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# A SWARA-GRA Integrated Approach For Combating Information Overload: Investment Appraisal And Decisions*

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## *ABSTRACT*

*The usage of multi-criteria decision making methods under investment appraisals and decisions has become fairly popular over the years. Working towards simplifying the information amount/complexity for the decision process, these methods also serve towards combating information overload in increasingly saturated markets. The SWARA-GRA integrated approach is offered as an alternative to the traditional ratio analysis, providing the best available investment alternatives within a number of criteria or attributes. The study analyzes the 2015-2017 financial performance of 27 BIST Food and Beverage firms based on the BIST approved quoting criteria (43 variables). The results of the analysis highlight the benefits of a SWARA-GRA approach for investment appraisals, as sudden jumps between ranks from one period to the next were made easier to follow without relinquishing use of any of the assessment variables. This method could prove useful for investors as it aids in providing a holistic view of the firm.*

***Keywords:*** *Financial Information Overload; SWARA-GRA; Financial Decisions; Multi Criteria Decision Making; Investment Appraisal.*

***Jel Classification****: M40, M41, M49.*

## *Aşırı Bilgi Yüklemesi ile Mücadelede Entegre SWARA-GRA Yaklaşımı: Yatırım Değerlendirme ve Kararlar*

## *ÖZET*

*Yatırım değerlendirme ve kararlarında çok-kriterli karar verme yöntemleri son yıllarda yaygın olarak kullanılır hale gelmiştir. Karar sürecini olumsuz etkileyen aşırı bilgi yükü ve karmaşıklığını azaltmak için kullanılan bu yöntemler, özellikle bilgiye doymuş pazarlarda geleneksel rasyo analizlerine bir alternatif olarak sunulmuştur. SWARA-GRA entegre yaklaşımı, bir dizi kriter veya nitelik içinde mevcut en iyi yatırım alternatiflerini sunmaktadır. Bu çalışmada, BİST kotasyon şartları (43 değişken) göz önüne alınarak, Yiyecek ve İçecek sektöründe faaliyet gösteren 27 şirketin 2015-2017 finansal performansı analiz edilmiştir. Analiz sonuçları, SWARA-GRA yaklaşımının yatırım değerlendirmelerine sağladığı faydalar vurgulanmaktadır. Bu yöntem sayesinde dönemsel şirket performansındaki ani hareketlerin takibi, değerlendirme kriterlerinin kullanımından ödün vermeden, kolay hale getirilmektedir. SWARA-GRA entegre yaklaşımı şirketin bütünsel görünümünü sergilediğinden dolayı bu yöntemin uygulanması yatırım kararları almakta fayda sağlayacaktır.*

***Anahtar Kelimeler:*** *Aşırı Bilgi Yüklenmesi; Swara-GRA; Finansal Kararlar; Çok Kriterli Karar Verme; Yatırım Değerlendirmeleri*

***JEL Sınıflandırması:*** *M40, M41, M49.*

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## 1. INTRODUCTION

Initially coined by Alvin Toffler (1984) in their book titled "*Future Shock"*, the term Information Overload refers to the disadvantageous effect of too much information on decision-making. Argued to reduce predictive accuracy by confronting individuals with rapidly and irregularly changing inputs and situations, information overload under the field of accounting/finance translates into reduced quality of decision-making (Keller and Staelin, 1987), as the quantity of information increases (Speier et al., 1999). Coupled with the fact that the internet is often plagued with unwanted noise (Farhoomand and Drury, 2002), it is not surprising that investors are face with an excess clutter (Raddin, 2007). This information can not only arise in the form of regulated financial statements, disclosures and corporate website postings, but can also consist of unregulated information, such as; investor or news reports. Moreover, Martin (2013: 1) argues that in addition to information overload, the inherent complexity and volume of financial statement disclosures contributes towards reducing the quality of decision making. The IASB and FASB too are both supportive of this argument and recognize the general discontent regarding the (1) overload of information and (2) increasing financial disclosure requirements (Martin, 2013). In 2011 an Institute of Chartered Accountants of Scotland and the New Zealand representative stated that "*losing the excess baggage and reducing disclosures in financial statements to what's important*". Similarly, Möllers (2010: 1009) states that although the annual financial statement as one of the most important data on corporations, it is still too complex.

In order to combat this, both IASB and FASB have started consideration of several projects with the aim of reducing the hundreds of pages long documents in the future. However, in the meantime the problem of information overload could be solved via use of rigorous statistical techniques (Buchanan and Kock, 2001: 4) serving to filter through information and present it in a way investor can understand, drastically reducing the risk of information overload. With the amount of information available to investors, the question becomes what is more important for evaluating the financial performance of organizations. Although more traditional methods are available for investors, such as traditional ratio analysis, their usage has become limited, in comparison. On the other hand, multi-criteria decision making methods permits the best alternative amongst a number of criteria or attributes (Tan and Chen, 2010) by ranking (Spearman, 1904; Zavadskas et al., 2009), preference comparison (Roy, 1996; Beccali et al., 2003; Brans et al., 1986; Albadvi et al., 2007), initial qualitative assessment (Saaty, 1977) and reference point development (Hwang and Yoon 1981; Wang et al., 2009; Yazdani et al., 2016).

The usage of multi-criteria decision making methods under investment appraisals and decisions, works towards simplifying the information amount/complexity for the decision process. Collected information is condensed with the aid of assessment criteria (multiple criteria) and modelled. As a unique optimal solution to investment decision does not exist, a decision-making method allows modelling potential solutions based on the decision makers preferences and determined assessment criteria. Introduced in 2010 by Kersuliene et al. (2010), SWARA multi criteria decision making method, incorporates "expert or interest groups opinion" and determination of criteria weights. The GRA, on the other hand, condenses the decision point into one form and determines the reference sequence. Commonly employed for evaluating company attributes in the accounting/finance field (Kung

and Wen, 2007), GRA allows for predicting financial distress (Lin and Wu, 2011), assess the sustainability performance of banks/firms (Özçelik and Öztürk, 2014) and investigates firm financial performance (Sakinc, 2014; Kaya, 2016). Thus, the GRA method will aid in providing investors with the best available investment alternatives within the provided information (Kuo et al., 2008; Wu, 2002). Thus, the purpose of this study is to employ use of a SWARA-GRA integrated approach for evaluating the 2015-2017 financial performance of BIST Food and Beverage firms and determine best potential investment solutions for investors based on pre-determined assessment criteria (BIST quoting criteria). By comparing the results to the industry average, the study will attempt to highlight the benefits of the SWARA-GRA models for investment appraisals and decisions. The analysis only focuses on the BIST Food and Beverage industry as the method requires that compared firms should come from a homogenous sample in order to increase comparability between assessment criteria. The paper is structured as follows, the second section summarizes the current literature on SWARA-GRA, while the third and fourth section covers the methodology and findings of the study. The last section, concludes.

## 2. LITERATURE REVIEW

The SWARA and GRA methods, classified under the multi-criteria decision making (MCDM) applications, have been employed by managers or decision makers to evaluate various human resources, management, supplier selection, construction equipment selection issues in more rational and consistent way. For example, in 2013, Hashemkhani Zolfani (2013a) examined seven success factors that affect online games preferences. The transaction fees, game scenario, customer service, game rewards, game play, attractive website graphic and similarity to real world success factors are evaluated using the SWARA method and contributing factors of importance were determined. Moreover, in 2015, Stanujkic et al. evaluated the bottle shape, bottle colour, label and PVC shrink capsule criteria with the SWARA method, in order to help managers to choose most suitable packaging design for wine.

On the other hand, some of the researchers use different and combine them due to to select most suitable solution for business problem. This method has been called as Hybrid method in the literature. Keršulienė and Turskis (2011) combine different multi criteria decision making methods (dependent on weighting and evaluating criteria) and conduct and develop a hybrid Additive Ratio Assessment (ARAS), Fuzzy ARAS and SWARA multi criteria decision making method to select the best architect for a company. Karabasevic (2015) on the other hand, combined SWARA and MULTIMOORA (multi-objective optimization by a ratio analysis plus the full multiplicative form) methods to determine candidates to work in the mining industry. Hashemkhani Zolfani (2013b) combined SWARA and WASPAS (weighted aggregated sum product assessment) methods due to determining best location area for a new shopping mall. SWARA method has also been used to determine weights of criteria. Vafaeipour et al. (2014) has similarly, employed use of a hybrid method to select the best place to build a new solar power plant. Likewise, Popovic et al. (2019) employs a SWARA and WS PLP (weighted sum preferred levels of performances) hybrid method to select the best location for a new tourist hotel construction.

Other hybrid MCDM methods is used by Dehnavi et al. (2015). They combine SWARA and ANFIS (adaptive neuro-fuzzy inference system) procedures to assess the regional landslide hazards of Iran. Moreover, Erdoğan et al. (2019) combine SWARA and MOORA (multi-objective optimization by a ratio analysis) methods to determine best suitable fuel for the compression ignition.

Alimardani et al. (2013), evaluates suppliers via the SWARA and VIKOR ((Vise Kriterijumska Optimizacija I Kompromisno Resenje) hybrid models. Moreover, Zarbakhshnia et al. (2018) evaluate and rank the third-party reverse logistics providers by using SWARA and COPRAS (complex proportional assessment) methods, determining the weights of third-party reverse logistics criteria. Additionally, Ghorabaee et al. (2018) assess construction equipment based on the perspective of sustainability. They combine three methods, which are SWARA, fuzzy CRITIC (criteria importance through inter criteria correlation) and fuzzy EDAS (evaluation based on distance from average solution) to evaluate sustainability of the construction equipment. Hashemkhani Zolfani and Chatterjee (2019) compare outcomes of the SWARA and BWM (best worst method) for evaluating household furnishing materials. Based on the result of the evaluation, SWARA method is more accurate and effective than alternatives.

In addition, the SWARA method is also used by researchers for evaluating and selecting the most suitable project for a company, such as; Hashemkhani Zolfani et al. (2015) have selected SWARA as research and development projects assessment method. Furthermore, Karabašević and friends (2016) rank companies based on their corporate social responsibility indicators with using SWARA and ARAS methods.

There are different multi criteria decision making methods to determine "best option, solutions and alternatives". Grey relational analysis (GRA), which is one of the MCDM, has also been employed by researcher as it is an easily calculated method that allows for a clear comparison of original data and results (Wu, 2002: 211).

A survey of the literature reveals several methods in which GRA has been employed to solve different daily and professional issues. For example, Kuo et al. (2008) have used the GRA method to study the facility layout and dispatching rules related decisions. Moreover, Chan and Tong (2007) have applied this procedure to select best materials that are used in the production of a vacuum cleaner. They have calculated grey relational grades of all possible candidates materials were used in the vacuum cleaner production through consideration of the product life cycle. Based on the results, the best materials were ordered that paved the way for easier decision making.

Some researchers designed a series of experiments to evaluate the equipment performance. Combining the Taguchi experimental design method and the grey relational analysis procedure, Lin (2004) has made a series of experiments to optimize turning operations. Nine different experiments were performed using the Taguchi method to determine best optimal cutting factor. Cutting parameters, cutting speed, feed rate and depth of the cut were ranked based on the GRA analysis. The study found that the feed rate is a substantial cutting factor. Similarly, Tosun (2006) designed an experiment in order to optimize the drilling process factors. Moreover, Çaydaş and Hasçalık (2008) have determined optimum laser cutting parameters with that hybrid approach and Tzeng et al. (2009) have

optimized the computerized numerical control (CNC) machines operation parameters. Finally, the grey relation analysis is used by researchers to evaluate and select best suppliers (Yang and Chen, 2006; Hashemi et. al., 2015), estimate software effort (Huang et. al., 2008), determine best wastewater treatment (Zeng et al., 2007), estimate energy performance of structure (Lee and Lin, 2011) and calculate effectiveness of weapon systems (Hui and Bifeng, 2009).

## 3. METHODOLOGY

As mentioned before, the purpose of this study is to employ use of a SWARA-GRA integrated approach for evaluating the 2015-2017 financial performance of BIST Food and Beverage firms and determine best potential investment solutions for investors based on pre-determined assessment criteria. Moreover, the results are compared with the industry averages of the criteria to highlight the benefits of the SWARA-GRA models. In order to accomplish this the assessment criteria are determined by reviewing the BIST quotation criteria listed on the stock exchange website (BIST, 2018). The conditions of listing for BIST are determined on the basis of discrete measures and criteria that are continuously amended. According to the bylaws presented by the BIST Index and Data Directorate, items such as the total number of years listed, profits before tax, shareholders' equity, free float rate and similar other criteria are employed when evaluating a firm. Thus, the 43 assessment criteria were collected by reviewing the related bylaws published under the BIST Index and Data Directorate. The full list of the assessment criteria is presented under Table 1. As mentioned under section two, the SWARA-GRA integrated approach incorporates "expert or interest groups opinion" to determine criteria weights. Drawing on the set of criteria determined by evaluating the bylaws of BIST, a respondent survey is prepared. Three investment experts are contacted and asked to arrange the assessment criteria according to rank- starting with the most important criteria being listed as the first. The expert opinions are then condensed (using a geometric average) according to the frequency of indication, providing the criteria weights to be included under the approach. This method allows for relative comparison between criteria. The weight assessment approach and the respondent survey allow experts to use their implicit knowledge and expertise when determining priorities and ranks. The steps and equations employed under the SWARA and GRA models are presented below.

*Step-Wise Weight Assessment (Swara):* Developed by Kersuliene, Zavasdkas and Turskis (2010), the SWARA procedure is conducted following the steps of (Özbek, 2017: 46). Under the first step of the SWARA method, the evaluation criteria is sorted from the most important criterion to the least important criterion.

$j$: *the evaluation criterion from* the most important criterion to the least important criterion

$j = 1,2,3, \dots, n$

$l$: *the expert*; $l = 1,2, \dots, L$

After sorting, an importance level is assigned to the criteria via employing use of expert opinions.

$s_{jl}$: *the importance of j.evaluation criterion according to (j + 1).evaluation criterion according to expert l*

$k_{jl}$ values have been calculated by using Equation 1.

$$k_{jl} = \begin{cases} j = 1 \implies 1 \\ j > 1 \implies s_{jl} + 1 \end{cases}$$ Equation 1

The compound function in Equation 2 gives $q_{jk}$ values.

$$q_{jl} = \begin{cases} j = 1 \implies 1 \\ j > 1 \implies \frac{q_{jl-1}}{k_{jl}} \end{cases}$$ Equation 2

$w_{jl}$: *the importance level of j.evaluation criterion according to expert l;* $j = 1,2,3,\dots,n$

$k$: *evaluation criterion;* $k = 1,2,3,\dots,n$

Following this, the importance levels of the evaluation criteria are calculated with Equation 3.

$$w_{jl} = \frac{q_{jl}}{\sum_{k=1}^{n} q_{kl}}$$ Equation 3

The last step of SWARA method is to integrate expert opinions. The integration of expert opinions is calculated with Equation 4.

$w_j$: *the integrated importance level of j.evaluation criterion;* $j = 1,2,3,\dots,n$

$$w_j = \sqrt[L]{\prod_{l=1}^{L} w_{jl}}$$ Equation 4

*Grey Relational Analysis (GRA):* GRA procedure is as follows (Singh et al., 2012: 2048): First step is to construct the original sequence.

$m$: *the number of the evaluation criteria*

$n$: *the number of the alternatives*

$X_n(m)$: *the performance value of alternative n with respect to criterion m*

Following this, the original sequence is normalized.

$X_i^*(k)$: *normalized value*

$X_i(k)$: *original sequence value*

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

$k: 1,2,3,\dots,m; evaluation\ criterion$

If the target value of the original sequence is "the greater-the better", then the original sequence is normalized as in Equation 5.

$$X_i^*(k) = \frac{X_i(k) - min_k\, X_i(k)}{max_k\, X_i(k) - min_k\, X_i(k)} \qquad \text{Equation 5}$$

If the target value of the original sequence is "the lower-the better", then the original sequence is normalized as in Equation 6.

$$X_i^*(k) = \frac{max_k\, X_i(k) - X_i(k)}{max_k\, X_i(k) - min_k\, X_i(k)} \qquad \text{Equation 6}$$

However, if there is "a specific target value", then the original sequence is normalized as in Equation 7.

$$X_i^*(k) = 1 - \frac{|X_i(k) - X_0(k)|}{max_k\, X_i(k) - X_0(k)} \qquad \text{Equation 7}$$

Next step is to calculate the deviation sequence using Equation 8.

$\Delta_{0i}: deviation\ sequence\ value$

$$\Delta_{0i}(k) = |X_i^*(k) - X_0^*(k)| \qquad \text{Equation 8}$$

Next, the grey relational coefficients have been calculated by using Equation 9.

$\gamma: grey\ relational\ coefficient$

$0 \leq \varsigma \leq 1$

$\Delta_{max}: the\ greatest\ value\ in\ the\ deviation\ sequence$

$\Delta_{min}: the\ lowest\ value\ in\ the\ deviation\ sequence$

$$\gamma(X_0(k), X_i(k)) = \frac{\Delta_{min} + \varsigma \times \Delta_{max}}{\Delta_{0j} + \varsigma \times \Delta_{max}} \qquad \text{Equation 9}$$

In the last step of the GRA method, grey relational grades of the alternatives are determined by using Equation 10.

$W_i(k): the\ weight\ of\ the\ criterion$

$$\tau\,(X_0, X_i) = \sum_{k=1}^{m} \gamma(X_0(k), X_i(k)) \cdot W_i(k) \qquad \text{Equation 10}$$

The assessment criteria were calculated by downloading four years' worth of annual financial reports (balance sheets, income statements, cash flow statements and disclosures) of the listed firms. Moreover, information such as; the IPO date and share price were collected from the "big-para" website (http://bigpara.hurriyet.com.tr/borsa/hisse-fiyatlari/). The analysis

was restricted the data for the year 2017 as the annual reports for later dates were not available at the date of the analysis. The information was hand-collected from the documents and subsequently coded under Excel. Although the analysis compares the performance of 2015-2017, the 2014 reports were also downloaded and coded, as the information was used in calculating some of the 2015 ratios. The study compares three years' worth of reports as Edmister (1972) argues that it is sufficient for providing adequate insight into the firms' financial performance. The sample consisted of 27 BIST listed firms as they are required to periodically publish financial statements that are made available on their official website. The BIST Food and Beverage industry was selected, as the sample of firms were consistently listed on the exchange and provided a comparable base for conducting the SWARA-GRA integrated approach. The analysis only focuses on the BIST Food and Beverage industry as the method requires that compared firms should come from a homogenous sample in order to increase comparability between assessment criteria.

## 4. FINDINGS

The following tables depict the usage of the SWARA-GRA integrated approach under the study. As mentioned before, under the first step of the study, a respondent survey was employed in order to calculate (Equation 1-4) the criteria individual weights of the “expert or interest groups opinion". The information collected from the survey is summarized under Table 1. Because of space constraints, the information was condensed to only include the first expert responses ($S_{j1}$). The coded variables were sorted and assigned an importance level via use of Equation 1 ($k_{j1}$). The compound function ($q_{j1}$) was then calculated with Equation 2 and the importance levels of the evaluation criteria determined with Equation 3. This process afforded the researchers with the individual criteria weights ($w_{j1}$) to be included under Equation 4, which integrates the expert opinions using ($w_j$) a geometric average.

**Table 1.** Results of Equation 1-4

| Criterion | $s_{j1}$ | $k_{j1}$ | $q_{j1}$ | $w_{j1}$ | Evaluation Criteria | $w_j$ |
|---|---|---|---|---|---|---|
| Return on Equity (ROE) | 0,0000 | 1,0000 | 1,0000 | 0,0294 | Maximize | 0,0263 |
| Return on Assets (ROA) | 0,0000 | 1,0000 | 1,0000 | 0,0294 | Maximize | 0,0263 |
| Market Value Added per Share | 0,0000 | 1,0000 | 1,0000 | 0,0294 | Maximize | 0,0250 |
| Sustainable Growth Ratio | 0,0000 | 1,0000 | 1,0000 | 0,0294 | 0,2500 | 0,0177 |
| Economic Viability | 0,0000 | 1,0000 | 1,0000 | 0,0294 | Maximize | 0,0226 |
| Current Ratio | 0,0500 | 1,0500 | 0,9524 | 0,0280 | 3 | 0,0257 |
| Acid Test Ratio | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Maximize | 0,0238 |
| Cash Ratio | 0,0000 | 1,0000 | 0,9524 | 0,0280 | 3 | 0,0238 |
| Cash Conversion Cycle (CCC) | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Minimize | 0,0263 |
| Efficiency Ratio | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Minimize | 0,0226 |
| Account Payable Turnover | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Minimize | 0,0204 |
| Account Receivables Turnover | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Maximize | 0,0182 |
| Inventory Turnover Ratio | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Maximize | 0,0229 |
| Inventory Dependency Ratio | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Minimize | 0,0233 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Current Liabilities/Total Assets | 0,0000 | 1,0000 | 0,9524 | 0,0280 | Minimize | 0,0221 |
| Long Term Assets/ (Equity + Long Term Liabilities) | 0,0500 | 1,0500 | 0,9070 | 0,0267 | 0,5000 | 0,0166 |
| Total Liabilities/Equity | 0,0000 | 1,0000 | 0,9070 | 0,0267 | 0,5000 | 0,0251 |
| Total Liabilities/Total Assets | 0,0000 | 1,0000 | 0,9070 | 0,0267 | 0,2500 | 0,0246 |
| Stock Price (Closing) | 0,1000 | 1,1000 | 0,8246 | 0,0242 | Maximize | 0,0171 |
| Firms Total Market Value | 0,0000 | 1,0000 | 0,8246 | 0,0242 | Maximize | 0,0270 |
| Firms Public Shares Market Value | 0,0000 | 1,0000 | 0,8246 | 0,0242 | Maximize | 0,0248 |
| Operating profit Margin | 0,0500 | 1,0500 | 0,7853 | 0,0231 | Maximize | 0,0175 |
| Net profit Margin | 0,0200 | 1,0200 | 0,7699 | 0,0226 | Maximize | 0,0263 |
| Gross profit Margin | 0,0200 | 1,0200 | 0,7548 | 0,0222 | Maximize | 0,0269 |
| Global Sales Ratio | 0,0500 | 1,0500 | 0,7189 | 0,0211 | Maximize | 0,0179 |
| Fixed Assets Turnover | 0,0300 | 1,0300 | 0,6979 | 0,0205 | Maximize | 0,0212 |
| Asset Turnover | 0,0000 | 1,0000 | 0,6979 | 0,0205 | Maximize | 0,0244 |
| Research & Development Ratio | 0,0000 | 1,0000 | 0,6979 | 0,0205 | Maximize | 0,0263 |
| Research & Development Expenses | 0,0400 | 1,0400 | 0,6711 | 0,0197 | Maximize | 0,0276 |
| Free Float % | 0,0200 | 1,0200 | 0,6579 | 0,0193 | Maximize | 0,0276 |
| Sales to Stock Ratio | 0,0000 | 1,0000 | 0,6579 | 0,0193 | Maximize | 0,0297 |
| EBITDA | 0,0000 | 1,0000 | 0,6579 | 0,0193 | Maximize | 0,0263 |
| Operating profit | 0,0300 | 1,0300 | 0,6388 | 0,0188 | Maximize | 0,0270 |
| Net income | 0,0000 | 1,0000 | 0,6388 | 0,0188 | Maximize | 0,0208 |
| Volume | 0,0500 | 1,0500 | 0,6083 | 0,0179 | Maximize | 0,0173 |
| Dividend Payment per Share | 0,0000 | 1,0000 | 0,6083 | 0,0179 | Maximize | 0,0221 |
| IPO Date | 0,0000 | 1,0000 | 0,6083 | 0,0179 | Minimize | 0,0161 |
| Equity Turnover | 0,0000 | 1,0000 | 0,6083 | 0,0179 | Maximize | 0,0276 |
| Capital | 0,0500 | 1,0500 | 0,5794 | 0,0170 | Maximize | 0,0185 |
| Paid-in Share Capital | 0,0300 | 1,0300 | 0,5625 | 0,0165 | Maximize | 0,0175 |
| Equity | 0,0000 | 1,0000 | 0,5625 | 0,0165 | Maximize | 0,0257 |
| Parent Equity | 0,0000 | 1,0000 | 0,5625 | 0,0165 | Maximize | 0,0214 |
| Total Assets | 0,0000 | 1,0000 | 0,5625 | 0,0165 | Maximize | 0,0270 |

The next step of the analysis consists of the procedures identified by Singh et al. (2012: 2048). Because of space constraints, the 2015 variables of 10 firms are presented along with 6 variables out of the 43 assessment criteria. The full data is available upon request. The raw information collected from the respondent survey, the original sequence, is presented under Table 2.

**Table 2.** Original Sequence Example 2015

| Sirket Kodu | R&D Ratio | ROA | ROE | CCC | Acid Test | Sustainable Growth |
|---|---|---|---|---|---|---|
| AVOD | 0,0000 | 0,0237 | 0,0565 | 84.4113 | 0,6596 | 0,0715 |
| ALYAG | 0,0000 | -0,0420 | -0,0949 | 5.6568 | 0,3919 | -0,0481 |
| AEFES | 0,0000 | -0,0062 | -0,0112 | 12.9527 | 1,4626 | -0,0413 |
| BANVT | 0,0003 | -0,0949 | -0,6421 | 26.6750 | 0,4401 | -0,8744 |
| CCOLA | 0,0000 | 0,0142 | 0,0337 | 13.6272 | 1,3387 | 0,0488 |
| DARDL | 0,0186 | -0,4326 | 0,1543 | -104.6361 | 0,1337 | 1,0966 |
| EKIZ | 0,0000 | -0,1172 | -1,2245 | 216.0097 | 0,5420 | 0,4055 |
| ERSU | 0,0000 | -0,0167 | -0,0276 | 229.1106 | 0,9644 | -0,0152 |
| FRIGO | 0,0000 | -0,0930 | -0,4592 | 39.7206 | 0,2911 | -0,0101 |
| KRSAN | 0,0000 | -0,0302 | -0,0869 | -93.9561 | 0,5555 | -0,0655 |

The original sequence is then normalized, however dependent on the evaluation criteria presented under Table 1, the employed formula is adapted to accommodate maximizing (Equation 5: the greater-the better), minimizing (Equation 6: the lower-the better) and ideal point (Equation 7: a specific target value) variables. The results of the normalization process is presented below, under Table 3.

**Table 3.** Normalized Values Example 2015

| Sirket Kodu | R&D Ratio | ROA | ROE | CCC | Acid Test | Sustainable Growth |
|---|---|---|---|---|---|---|
| AVOD | 0,0000 | 0,7534 | 0,0489 | 0,8842 | 0,0877 | 0,8413 |
| ALYAG | 0,0000 | 0,6448 | 0,0431 | 0,9324 | 0,0431 | 0,7349 |
| AEFES | 0,0000 | 0,7039 | 0,0463 | 0,9280 | 0,2217 | 0,7410 |
| BANVT | 0,0174 | 0,5576 | 0,0222 | 0,9196 | 0,0511 | 0,0000 |
| CCOLA | 0,0000 | 0,7376 | 0,0480 | 0,9275 | 0,2010 | 0,8211 |
| DARDL | 1,0000 | 0,0000 | 0,0526 | 1,0000 | 0,0000 | 0,2471 |
| EKIZ | 0,0000 | 0,5206 | 0,0000 | 0,8036 | 0,0681 | 0,8617 |
| ERSU | 0,0000 | 0,6867 | 0,0456 | 0,7955 | 0,1386 | 0,7641 |
| FRIGO | 0,0000 | 0,5607 | 0,0292 | 0,9116 | 0,0263 | 0,7687 |
| KRSAN | 0,0000 | 0,6643 | 0,0434 | 0,9935 | 0,0704 | 0,7194 |

The next step under the GRA model is the consideration of the deviation sequence. Employing use of Equation 8 and 9, the grey relational coefficients are calculated taking into consideration the greatest and lowest value in the sequence. The calculation are presented under Table 4-5.

**Table 4.** Deviation Sequence Values Example 2015

| Sirket Kodu | R&D Ratio | ROA | ROE | CCC | Acid Test | Sustainable Growth |
|---|---|---|---|---|---|---|
| AVOD | 1,0000 | 0,2466 | 0,9511 | 0,1158 | 0,9123 | 0,1587 |
| ALYAG | 1,0000 | 0,3552 | 0,9569 | 0,0676 | 0,9569 | 0,2651 |
| AEFES | 1,0000 | 0,2961 | 0,9537 | 0,0720 | 0,7783 | 0,2590 |
| BANVT | 0,9826 | 0,4424 | 0,9778 | 0,0804 | 0,9489 | 1,0000 |
| CCOLA | 1,0000 | 0,2624 | 0,9520 | 0,0725 | 0,7990 | 0,1789 |
| DARDL | 0,0000 | 1,0000 | 0,9474 | 0,0000 | 1,0000 | 0,7529 |
| EKIZ | 1,0000 | 0,4794 | 1,0000 | 0,1964 | 0,9319 | 0,1383 |
| ERSU | 1,0000 | 0,3133 | 0,9544 | 0,2045 | 0,8614 | 0,2359 |
| FRIGO | 1,0000 | 0,4393 | 0,9708 | 0,0884 | 0,9737 | 0,2313 |
| KRSAN | 1,0000 | 0,3357 | 0,9566 | 0,0065 | 0,9296 | 0,2806 |

**Table 5.** Grey Relational Coefficients Example 2015

| Sirket Kodu | R&D Ratio | ROA | ROE | CCC | Acid Test | Sustainable Growth |
|---|---|---|---|---|---|---|
| AVOD | 0,3333 | 0,6697 | 0,3446 | 0,8119 | 0,3540 | 0,7590 |
| ALYAG | 0,3333 | 0,5847 | 0,3432 | 0,8810 | 0,3432 | 0,6535 |
| AEFES | 0,3333 | 0,6281 | 0,3439 | 0,8741 | 0,3911 | 0,6587 |
| BANVT | 0,3372 | 0,5306 | 0,3383 | 0,8614 | 0,3451 | 0,3333 |
| CCOLA | 0,3333 | 0,6558 | 0,3443 | 0,8734 | 0,3849 | 0,7364 |
| DARDL | 1,0000 | 0,3333 | 0,3454 | 1,0000 | 0,3333 | 0,3991 |
| EKIZ | 0,3333 | 0,5105 | 0,3333 | 0,7179 | 0,3492 | 0,7833 |
| ERSU | 0,3333 | 0,6147 | 0,3438 | 0,7098 | 0,3673 | 0,6795 |
| FRIGO | 0,3333 | 0,5323 | 0,3399 | 0,8497 | 0,3393 | 0,6837 |
| KRSAN | 0,3333 | 0,5983 | 0,3433 | 0,9871 | 0,3497 | 0,6406 |

Finally, the grey relational grades of the alternatives are calculated via Equation 10, taking into account the weight of the criterion. The grey relational grades provide the researchers with the 2015-2017 comparison of the financial performance ranking identified by the SWARA-GRA integrated approach. The results of the analysis are presented under Table 6.

**Table 6.** Grey Relational Grades 2015-2017

| | 2015 | | 2016 | | 2017 | |
|---|---|---|---|---|---|---|
| **Şirket Kodu** | **Grey Relational Grade** | **Rank** | **Grey Relational Grade** | **Rank** | **Grey Relational Grade** | **Rank** |
| AVOD | 0,5081 | 14 | 0,6864 | 15 | 0,4974 | 19 |
| ALYAG | 0,4654 | 26 | 0,6644 | 22 | 0,4689 | 23 |
| AEFES | 0,6292 | 1 | 0,7670 | 1 | 0,6269 | 1 |
| BANVT | 0,4623 | 27 | 0,6957 | 11 | 0,5421 | 6 |
| CCOLA | 0,5541 | 5 | 0,7286 | 4 | 0,5520 | 4 |
| DARDL | 0,4614 | 28 | 0,6473 | 27 | 0,4601 | 25 |
| EKIZ | 0,4674 | 25 | 0,6580 | 26 | 0,4735 | 22 |
| ERSU | 0,4947 | 17 | 0,6775 | 17 | 0,5098 | 14 |
| FRIGO | 0,4844 | 22 | 0,6715 | 18 | 0,4896 | 20 |
| KRSAN | 0,4853 | 20 | 0,6636 | 24 | 0,4453 | 27 |
| KENT | 0,5815 | 3 | 0,7085 | 7 | 0,5488 | 5 |
| KERVT | 0,4731 | 24 | 0,6639 | 23 | 0,5024 | 15 |
| KNFRT | 0,5192 | 12 | 0,6878 | 14 | 0,5221 | 11 |
| KRSTL | 0,5211 | 11 | 0,7036 | 9 | 0,5377 | 7 |
| MERKO | 0,4980 | 15 | 0,6667 | 21 | 0,4431 | 28 |
| OYLUM | 0,4909 | 18 | 0,6667 | 20 | 0,4802 | 21 |
| PENGD | 0,4966 | 16 | 0,6591 | 25 | 0,4513 | 26 |
| PETUN | 0,5364 | 7 | 0,7081 | 8 | 0,5109 | 13 |
| PINSU | 0,4883 | 19 | 0,6699 | 19 | 0,4677 | 24 |
| PNSUT | 0,5499 | 6 | 0,7157 | 5 | 0,5184 | 12 |
| SELGD | 0,5329 | 9 | 0,6936 | 13 | 0,5228 | 10 |
| TATGD | 0,5336 | 8 | 0,7121 | 6 | 0,5292 | 9 |
| TKURU | 0,4852 | 21 | 0,6864 | 16 | 0,4991 | 17 |
| TUKAS | 0,5254 | 10 | 0,6940 | 12 | 0,4974 | 18 |
| TBORG | 0,5637 | 4 | 0,7311 | 3 | 0,5671 | 3 |
| ULKER | 0,5892 | 2 | 0,7332 | 2 | 0,5911 | 2 |
| ULUUN | 0,5111 | 13 | 0,6960 | 10 | 0,5011 | 16 |
| VANGD | 0,4797 | 23 | 0,6369 | 28 | 0,5333 | 8 |

The results of the SWARA-GRA integrated approach are summarized under Table 6. According to the analysis, we see that fairly consistent results are achieved through the years 2015-2017. However, Merko Gıda (15 to 28), Penguen Gıda (16 to 26), Pınar Et ve Un (7 to 13), Pınat Su ve İçecek (19 to 24), Pınar Süt (6 to 12), Tukas Gıda (10 to 18) firms' financial performance has slumped from 2015-2017. On the other hand, Banvit (27 to 6), Kerevitas (24 to 15), Vanet Gıda (23 to 8) has shown a considerable increase within the sample period.

## 6. CONCLUSION

The SWARA-GRA is a multi-criteria decision making approach that permits the ranking of best alternatives amongst a number of criteria or attributes. The method is particularly useful in markets plagued with unwanted noise and information overload. By employing use of this model under the BIST Food and Beverage industry, the researchers were able to simplify the information amount by condensing it into a manageable and comparable rank. With the aid of recognized BIST assessment criteria (multiple criteria), fairly consistent ranking across the sample period was achieved. Moreover, sudden jumps between ranks from one period to the next were made easier to follow without relinquishing use of any of the 43 assessment variables. For example, we see that firms such as; Vanet Gıda Sanayi (23 to 8), Kristal Kola (11 to 7) and Banvit (27 to 6) have increased dramatically within the ranks, while Anadolu Efes has consistently remained first across 2015-2017. Investors employing use of the SWARA-GRA approach for investment appraisals could base their decisions on the results of such an analysis; either choosing to invest more or hold on to their current shares of these firms. Thus, this method proves useful in providing a holistic view of the firm for investors.

Although, the weights determined by the approach are in no means an absolute solution to investment alternative, the study presents a unique opportunity for investment firms to evaluate investment decisions and create unique portfolios based on the preferences of investor groups. Deviating from the traditional ratio analysis, the method provides the best available investment alternatives within the provided information. Thus, the method is offered as a temporary solution to the problem of information overload, until such a time both the IASB and FASB begin deliberations for reducing the hundreds of pages long documents in the future.

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