0,06	0,08	0,32	0,06	Firm 91
TRKCM	2,74	2,16	0,44	3,53	0,27	0,05	0,08	0,09	0,08	0,06	0,04	Firm 92
TUKAS	1,48	0,63	0,55	1,30	0,20	0,11	0,18	0,11	0,23	0,31	0,07	Firm 93
TUPRS	0,98	0,74	0,67	15,56	0,11	0,09	0,07	0,06	0,07	0,31	0,09	Firm 94
ULKER	3,70	3,34	0,58	10,29	0,22	0,12	0,13	0,10	0,09	0,19	0,08	Firm 95
UNYEC	5,71	4,59	0,13	4,24	0,33	0,22	0,25	0,27	0,22	0,17	0,19	Firm 96
VESTL	1,07	0,69	0,83	3,31	0,21	0,06	0,03	0,01	0,01	0,04	0,01	Firm 97
YUNSA	1,14	0,60	0,71	1,98	0,22	0,05	0,10	0,02	0,02	0,06	0,02	Firm 98

Step 3 is the normalization of the decision matrix. In this step, ratios are converted into standard values between 0 and 1 by using equations explained in Part 2. Equation 5 is used for R1, R2 and R3, and equation 3 is used for the other ratios in normalization process.

The normalized decision matrix can be constructed as in Table 3.

Table 3. Normalized Decision Matrix

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
ACSEL	0,00	0,49	0,11	0,00	0,47	0,88	0,84	0,65	0,47	0,67	0,28	Firm 1
ADEL	0,98	0,98	0,91	0,00	0,98	0,95	0,91	0,91	0,75	0,92	0,64	Firm 2
AFYON	0,69	0,51	0,87	0,04	0,57	0,94	0,90	0,85	0,68	0,72	0,32	Firm 3
ALCAR	0,58	0,52	0,30	0,02	0,59	0,89	0,86	0,71	0,53	0,73	0,44	Firm 4
ALKA	0,90	0,85	0,63	0,02	0,40	0,91	0,83	0,69	0,51	0,73	0,38	Firm 5
ATPET	0,98	0,97	1,00	0,02	0,52	0,88	0,84	0,62	0,44	0,65	0,24	Firm 6
BAGFS	0,93	0,92	0,88	0,01	0,47	0,92	0,85	0,70	1,00	1,00	0,30	Firm 7
BFREN	0,83	0,72	0,48	0,09	0,46	0,92	0,90	0,77	0,60	0,85	0,64	Firm 8
BNTAS	0,81	0,73	0,67	0,02	0,45	0,91	0,88	0,72	0,55	0,70	0,33	Firm 9
BOLUC	0,99	0,96	0,62	0,03	0,83	1,00	1,00	0,92	0,73	0,85	0,65	Firm 10
BRISA	0,96	1,00	0,56	0,01	0,71	0,93	0,90	0,72	0,56	0,88	0,42	Firm 11
BSOKE	0,84	0,74	0,91	0,02	0,72	0,96	0,97	0,81	0,61	0,71	0,35	Firm 12
CEMTS	0,83	0,86	0,40	0,02	0,41	0,89	0,84	0,65	0,47	0,68	0,31	Firm 13
DAGI	1,00	0,95	0,97	0,02	0,77	0,90	0,87	0,67	0,48	0,70	0,32	Firm 14
DENCM	0,99	0,96	0,49	0,02	0,50	0,88	0,83	0,65	0,47	0,67	0,29	Firm 15
DERIM	0,98	0,93	0,29	0,12	0,31	0,89	0,85	0,65	0,47	0,76	0,30	Firm 16
DGZTE	0,46	0,19	0,10	1,00	0,92	0,92	0,96	0,99	0,79	0,77	0,57	Firm 17
DMSAS	0,96	0,98	0,81	0,02	0,34	0,88	0,83	0,65	0,47	0,70	0,31	Firm 18
EGGUB	0,89	0,90	0,85	0,01	0,53	0,93	0,87	0,63	0,45	0,66	0,25	Firm 19
EGSER	0,98	0,95	0,80	0,01	0,70	0,95	0,91	0,77	0,61	0,84	0,51	Firm 20
ERBOS	0,90	0,91	0,56	0,01	0,39	0,90	0,85	0,70	0,52	0,75	0,44	Firm 21
FMIZP	0,25	0,00	0,09	0,10	0,64	0,97	0,95	0,91	0,74	0,95	1,00	Firm 22
FROTO	0,93	0,97	0,69	0,09	0,35	0,90	0,84	0,67	0,49	0,86	0,43	Firm 23
GOODY	0,99	0,96	0,81	0,03	0,41	0,89	0,85	0,68	0,50	0,77	0,45	Firm 24
HEKTS	0,95	0,97	0,73	0,00	0,81	0,96	0,94	0,79	0,60	0,81	0,55	Firm 25
IHEVA	0,77	0,73	0,39	0,00	0,50	0,90	0,83	0,72	0,58	0,70	0,31	Firm 26
IHGZT	0,74	0,59	0,27	0,07	0,20	0,78	0,70	0,50	0,40	0,64	0,17	Firm 27
IZOCM	0,99	0,94	0,72	0,04	0,57	0,91	0,87	0,70	0,52	0,79	0,51	Firm 28
JANTS	0,98	0,98	0,68	0,01	0,55	0,92	0,89	0,71	0,53	0,74	0,40	Firm 29
KENT	0,99	0,94	0,59	0,04	0,79	0,90	0,85	0,71	0,54	0,75	0,42	Firm 30
KLMSN	0,91	0,83	0,40	0,02	0,54	0,92	0,89	0,70	0,53	0,83	0,35	Firm 31
KNFRT	0,30	0,78	0,14	0,00	0,51	0,93	0,90	0,77	0,58	0,73	0,47	Firm 32
KUTPO	0,90	0,95	0,49	0,00	0,78	0,91	0,88	0,73	0,54	0,74	0,44	Firm 33
MERKO	0,96	0,92	0,59	0,00	0,49	0,90	0,84	0,63	0,45	0,67	0,26	Firm 34
MRDIN	0,91	0,90	0,29	0,01	0,81	0,97	0,97	0,94	0,75	0,79	0,59	Firm 35
OTKAR	0,95	0,97	0,22	0,01	0,62	0,91	0,86	0,67	0,50	0,90	0,34	Firm 36
PETUN	0,99	1,00	0,37	0,05	0,45	0,91	0,85	0,74	0,56	0,78	0,52	Firm 37
PINSU	0,89	0,94	0,68	0,04	1,00	0,86	0,77	0,55	0,37	0,52	0,09	Firm 38
PNSUT	0,94	0,96	0,63	0,04	0,44	0,90	0,84	0,68	0,51	0,73	0,38	Firm 39
PRKME	0,83	0,76	0,27	0,01	0,49	0,88	0,90	0,81	0,63	0,70	0,36	Firm 40
PRZMA	0,16	0,25	0,00	0,01	0,35	0,90	0,84	0,69	0,51	0,67	0,30	Firm 41
SAMAT	0,99	0,95	0,57	0,01	0,40	0,91	0,86	0,63	0,45	0,66	0,25	Firm 42
TATGD	0,94	0,94	0,69	0,02	0,56	0,90	0,85	0,68	0,52	0,77	0,43	Firm 43
TTRAK	0,99	1,00	0,60	0,02	0,50	0,92	0,88	0,71	0,53	0,96	0,53	Firm 44
TUCLK	0,98	0,95	0,46	0,03	0,36	0,89	0,89	0,63	0,46	0,68	0,24	Firm 45
USAK	0,93	0,97	0,45	0,01	0,52	0,92	0,88	0,63	0,45	0,66	0,25	Firm 46
VESBE	1,00	0,95	0,81	0,04	0,42	0,92	0,87	0,68	0,51	0,83	0,43	Firm 47
ADANA	0,73	0,64	0,10	0,02	0,84	0,99	0,98	1,00	0,81	0,79	0,62	Firm 48
ADBGR	0,73	0,64	0,10	0,02	0,84	0,99	0,98	1,00	0,81	0,79	0,62	Firm 49
ADNAC	0,73	0,64	0,10	0,02	0,84	0,99	0,98	1,00	0,81	0,79	0,62	Firm 50
AEFES	0,99	0,94	0,84	0,03	0,88	0,91	0,86	0,61	0,42	0,63	0,23	Firm 51
AKCNS	1,00	0,96	0,54	0,04	0,67	0,97	0,95	0,84	0,65	0,84	0,63	Firm 52

Table 3. Normalized Decision Matrix

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
AKSA	0,97	0,98	0,88	0,05	0,50	0,93	0,91	0,74	0,55	0,77	0,46	Firm 53
ALKIM	0,87	0,86	0,42	0,02	0,61	0,93	0,88	0,75	0,58	0,78	0,49	Firm 54
ANACM	0,97	0,98	0,92	0,02	0,53	0,89	0,84	0,62	0,46	0,66	0,24	Firm 55
ARCLK	1,00	0,95	0,64	0,02	0,72	0,91	0,86	0,67	0,51	0,80	0,35	Firm 56
ASLAN	0,94	1,00	0,69	0,04	0,82	0,98	0,97	0,84	0,65	0,80	0,53	Firm 57
ASUZU	0,99	1,00	0,70	0,01	0,45	0,90	0,82	0,63	0,46	0,69	0,27	Firm 58
AYGAZ	0,95	1,00	0,63	0,18	0,34	0,89	0,83	0,68	0,51	0,77	0,46	Firm 59
BLCYT	0,99	0,94	0,73	0,02	0,59	0,95	0,96	0,86	0,71	0,84	0,46	Firm 60
BRSAN	0,92	0,94	0,77	0,01	0,36	0,89	0,84	0,64	0,45	0,66	0,27	Firm 61
BUCIM	0,89	0,86	0,60	0,02	0,53	0,92	0,88	0,72	0,53	0,77	0,44	Firm 62
CCOLA	1,00	0,95	0,92	0,04	0,77	0,92	0,86	0,65	0,46	0,68	0,28	Firm 63
CIMSA	0,98	0,95	0,66	0,05	0,71	0,98	0,96	0,86	0,67	0,81	0,53	Firm 64
CMBTN	0,96	0,95	0,99	0,57	0,29	0,88	0,81	0,63	0,45	0,68	0,30	Firm 65
CMENT	1,00	0,97	0,37	0,02	0,54	0,90	0,85	0,70	0,52	0,69	0,32	Firm 66
CUSAN	0,91	0,87	0,57	0,03	0,53	0,92	0,89	0,73	0,55	0,81	0,54	Firm 67
DITAS	0,99	0,99	0,69	0,02	0,50	0,87	0,81	0,62	0,43	0,64	0,23	Firm 68
DYOBY	0,94	1,00	0,24	0,03	0,74	0,92	0,85	0,61	0,44	0,67	0,23	Firm 69
GEDZA	0,58	0,57	0,29	0,02	0,47	0,90	0,86	0,70	0,50	0,68	0,33	Firm 70
GENTS	0,80	0,82	0,45	0,01	0,31	0,86	0,83	0,68	0,50	0,70	0,35	Firm 71
HURGZ	0,91	0,98	0,79	0,17	0,92	0,88	0,83	0,53	0,35	0,55	0,11	Firm 72
IHMAD	0,36	0,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,64	0,21	Firm 73
IZMDC	0,89	0,93	0,16	0,05	0,25	0,89	0,82	0,50	0,33	0,00	0,00	Firm 74
KARTN	0,99	0,98	0,36	0,02	0,31	0,88	0,81	0,69	0,53	0,71	0,35	Firm 75
KONYA	0,72	0,62	0,23	0,03	0,55	0,93	0,88	0,78	0,59	0,75	0,49	Firm 76
KORDS	0,98	0,98	0,87	0,01	0,48	0,91	0,86	0,69	0,51	0,74	0,36	Firm 77
KRATL	0,97	0,96	0,78	0,03	0,23	0,89	0,84	0,61	0,43	0,62	0,19	Firm 78
KRSTL	0,82	0,76	0,35	0,04	0,29	0,88	0,82	0,65	0,47	0,67	0,29	Firm 79
MNDRS	0,94	0,96	0,76	0,01	0,30	0,89	0,80	0,55	0,38	0,57	0,13	Firm 80
NUHCM	0,90	0,84	0,44	0,03	0,81	0,99	0,95	0,84	0,63	0,78	0,56	Firm 81
OLMIP	1,00	0,96	0,79	0,03	0,39	0,86	0,79	0,63	0,45	0,67	0,26	Firm 82
PARSN	0,93	0,95	0,78	0,01	0,65	0,91	0,86	0,69	0,56	0,69	0,27	Firm 83
PETKM	1,00	0,93	0,97	0,06	0,44	0,93	0,87	0,74	0,59	0,83	0,44	Firm 84
PIMAS	0,97	0,98	0,89	0,04	0,40	0,87	0,80	0,60	0,40	0,59	0,21	Firm 85
PRKAB	0,95	0,99	0,40	0,04	0,37	0,89	0,82	0,64	0,45	0,72	0,29	Firm 86
RTALB	0,80	0,75	0,44	0,01	0,96	0,96	0,97	0,88	0,69	0,78	0,54	Firm 87
SASA	0,99	1,00	0,87	0,02	0,39	0,90	0,86	0,68	0,51	0,79	0,44	Firm 88
SODA	0,78	0,68	0,38	0,04	0,63	0,95	0,92	0,89	0,71	0,81	0,59	Firm 89
TMPOL	0,96	0,99	0,63	0,02	0,53	0,94	0,89	0,67	0,49	0,75	0,34	Firm 90
TOASO	0,94	1,00	0,46	0,09	0,37	0,90	0,85	0,68	0,53	0,90	0,36	Firm 91
TRKCM	0,90	0,85	0,87	0,02	0,63	0,89	0,85	0,70	0,53	0,69	0,30	Firm 92
TUKAS	0,97	0,95	0,88	0,00	0,52	0,92	0,91	0,72	0,70	0,89	0,37	Firm 93
TUPRS	0,92	0,97	0,61	0,09	0,36	0,91	0,85	0,67	0,51	0,89	0,40	Firm 94
ULKER	0,80	0,69	0,81	0,06	0,54	0,92	0,88	0,71	0,54	0,79	0,39	Firm 95
UNYEC	0,60	0,52	0,17	0,02	0,73	0,96	0,96	0,87	0,68	0,78	0,60	Firm 96
VESTL	0,93	0,96	0,25	0,01	0,53	0,90	0,83	0,62	0,45	0,68	0,25	Firm 97
YUNSA	0,94	0,95	0,54	0,01	0,55	0,90	0,87	0,64	0,46	0,69	0,27	Firm 98

The fourth step is the construction of the difference series which is finding the absolute differences between the entries of the normalized decision matrix and the standard series values. Equation 6 is used for each cell in Table 3 in order to get difference series shown in equation 7. The results are given in Table 4.

Table 4. Difference Series

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
ACSEL	1,00	0,51	0,89	1,00	0,53	0,12	0,16	0,35	0,53	0,33	0,72	Firm 1
ADEL	0,02	0,02	0,09	1,00	0,02	0,05	0,09	0,09	0,25	0,08	0,36	Firm 2
AFYON	0,31	0,49	0,13	0,96	0,43	0,06	0,10	0,15	0,32	0,28	0,68	Firm 3
ALCAR	0,42	0,48	0,70	0,98	0,41	0,11	0,14	0,29	0,47	0,27	0,56	Firm 4
ALKA	0,10	0,15	0,37	0,98	0,60	0,09	0,17	0,31	0,49	0,27	0,62	Firm 5
ATPET	0,02	0,03	0,00	0,98	0,48	0,12	0,16	0,38	0,56	0,35	0,76	Firm 6
BAGFS	0,07	0,08	0,12	0,99	0,53	0,08	0,15	0,30	0,00	0,00	0,70	Firm 7
BFREN	0,17	0,28	0,52	0,91	0,54	0,08	0,10	0,23	0,40	0,15	0,36	Firm 8
BNTAS	0,19	0,27	0,33	0,98	0,55	0,09	0,12	0,28	0,45	0,30	0,67	Firm 9
BOLUC	0,01	0,04	0,38	0,97	0,17	0,00	0,00	0,08	0,27	0,15	0,35	Firm 10
BRISA	0,04	0,00	0,44	0,99	0,29	0,07	0,10	0,28	0,44	0,12	0,58	Firm 11
BSOKE	0,16	0,26	0,09	0,98	0,28	0,04	0,03	0,19	0,39	0,29	0,65	Firm 12
CEMTS	0,17	0,14	0,60	0,98	0,59	0,11	0,16	0,35	0,53	0,32	0,69	Firm 13
DAGI	0,00	0,05	0,03	0,98	0,23	0,10	0,13	0,33	0,52	0,30	0,68	Firm 14
DENCM	0,01	0,04	0,51	0,98	0,50	0,12	0,17	0,35	0,53	0,33	0,71	Firm 15
DERIM	0,02	0,07	0,71	0,88	0,69	0,11	0,15	0,35	0,53	0,24	0,70	Firm 16
DGZTE	0,54	0,81	0,90	0,00	0,08	0,08	0,04	0,01	0,21	0,23	0,43	Firm 17
DMSAS	0,04	0,02	0,19	0,98	0,66	0,12	0,17	0,35	0,53	0,30	0,69	Firm 18
EGGUB	0,11	0,10	0,15	0,99	0,47	0,07	0,13	0,37	0,55	0,34	0,75	Firm 19
EGSER	0,02	0,05	0,20	0,99	0,30	0,05	0,09	0,23	0,39	0,16	0,49	Firm 20
ERBOS	0,10	0,09	0,44	0,99	0,61	0,10	0,15	0,30	0,48	0,25	0,56	Firm 21
FMIZP	0,75	1,00	0,91	0,90	0,36	0,03	0,05	0,09	0,26	0,05	0,00	Firm 22
FROTO	0,07	0,03	0,31	0,91	0,65	0,10	0,16	0,33	0,51	0,14	0,57	Firm 23
GOODY	0,01	0,04	0,19	0,97	0,59	0,11	0,15	0,32	0,50	0,23	0,55	Firm 24
HEKTS	0,05	0,03	0,27	1,00	0,19	0,04	0,06	0,21	0,40	0,19	0,45	Firm 25
IHEVA	0,23	0,27	0,61	1,00	0,50	0,10	0,17	0,28	0,42	0,30	0,69	Firm 26
IHGZT	0,26	0,41	0,73	0,93	0,80	0,22	0,30	0,50	0,60	0,36	0,83	Firm 27
IZOCM	0,01	0,06	0,28	0,96	0,43	0,09	0,13	0,30	0,48	0,21	0,49	Firm 28
JANTS	0,02	0,02	0,32	0,99	0,45	0,08	0,11	0,29	0,47	0,26	0,60	Firm 29
KENT	0,01	0,06	0,41	0,96	0,21	0,10	0,15	0,29	0,46	0,25	0,58	Firm 30
KLMSN	0,09	0,17	0,60	0,98	0,46	0,08	0,11	0,30	0,47	0,17	0,65	Firm 31
KNFRT	0,70	0,22	0,86	1,00	0,49	0,07	0,10	0,23	0,42	0,27	0,53	Firm 32
KUTPO	0,10	0,05	0,51	1,00	0,22	0,09	0,12	0,27	0,46	0,26	0,56	Firm 33
MERKO	0,04	0,08	0,41	1,00	0,51	0,10	0,16	0,37	0,55	0,33	0,74	Firm 34
MRDIN	0,09	0,10	0,71	0,99	0,19	0,03	0,03	0,06	0,25	0,21	0,41	Firm 35
OTKAR	0,05	0,03	0,78	0,99	0,38	0,09	0,14	0,33	0,50	0,10	0,66	Firm 36
PETUN	0,01	0,00	0,63	0,95	0,55	0,09	0,15	0,26	0,44	0,22	0,48	Firm 37
PINSU	0,11	0,06	0,32	0,96	0,00	0,14	0,23	0,45	0,63	0,48	0,91	Firm 38
PNSUT	0,06	0,04	0,37	0,96	0,56	0,10	0,16	0,32	0,49	0,27	0,62	Firm 39
PRKME	0,17	0,24	0,73	0,99	0,51	0,12	0,10	0,19	0,37	0,30	0,64	Firm 40
PRZMA	0,84	0,75	1,00	0,99	0,65	0,10	0,16	0,31	0,49	0,33	0,70	Firm 41
SAMAT	0,01	0,05	0,43	0,99	0,60	0,09	0,14	0,37	0,55	0,34	0,75	Firm 42
TATGD	0,06	0,06	0,31	0,98	0,44	0,10	0,15	0,32	0,48	0,23	0,57	Firm 43
TTRAK	0,01	0,00	0,40	0,98	0,50	0,08	0,12	0,29	0,47	0,04	0,47	Firm 44
TUCLK	0,02	0,05	0,54	0,97	0,64	0,11	0,11	0,37	0,54	0,32	0,76	Firm 45
USAK	0,07	0,03	0,55	0,99	0,48	0,08	0,12	0,37	0,55	0,34	0,75	Firm 46

Table 4. Difference Series

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
VESBE	0,00	0,05	0,19	0,96	0,58	0,08	0,13	0,32	0,49	0,17	0,57	Firm 47
ADANA	0,27	0,36	0,90	0,98	0,16	0,01	0,02	0,00	0,19	0,21	0,38	Firm 48
ADBGR	0,27	0,36	0,90	0,98	0,16	0,01	0,02	0,00	0,19	0,21	0,38	Firm 49
ADNAC	0,27	0,36	0,90	0,98	0,16	0,01	0,02	0,00	0,19	0,21	0,38	Firm 50
AEFES	0,01	0,06	0,16	0,97	0,12	0,09	0,14	0,39	0,58	0,37	0,77	Firm 51
AKCNS	0,00	0,04	0,46	0,96	0,33	0,03	0,05	0,16	0,35	0,16	0,37	Firm 52
AKSA	0,03	0,02	0,12	0,95	0,50	0,07	0,09	0,26	0,45	0,23	0,54	Firm 53
ALKIM	0,13	0,14	0,58	0,98	0,39	0,07	0,12	0,25	0,42	0,22	0,51	Firm 54
ANACM	0,03	0,02	0,08	0,98	0,47	0,11	0,16	0,38	0,54	0,34	0,76	Firm 55
ARCLK	0,00	0,05	0,36	0,98	0,28	0,09	0,14	0,33	0,49	0,20	0,65	Firm 56
ASLAN	0,06	0,00	0,31	0,96	0,18	0,02	0,03	0,16	0,35	0,20	0,47	Firm 57
ASUZU	0,01	0,00	0,30	0,99	0,55	0,10	0,18	0,37	0,54	0,31	0,73	Firm 58
AYGAZ	0,05	0,00	0,37	0,82	0,66	0,11	0,17	0,32	0,49	0,23	0,54	Firm 59
BLCYT	0,01	0,06	0,27	0,98	0,41	0,05	0,04	0,14	0,29	0,16	0,54	Firm 60
BRSAN	0,08	0,06	0,23	0,99	0,64	0,11	0,16	0,36	0,55	0,34	0,73	Firm 61
BUCIM	0,11	0,14	0,40	0,98	0,47	0,08	0,12	0,28	0,47	0,23	0,56	Firm 62
CCOLA	0,00	0,05	0,08	0,96	0,23	0,08	0,14	0,35	0,54	0,32	0,72	Firm 63
CIMSA	0,02	0,05	0,34	0,95	0,29	0,02	0,04	0,14	0,33	0,19	0,47	Firm 64
CMBTN	0,04	0,05	0,01	0,43	0,71	0,12	0,19	0,37	0,55	0,32	0,70	Firm 65
CMENT	0,00	0,03	0,63	0,98	0,46	0,10	0,15	0,30	0,48	0,31	0,68	Firm 66
CUSAN	0,09	0,13	0,43	0,97	0,47	0,08	0,11	0,27	0,45	0,19	0,46	Firm 67
DITAS	0,01	0,01	0,31	0,98	0,50	0,13	0,19	0,38	0,57	0,36	0,77	Firm 68
DYOBY	0,06	0,00	0,76	0,97	0,26	0,08	0,15	0,39	0,56	0,33	0,77	Firm 69
GEDZA	0,42	0,43	0,71	0,98	0,53	0,10	0,14	0,30	0,50	0,32	0,67	Firm 70
GENTS	0,20	0,18	0,55	0,99	0,69	0,14	0,17	0,32	0,50	0,30	0,65	Firm 71
HURGZ	0,09	0,02	0,21	0,83	0,08	0,12	0,17	0,47	0,65	0,45	0,89	Firm 72
IHMAD	0,64	0,90	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,36	0,79	Firm 73
IZMDC	0,11	0,07	0,84	0,95	0,75	0,11	0,18	0,50	0,67	1,00	1,00	Firm 74
KARTN	0,01	0,02	0,64	0,98	0,69	0,12	0,19	0,31	0,47	0,29	0,65	Firm 75
KONYA	0,28	0,38	0,77	0,97	0,45	0,07	0,12	0,22	0,41	0,25	0,51	Firm 76
KORDS	0,02	0,02	0,13	0,99	0,52	0,09	0,14	0,31	0,49	0,26	0,64	Firm 77
KRATL	0,03	0,04	0,22	0,97	0,77	0,11	0,16	0,39	0,57	0,38	0,81	Firm 78
KRSTL	0,18	0,24	0,65	0,96	0,71	0,12	0,18	0,35	0,53	0,33	0,71	Firm 79
MNDRS	0,06	0,04	0,24	0,99	0,70	0,11	0,20	0,45	0,62	0,43	0,87	Firm 80
NUHCM	0,10	0,16	0,56	0,97	0,19	0,01	0,05	0,16	0,37	0,22	0,44	Firm 81
OLMIP	0,00	0,04	0,21	0,97	0,61	0,14	0,21	0,37	0,55	0,33	0,74	Firm 82
PARSN	0,07	0,05	0,22	0,99	0,35	0,09	0,14	0,31	0,44	0,31	0,73	Firm 83
PETKM	0,00	0,07	0,03	0,94	0,56	0,07	0,13	0,26	0,41	0,17	0,56	Firm 84
PIMAS	0,03	0,02	0,11	0,96	0,60	0,13	0,20	0,40	0,60	0,41	0,79	Firm 85
PRKAB	0,05	0,01	0,60	0,96	0,63	0,11	0,18	0,36	0,55	0,28	0,71	Firm 86
RTALB	0,20	0,25	0,56	0,99	0,04	0,04	0,03	0,12	0,31	0,22	0,46	Firm 87
SASA	0,01	0,00	0,13	0,98	0,61	0,10	0,14	0,32	0,49	0,21	0,56	Firm 88
SODA	0,22	0,32	0,62	0,96	0,37	0,05	0,08	0,11	0,29	0,19	0,41	Firm 89
TMPOL	0,04	0,01	0,37	0,98	0,47	0,06	0,11	0,33	0,51	0,25	0,66	Firm 90
TOASO	0,06	0,00	0,54	0,91	0,63	0,10	0,15	0,32	0,47	0,10	0,64	Firm 91
TRKCM	0,10	0,15	0,13	0,98	0,37	0,11	0,15	0,30	0,47	0,31	0,70	Firm 92
TUKAS	0,03	0,05	0,12	1,00	0,48	0,08	0,09	0,28	0,30	0,11	0,63	Firm 93
TUPRS	0,08	0,03	0,39	0,91	0,64	0,09	0,15	0,33	0,49	0,11	0,60	Firm 94
ULKER	0,20	0,31	0,19	0,94	0,46	0,08	0,12	0,29	0,46	0,21	0,61	Firm 95
UNYEC	0,40	0,48	0,83	0,98	0,27	0,04	0,04	0,13	0,32	0,22	0,40	Firm 96

Table 4. Difference Series

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
VESTL	0,07	0,04	0,75	0,99	0,47	0,10	0,17	0,38	0,55	0,32	0,75	Firm 97
YUNSA	0,06	0,05	0,46	0,99	0,45	0,10	0,13	0,36	0,54	0,31	0,73	Firm 98

Calculation of grey relational coefficients and construction of grey factor matrix is the fifth step. Equation 8 is used for each cell in Table 4 in order to get grey factor matrix shown in equation 9. The results of step 5 (Grey factor matrix) can be constructed as in Table 5.

Table 5. Grey Factor Matrix

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
ACSEL	0,33	0,50	0,36	0,33	0,49	0,81	0,76	0,59	0,49	0,60	0,41	Firm 1
ADEL	0,96	0,96	0,84	0,33	0,96	0,91	0,84	0,85	0,67	0,86	0,58	Firm 2
AFYON	0,61	0,50	0,80	0,34	0,54	0,90	0,84	0,77	0,61	0,64	0,42	Firm 3
ALCAR	0,55	0,51	0,42	0,34	0,55	0,82	0,79	0,64	0,52	0,65	0,47	Firm 4
ALKA	0,83	0,77	0,57	0,34	0,45	0,84	0,75	0,61	0,51	0,65	0,45	Firm 5
ATPET	0,96	0,94	1,00	0,34	0,51	0,81	0,76	0,57	0,47	0,59	0,40	Firm 6
BAGFS	0,88	0,87	0,80	0,33	0,49	0,86	0,77	0,63	1,00	1,00	0,42	Firm 7
BFREN	0,75	0,64	0,49	0,35	0,48	0,87	0,83	0,69	0,56	0,77	0,58	Firm 8
BNTAS	0,72	0,65	0,60	0,34	0,48	0,84	0,80	0,64	0,53	0,63	0,43	Firm 9
BOLUC	0,98	0,92	0,57	0,34	0,74	1,00	1,00	0,86	0,65	0,77	0,59	Firm 10
BRISA	0,93	0,99	0,53	0,34	0,63	0,88	0,84	0,64	0,53	0,81	0,46	Firm 11
BSOKE	0,76	0,66	0,84	0,34	0,64	0,92	0,94	0,72	0,56	0,64	0,43	Firm 12
CEMTS	0,74	0,79	0,45	0,34	0,46	0,82	0,75	0,59	0,49	0,61	0,42	Firm 13
DAGI	0,99	0,90	0,95	0,34	0,68	0,84	0,80	0,60	0,49	0,62	0,43	Firm 14
DENCM	0,98	0,92	0,50	0,34	0,50	0,81	0,74	0,59	0,49	0,61	0,41	Firm 15
DERIM	0,97	0,88	0,41	0,36	0,42	0,83	0,77	0,59	0,48	0,68	0,42	Firm 16
DGZTE	0,48	0,38	0,36	1,00	0,86	0,87	0,92	0,98	0,71	0,68	0,54	Firm 17
DMSAS	0,93	0,96	0,73	0,34	0,43	0,81	0,74	0,59	0,49	0,63	0,42	Firm 18
EGGUB	0,82	0,84	0,77	0,34	0,51	0,88	0,79	0,57	0,47	0,60	0,40	Firm 19
EGSER	0,96	0,91	0,72	0,34	0,63	0,90	0,84	0,68	0,56	0,75	0,50	Firm 20
ERBOS	0,83	0,85	0,53	0,34	0,45	0,84	0,77	0,62	0,51	0,66	0,47	Firm 21
FMIZP	0,40	0,33	0,35	0,36	0,58	0,94	0,91	0,84	0,66	0,91	1,00	Firm 22
FROTO	0,88	0,95	0,62	0,35	0,44	0,83	0,76	0,60	0,50	0,79	0,47	Firm 23
GOODY	0,98	0,92	0,72	0,34	0,46	0,82	0,76	0,61	0,50	0,68	0,48	Firm 24
HEKTS	0,90	0,95	0,65	0,33	0,73	0,92	0,89	0,71	0,56	0,73	0,53	Firm 25
IHEVA	0,69	0,65	0,45	0,33	0,50	0,83	0,75	0,64	0,54	0,62	0,42	Firm 26
IHGZT	0,66	0,55	0,41	0,35	0,38	0,70	0,63	0,50	0,45	0,58	0,38	Firm 27
IZOCM	0,98	0,90	0,64	0,34	0,54	0,85	0,79	0,63	0,51	0,70	0,50	Firm 28
JANTS	0,96	0,96	0,61	0,34	0,53	0,86	0,83	0,63	0,51	0,66	0,46	Firm 29
KENT	0,99	0,89	0,55	0,34	0,71	0,83	0,77	0,63	0,52	0,66	0,46	Firm 30
KLMSN	0,85	0,75	0,45	0,34	0,52	0,86	0,82	0,63	0,51	0,75	0,44	Firm 31
KNFRT	0,42	0,70	0,37	0,33	0,51	0,87	0,83	0,68	0,54	0,65	0,48	Firm 32
KUTPO	0,83	0,91	0,49	0,33	0,69	0,85	0,80	0,65	0,52	0,66	0,47	Firm 33
MERKO	0,92	0,87	0,55	0,33	0,49	0,83	0,75	0,57	0,48	0,60	0,40	Firm 34
MRDIN	0,85	0,83	0,41	0,34	0,72	0,95	0,95	0,89	0,67	0,71	0,55	Firm 35
OTKAR	0,92	0,94	0,39	0,34	0,57	0,84	0,79	0,61	0,50	0,84	0,43	Firm 36
PETUN	0,98	1,00	0,44	0,34	0,48	0,84	0,77	0,65	0,53	0,69	0,51	Firm 37
PINSU	0,83	0,89	0,61	0,34	1,00	0,78	0,69	0,52	0,44	0,51	0,36	Firm 38

Table 5. Grey Factor Matrix

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
PNSUT	0,89	0,92	0,57	0,34	0,47	0,83	0,75	0,61	0,50	0,65	0,45	Firm 39
PRKME	0,75	0,67	0,41	0,34	0,50	0,80	0,83	0,73	0,58	0,63	0,44	Firm 40
PRZMA	0,37	0,40	0,33	0,34	0,43	0,83	0,76	0,61	0,50	0,60	0,42	Firm 41
SAMAT	0,97	0,91	0,54	0,33	0,45	0,85	0,78	0,57	0,47	0,60	0,40	Firm 42
TATGD	0,89	0,89	0,62	0,34	0,53	0,84	0,77	0,61	0,51	0,69	0,47	Firm 43
TTRAK	0,97	1,00	0,56	0,34	0,50	0,87	0,81	0,63	0,52	0,92	0,51	Firm 44
TUCLK	0,96	0,91	0,48	0,34	0,44	0,82	0,82	0,57	0,48	0,61	0,40	Firm 45
USAK	0,88	0,94	0,47	0,34	0,51	0,87	0,80	0,58	0,47	0,59	0,40	Firm 46
VESBE	0,99	0,91	0,72	0,34	0,46	0,86	0,79	0,61	0,50	0,74	0,47	Firm 47
ADANA	0,65	0,58	0,36	0,34	0,76	0,97	0,96	1,00	0,73	0,71	0,57	Firm 48
ADBGR	0,65	0,58	0,36	0,34	0,76	0,97	0,96	1,00	0,73	0,71	0,57	Firm 49
ADNAC	0,65	0,58	0,36	0,34	0,76	0,97	0,96	1,00	0,73	0,71	0,57	Firm 50
AEFES	0,97	0,89	0,76	0,34	0,81	0,85	0,78	0,56	0,46	0,58	0,39	Firm 51
AKCNS	1,00	0,92	0,52	0,34	0,61	0,95	0,90	0,76	0,59	0,75	0,58	Firm 52
AKSA	0,94	0,95	0,80	0,34	0,50	0,88	0,85	0,65	0,52	0,69	0,48	Firm 53
ALKIM	0,79	0,78	0,46	0,34	0,56	0,87	0,80	0,66	0,54	0,69	0,49	Firm 54
ANACM	0,95	0,96	0,87	0,34	0,52	0,83	0,76	0,57	0,48	0,60	0,40	Firm 55
ARCLK	0,99	0,91	0,58	0,34	0,64	0,84	0,78	0,60	0,50	0,71	0,43	Firm 56
ASLAN	0,90	1,00	0,62	0,34	0,73	0,96	0,95	0,76	0,59	0,71	0,52	Firm 57
ASUZU	0,99	1,00	0,63	0,34	0,48	0,83	0,74	0,58	0,48	0,62	0,41	Firm 58
AYGAZ	0,90	1,00	0,57	0,38	0,43	0,82	0,75	0,61	0,51	0,69	0,48	Firm 59
BLCYT	0,98	0,89	0,65	0,34	0,55	0,91	0,92	0,78	0,64	0,76	0,48	Firm 60
BRSAN	0,87	0,90	0,68	0,34	0,44	0,82	0,75	0,58	0,48	0,60	0,41	Firm 61
BUCIM	0,82	0,78	0,55	0,34	0,52	0,86	0,80	0,64	0,52	0,68	0,47	Firm 62
CCOLA	1,00	0,92	0,86	0,34	0,69	0,86	0,78	0,58	0,48	0,61	0,41	Firm 63
CIMSA	0,97	0,92	0,59	0,34	0,63	0,96	0,93	0,78	0,60	0,73	0,52	Firm 64
CMBTN	0,93	0,91	0,97	0,54	0,41	0,80	0,73	0,58	0,48	0,61	0,42	Firm 65
CMENT	0,99	0,94	0,44	0,34	0,52	0,84	0,77	0,63	0,51	0,62	0,42	Firm 66
CUSAN	0,85	0,79	0,54	0,34	0,52	0,86	0,82	0,65	0,53	0,73	0,52	Firm 67
DITAS	0,97	0,98	0,62	0,34	0,50	0,80	0,72	0,57	0,47	0,58	0,39	Firm 68
DYOBY	0,90	0,99	0,40	0,34	0,65	0,86	0,77	0,56	0,47	0,60	0,39	Firm 69
GEDZA	0,54	0,54	0,41	0,34	0,49	0,84	0,78	0,62	0,50	0,61	0,43	Firm 70
GENTS	0,72	0,73	0,47	0,34	0,42	0,78	0,75	0,61	0,50	0,63	0,43	Firm 71
HURGZ	0,85	0,96	0,70	0,38	0,86	0,80	0,75	0,52	0,43	0,52	0,36	Firm 72
IHMAD	0,44	0,36	0,33	0,33	0,33	0,33	0,33	0,33	0,33	0,58	0,39	Firm 73
IZMDC	0,82	0,87	0,37	0,34	0,40	0,82	0,74	0,50	0,43	0,33	0,33	Firm 74
KARTN	0,99	0,96	0,44	0,34	0,42	0,80	0,73	0,62	0,51	0,63	0,43	Firm 75
KONYA	0,64	0,57	0,39	0,34	0,52	0,87	0,81	0,69	0,55	0,66	0,50	Firm 76
KORDS	0,95	0,96	0,79	0,34	0,49	0,85	0,79	0,62	0,51	0,66	0,44	Firm 77
KRATL	0,93	0,93	0,69	0,34	0,39	0,81	0,76	0,56	0,47	0,57	0,38	Firm 78
KRSTL	0,74	0,67	0,43	0,34	0,41	0,81	0,74	0,59	0,48	0,60	0,41	Firm 79
MNDRS	0,89	0,92	0,68	0,34	0,42	0,82	0,72	0,53	0,45	0,54	0,36	Firm 80
NUHCM	0,84	0,76	0,47	0,34	0,72	0,98	0,91	0,76	0,58	0,69	0,53	Firm 81
OLMIP	1,00	0,93	0,70	0,34	0,45	0,79	0,71	0,57	0,48	0,60	0,40	Firm 82
PARSN	0,87	0,91	0,70	0,34	0,59	0,85	0,79	0,62	0,53	0,62	0,41	Firm 83
PETKM	1,00	0,88	0,94	0,35	0,47	0,87	0,80	0,65	0,55	0,75	0,47	Firm 84
PIMAS	0,94	0,95	0,82	0,34	0,45	0,79	0,71	0,56	0,45	0,55	0,39	Firm 85
PRKAB	0,91	0,99	0,45	0,34	0,44	0,82	0,73	0,58	0,48	0,64	0,41	Firm 86
RTALB	0,71	0,67	0,47	0,33	0,92	0,93	0,95	0,81	0,62	0,70	0,52	Firm 87
SASA	0,99	0,99	0,79	0,34	0,45	0,84	0,78	0,61	0,50	0,70	0,47	Firm 88

Table 5. Grey Factor Matrix

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	
SODA	0,70	0,61	0,45	0,34	0,58	0,91	0,87	0,82	0,64	0,72	0,55	Firm 89
TMPOL	0,93	0,98	0,58	0,34	0,52	0,89	0,81	0,61	0,49	0,67	0,43	Firm 90
TOASO	0,89	0,99	0,48	0,36	0,44	0,84	0,77	0,61	0,52	0,83	0,44	Firm 91
TRKCM	0,83	0,76	0,79	0,34	0,57	0,83	0,77	0,63	0,51	0,62	0,42	Firm 92
TUKAS	0,95	0,91	0,81	0,33	0,51	0,86	0,85	0,64	0,62	0,82	0,44	Firm 93
TUPRS	0,87	0,94	0,56	0,35	0,44	0,85	0,77	0,60	0,51	0,82	0,46	Firm 94
ULKER	0,72	0,62	0,73	0,35	0,52	0,87	0,81	0,64	0,52	0,71	0,45	Firm 95
UNYEC	0,56	0,51	0,38	0,34	0,65	0,93	0,92	0,80	0,61	0,70	0,56	Firm 96
VESTL	0,88	0,92	0,40	0,34	0,52	0,83	0,74	0,57	0,47	0,61	0,40	Firm 97
YUNSA	0,89	0,90	0,52	0,33	0,53	0,83	0,79	0,58	0,48	0,62	0,41	Firm 98

Determination of grey relational grades is the last step of GRA analysis. It is accepted that each ratio has the same importance weight and equation 10 is used for calculation. Values in Table 5 are employed in order to get the Grey relational grades of the manufacturing companies. Sorted Grey relational grades are shown in Table 6. The results interpret that the last ten companies are İhlas Madencilik, İhlas Gazetecilik, Prizma Press Matbaacılık, Acıpayam Seluloz, İzmir Demir Çelik, Gediz Ambalaj, Kristal Kola, Alarko Carrier, Gentaş, and Konfrut Gıda. On the other hand, top ten companies are Adel Kalemcilik, Bolu Çimento, Aslan Çimento, Bağfaş, Çimsa, Akçansa, Bilici Yatırım, Hektaş, Mardin Çimento and Ege Seramik. The massiveness of the cement companies is conspicuous.

It is quite difficult to detect the specific common points for the last ten companies. Majority of them have negative or very low profitability ratios, abnormally high current ratios, great difference between current ratio and acid-test ratios (which indicates excess inventory problem), very low financial leverage ratios except İzmir Demirçelik, and negative or very low ROE and economic profitability ratios.

Consequently, the findings manifest that companies which have positive profitability ratios, moderate liquidity ratios, acceptable inventory levels, higher ROE and economic profitability ratios, and which use financial leverage moderately show distinctive performances and are ranked as the leading companies.

Table 6. Sorted Grey Relational Grades

ADEL	0,80	Firm 2
BOLUC	0,77	Firm 10
ASLAN	0,73	Firm 57
BAGFS	0,73	Firm 7
CIMSA	0,72	Firm 64
AKCNS	0,72	Firm 52
BLCYT	0,72	Firm 60
HEKTS	0,72	Firm 25
MRDIN	0,71	Firm 35
EGSER	0,71	Firm 20
DGZTE	0,71	Firm 17
TUKAS	0,70	Firm 93
PETKM	0,70	Firm 84
DAGI	0,69	Firm 14
RTALB	0,69	Firm 87
TTRAK	0,69	Firm 44
ADANA	0,69	Firm 48
ADBGR	0,69	Firm 49
ADNAC	0,69	Firm 50
AKSA	0,69	Firm 53
NUHCM	0,69	Firm 81
BRISA	0,69	Firm 11

CCOLA	0,68	Firm 63
SASA	0,68	Firm 88
BSOKE	0,68	Firm 12
VESBE	0,67	Firm 47
AEFES	0,67	Firm 51
IZOCM	0,67	Firm 28
KORDS	0,67	Firm 77
CMBTN	0,67	Firm 65
KENT	0,67	Firm 30
JANTS	0,67	Firm 29
ARCLK	0,67	Firm 56
ATPET	0,67	Firm 6
GOODY	0,66	Firm 24
FMIZP	0,66	Firm 22
ANACM	0,66	Firm 55
PETUN	0,66	Firm 37
TMPOL	0,66	Firm 90
PARSN	0,66	Firm 83
KUTPO	0,66	Firm 33
FROTO	0,65	Firm 23
SODA	0,65	Firm 89
TUPRS	0,65	Firm 94
TOASO	0,65	Firm 91
OTKAR	0,65	Firm 36
TATGD	0,65	Firm 43
AYGAZ	0,65	Firm 59
CUSAN	0,65	Firm 67
HURGZ	0,65	Firm 72
TRKCM	0,64	Firm 92
ASUZU	0,64	Firm 58
DMSAS	0,64	Firm 18
CMENT	0,64	Firm 66
ALKIM	0,64	Firm 54
BFREN	0,64	Firm 8
PNSUT	0,64	Firm 39
BUCIM	0,63	Firm 62
EGGUB	0,63	Firm 19
PINSU	0,63	Firm 38
AFYON	0,63	Firm 3
OLMIP	0,63	Firm 82
PIMAS	0,63	Firm 85
UNYEC	0,63	Firm 96
DYOBY	0,63	Firm 69
DITAS	0,63	Firm 68
ULKER	0,63	Firm 95
KLMSN	0,63	Firm 31
SAMAT	0,63	Firm 42
ERBOS	0,63	Firm 21
YUNSA	0,63	Firm 98
KARTN	0,62	Firm 75
DENCM	0,62	Firm 15
USAK	0,62	Firm 46
BRSAN	0,62	Firm 61
KRATL	0,62	Firm 78
TUCLK	0,62	Firm 45
PRKAB	0,62	Firm 86
MERKO	0,62	Firm 34
DERIM	0,62	Firm 16
ALKA	0,62	Firm 5
VESTL	0,61	Firm 97
PRKME	0,61	Firm 40
BNTAS	0,61	Firm 9
MNDRS	0,60	Firm 80
KONYA	0,60	Firm 76
CEMTS	0,59	Firm 13
IHEVA	0,58	Firm 26
KNFRT	0,58	Firm 32
GENTS	0,58	Firm 71
ALCAR	0,57	Firm 4
KRSTL	0,57	Firm 79
GEDZA	0,55	Firm 70
IZMDC	0,54	Firm 74
ACSEL	0,51	Firm 1
PRZMA	0,51	Firm 41
IHGZT	0,51	Firm 27
IHMAD	0,37	Firm 73

4. CONCLUSION

As a reflection of industrial performance of the country, the financial performance of the manufacturing companies that are listed on the stock market can be considered as an indicator. The performance of those companies are frequently subject to analysis by investors, managers, financial institutions, and also government.

The history shows that companies have used different performance measurement methods in order to correctly evaluate the financial position of themselves. The most commonly used method is financial ratio analysis which focuses on financial statements through four main categories: liquidity, activity, debt structure and profitability. These categories comprise various indicators, and measuring the performance of companies over these indicators turns into a MCDM problem that necessitates an analytical approach to solve. The literature indicated that the commonly used MCDM methods are TOPSIS, DEA, and GRA methodologies, and their mixtures with similar methods. The studies employing GRA are comparatively less than others and it has offered a new method to the investors for evaluating companies.

In this context, this paper aimed at evaluating financial performance of the all listed manufacturing companies with GRA which is a compatible method with the selected indicators, i.e. ratios, and also the size of the dataset by considering uncertainty. This method, different than the financial ratio analysis, provides appraisal of various financial ratios totally, and prevents erroneous judgment resulting from focusing on specific ratios, not all of them.

All of ninety-eight manufacturing companies listed on Borsa İstanbul for the last year (2015) are evaluated with GRA via six steps; decision matrix construction, standard series construction, normalization of the decision matrix, construction of the difference series, calculation of grey relational coefficients and construction of grey factor matrix, and determination of grey relational grades. In total, eleven financial ratios are employed in the analysis in order to show the financial position of the selected companies in terms of liquidity, debt structure, activity and profitability. According to the results, most of the top ten companies are cement and fertilizer companies and a stationery company shows the highest performance. Findings indicated that in order to get higher grey relational grades and to be ranked at the top of the list; making profit, having optimal level of liquidity and debt, and efficiency in inventories are the most important factors. On the other hand, making loss, anomalies in liquidity (especially too high ratios, which indicates inefficient use of funds) and underutilized debt cause being ranked at the bottom of the list.

This study may contribute to the literature in two ways. First of all, it considers almost all ratios which are directly or indirectly related with profitability in order to measure and evaluate the performance exactly, hence a wide range of ratios provided more actual performance analysis. In addition, the company's exact performance is examined in all its

parts by considering uncertainty in the environment. As a matter of fact, this contribution is the result of using Grey analysis which enables bearing more than one indicator in mind with some deviations. Secondly, it covers all manufacturing industry companies. Previous studies have generally comprised limited number of companies. This study may be considered as the one which investigates all manufacturing industry companies listed on Borsa İstanbul and employs a great number of ratios for Grey analysis.

Future research may be conducted on various industries besides manufacturing, and a longer time span may be analyzed for comparison of different years by considering crisis periods. Comparing different industries is also possible, however one should consider the risky situation while evaluating the acceptable values of the selected ratios for the corresponding industries, because of the fact that high performance thresholds may differ.

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