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Performance Evaluation of Deposit Banks with Financial Ratios: Combined Use of Objective and Subjective Criteria Weighting Methods (Combined Entropy-SWARA Based EDAS Method)

(Research Article)

Finansal Rasyolarla Mevduat Bankalarının Performans Değerlendirmesi: Objektif ve Sübjektif Kriter Ağırlıklandırma Yöntemlerinin Birleşik Kullanımı (Birleşik ENTROPİ-SWARA Temelli EDAS Yöntemi)

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ABSTRACT

The aim of the study is to examine the performance of deposit banks in Turkey in 2020 with Multi-Criteria Decision Making (MCDM) methods. 10 criteria are determined and 17 deposit banks are analyzed. While calculating the weights of the evaluation criteria, the results of objective Entropy and subjective SWARA methods are used. Then, the calculated weights are combined with the Bayesian approach; optimal weights are obtained and used as inputs in the EDAS method. The most important criteria are identified as Net Profit (Loss) for the Period/Paid in Capital, Loans Received/Total Assets and Non-Performing Loans/Total Loans. The least important criteria are Interest Income/Total Assets, Total Revenues/Total Expenses and Interest Income/Interest Expenses. EDAS method results show that the top three most successful banks in 2020 are Garanti Bankası, İş Bankası and Akbank, respectively. Despite that, three most unsuccessful banks are Alternatif Bank, Odea Bank and Şekerbank.

Anahtar kelimeler:
Banka Performansı, Finansal Tablolar, Finansal Rasyolar, Çok Kriterli Karar Verme

ÖZET

Çalışmanın amacı, Türkiye'deki mevduat bankalarının 2020 yılı performanslarını Çok Kriterli Karar Verme (ÇKKV) yöntemleri ile incelemektir. 10 kriter belirlenmiş ve 17 mevduat bankası analiz edilmiştir. Değerlendirme kriterlerinin ağırlıkları hesaplanırken objektif Entropi ve sübjektif SWARA yöntemleri kullanılmıştır. Sonrasında, hesaplanan ağırlıklar Bayes yaklaşımı ile birleştirilmiş, optimal ağırlıklar elde edilmiş ve EDAS yönteminde girdi olarak kullanılmıştır. En önemli kriterler Dönem Net Kârı (Zararı)/Ödenmiş Sermaye, Alınan Krediler/Toplam Varlıklar ve Takipteki Krediler/Toplam Krediler olarak belirlenmiştir. Önem düzeyi en düşük olan kriterler ise Faiz Gelirleri/Toplam Varlıklar, Toplam Gelirler/Toplam Giderler ve Faiz Gelirleri/Faiz Giderleri'dir. EDAS yöntemi sonuçları, 2020

yılında en başarılı üç bankanın sırasıyla Garanti Bankası, İş Bankası ve Akbank olduğunu göstermektedir. Buna karşın, en başarısız üç banka Alternatif Bank, Odea Bank ve Şekerbank'tır.

1. INTRODUCTION

Financial system acts as a fund transfer mechanism for national economies. This systembrings together the actors who have surplus funds and those who demand funds due to their need for those funds. The most important institutions in the functioning of the financial system are various financial institutions and organizations. Banks come first in terms of both their contribution to the financial system and their market shares (Funso et al., 2012: 31).

By assuming an intermediary role in the financial sector, banks contribute to the conversion of deposits into investments, meeting the fund needs of companies, growth of businesses and sectors, and economic development (Alam et al., 2011:56). Considering the role of banks in terms of national economies, their financial performance emerges as an important issue. The unfavourable conditions that may arise in the banking sector may directly affect other actors in the financial system negatively (Çelik, 2018: 148). For this reason, it is extremely important to regularly analyze and monitor the financial performance of banks and to take the necessary actions when needed. Measuring the financial performance of banks using financial indicators will play a preventive role in avoiding potential risks that both banks and the banking industry as a whole may be exposed to (Karaca & Erdoğan, 2018: 24).

According to the Banking Regulation and Supervision Agency (BRSA) data, the total asset size of the financial sector in our country is 6,977 billion TL. 54 banks are operating in the banking sector and the total share of these banks in the financial sector is 87.5%. The remaining 12.5% share belongs to leasing, factoring, consumer finance, asset management companies and other financial institutions (BRSA, 2020: 15). Moreover, banks exhibited the highest growth performance in 2020, among all institutions in the financial sector with a growth rate of 36%. (BRSA, 2020: 14).

Due to the importance of banks in terms of the financial sector and national economies, the evaluation of their financial performance is one of the frequently researched topics in both national and international literature. Academic studies in the literature focus on different types of banks, mainly the deposit banks.

MCDM methods have started to be used frequently in studies conducted in different disciplines in both national and international literature in recent years. These methods are also used in studies that analyze the financial performance of banks. The methods used in the evaluation of criteria weights can be divided into two groups, objective and subjective. While only mathematical calculations are used in objective methods, weights are calculated taking into consideration the evaluations of decision makers' in subjective methods (Zoragh et al., 2013: 3). These calculated weights constitute an input to other MCDM methods that are used for ranking analysis.

The purpose of this study analyzing the performance of Turkish deposit banks during 2020, which is first year of the pandemic, by using MCDM methods, using some financial ratios determined as evaluation criteria. Analyzes are carried out using the banks' end-of-year financial data for 2020. In the analysis, MCDM methods such as ENTROPY, SWARA and EDAS are used. Due to the limited number of studies using objective and subjective methods together in the literature, the weights of the determined criteria are calculated with ENTROPY,

which is the objective criteria weighting method, and SWARA, which is a subjective method. Then, the weights obtained as a result of both methods are recalculated with the Bayesian approach, the optimal weights are reached and the performance rankings of the banks are made by using them as input in the EDAS method.

This study has some contributions to the literature. It applies a weighting method that includes the integrated use of subjective and objective methods in determining the criteria weights, although there are studies conducted in this way in the literature, they are limited in number. In addition, this study can contribute to the literature in terms of determining the financial performance criteria of deposit banks and allowing decision makers to monitor bank performances.

In the study, first, information about Entropy, SWARA and EDAS methods and Bayesian approach is given. Afterwards, a summary of academic studies in the national and international literature analyzing the financial performance of banks with MCDM methods is presented. The following sections include the analysis, findings and general results of the study.

2. ENTROPY METHOD

Entropy method is one of the methods used in determining the weights in MCDM methods. The most distinctive feature of the Entropy method is the use of observation values while determining the importance levels of the criteria. This ensures that the determined weights are objective (Chen, Feng & Chu, 2015: 91).

The main stages of the Entropy method are given below (Shannon, 1948):

Stage 1: Creating the Decision Matrix

At this stage, the decision matrix, which will form the basis of the analysis, is prepared.

Stage 2: Calculation of Normalized Decision Matrix.

Decision matrix is normalized using equation (1).

$$NS_{ij} = (x_{ij} / \sum_{i=1}^{m} x_{ij}); \forall_j \quad (1)$$

i: Alternative value

j: Criteria value

NS_{ij}: Normalized value

Stage 3: Calculating Entropy Values

Entropy values are calculated with the help of equation (2).

$$e_{ij} = -k\sum_{j=1}^{n} x_{ij}.\ln(x_j) \quad (i=1,\ldots,m; \quad j=1,\ldots,n) \quad (2)$$

k: Entropy coefficient $((\ln(n))^{-1}$

NS_{ij}: Normalized value

e_{ij}: Entropy Value

Stage 4: Calculation of D_j Differentiation Degrees

$$d_j = 1-E_j, \forall_j \quad (3)$$

Stage 5: Determination of Weights (W_j)

$$w_j = (d_j / \sum_{j=1}^{n} j_i), \forall_j \qquad \sum_{j=1}^{n} W_j = 1 \qquad 0 \leq W_j \leq 1 \tag{4}$$

After the completion of the above-mentioned stages, the weights of each criterion are determined, and the sum of these weights is equal to 1.

3. SWARA METHOD

SWARA (Step-wise Weight Assessment Ratio Analysis) method is a method applied by taking advantage of expert opinion during the weighting of criteria. From this point of view, it differs from the Entropy method described in the previous section. The Entropy method does not include subjective inputs and determines criteria weights with objective calculations. On the other hand, the SWARA method can be characterized as a subjective method since it includes expert opinion in the calculations. This method consists of 6 stages described below (Kersuliene et al., 2010):

Stage 1: Determinining Decision Makers and Criteria to be used in Evaluation

At this stage, decision makers and criteria are determined, and the number of decision makers is expressed with "m" and the number of criteria as "n".

Stage 2: Deciding on the Importance Levels of the Criteria

Decision makers rank all criteria according to their levels of importance. In case there is more than one decision maker, the geometric mean method is used during the determination of the overall ranking.

Stage 3: Determining Average Values of Comparative Importance

The relative importance of each criterion compared to the next criteria is calculated. The importance level of the upper criteria from the lower criteria is indicated as a percentage. As a result of this process, the "Average Values of Comparative Importance" value expressed as S_j is obtained.

Stage 4: Coefficients of Comparative Importance Criteria Calculation

At this stage, the k_J coefficients called “Coefficients of Comparative Importance Criteria” are calculated with equation (5).

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases} \tag{5}$$

Stage 5: Recalculated Criteria Weights Calculation

Recalculated weights (q_j) are calculated for each criteria using equation (6).

$$q_j = \begin{cases} 1 & j = 1 \\ (q_{j-1})/k_j & j > 1 \end{cases} \tag{6}$$

Stage 6: At this last stage, the final weight values (w_j) of the criteria are calculated with equation (7).

$$w_j = q_j / \sum_{j=1}^{n} q_j \tag{7}$$

4. BAYESIAN APPROACH

Objective or subjective weighting methods can be used in analyzes performed using MCDM methods. In objective methods, criteria weights are calculated using data obtained from a data set, while in subjective methods, criteria weights are determined by decision makers. There are also studies in which both subjective and objective weighting methods are used together. In such a case, the need to combine these values for a single value arises in order to ensure the accuracy of the weight values. Thus, criteria weights that take into account both objective data and subjective opinions of decision makers can be obtained (Demir, 2021a: 835).

In studies where objective and subjective weighting methods are used together, the Bayesian approach can be used to combine the weights of the evaluation criteria and obtain a single optimal weight score (Demir, 2022: 112). The Bayesian approach is applied using the equations (8) and (9) given below (Vinogradova et al. 2018: 4):

$$W(R_j/X) = [w(R_j)w(X/R_j)] / [\sum_{j=1}^{m} w(R_j)w(X/R_j)'] \quad (8)$$

$$\alpha_j = w_j W_j / \sum_{j=1}^{m} w_j W_j' \quad (9)$$

$w(R_j)=w_j$: Initial weight (j^{th} criteria R_j)

X: Event (when the weights of new evaluation criteria are obtained)

$w(X/R_j)=W_j$: New criteria weights

α_j: Recalculated criteria weights

5. EDAS METHOD

EDAS (Evaluation Based on Distance from Average Solution) is a method developed in 2015. Unlike other MCDM methods like TOPSIS or VIKOR, this method adopts the determination of positive and negative distances from the mean solution, rather than the approach of determining the best alternatives by calculating the distance from ideal and rare solutions. For this reason, ideal and rare solutions are not calculated for this method. In this method, two basic criteria are taken into account: positive distance from average (PDA) and negative distance from average (NDA). Alternatives are evaluated based on high PDA and low NDA values. A higher PDA value or a lower NDA value indicates that the alternative is better than the average solution. Main stages of EDAS method are explained below (Ghorabaee et al. 2015):

Stage 1: Determining the Criteria

At this stage, the criteria by which alternatives will be considered are determined.

Stage 2: Creating the Decision Matrix

Decision matrix is prepared as in equation (10).

$$X = [x_{ij}]_{nxm} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ \vdots & \vdots & \dots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nxm} \end{bmatrix} \quad (10)$$

n: Alternative

m: Criteria

X_{ij}: Performance of i^{th} alternative under j^{th} criteria

Stage 3: Establishing the Average Solution Matrix (AV) Considering All Criteria

At this stage, the following equation is used, which expresses the average solution for each criterion.

$$AV_j = (\sum_{i=1}^{n} X_{ij}) / n \quad (11)$$

AV_j: Average solution for each criteria

Stage 4: Creation of PDA and NDA Matrices

At this stage, PDA and NDA matrices are created by considering benefit and cost-based criteria.

$$PDA = [PDA_{ij}]_{nxm} \quad (12)$$

$$NDA = [NDA_{ij}]_{nxm} \quad (13)$$

PDA: Positive distance of the i^{th} alternative from the mean solution according to the j^{th} criteria

NDA: Negative distance of the i^{th} alternative to the mean solution according to the j^{th} criteria

In case of PDA, if the j^{th} criteria is benefit-based equation (14), if it is cost-based equation (16) is used. In the case of NDA, if the j^{th} criteria is benefit-based equation (15), if it is cost-based equation (17) is used.

$$PDA_{ij} = \max (0,(X_{ij} – AV_j)) / AV_j \quad (14)$$

$$NDA_{ij} = \max (0,(AV_j – X_{ij})) / AV_j \quad (15)$$

$$PDA_{ij} = \max (0,(AV_j - X_{ij})) / AV_j \quad (16)$$

$$NDA_{ij} = \max (0,(X_{ij} – AV_j)) / AV_j \quad (17)$$

Stage 5: Calculation of Weighted Total Positive (SP_i) and Negative (SN_i) Distances

At this stage, the weighted total positive and negative distances for all alternatives are calculated with the help of equations (18) and (19).

$$SP_i = \sum_{j=1}^{m} w_j PDA_{ij} \quad (18)$$

$$SN_i = \sum_{j=1}^{m} w_j NDA_{ij} \quad (19)$$

W_j: Predetermined weight of the j^{th} criteria

Stage 6: Normalizing SP and SN Values

At this stage, the SP and SN values for each alternative are normalized with the help of equations (20) and (21). In this way, the normalized positive and negative values of the i^{th} alternative are obtained.

$$NSP_i = SP_i / \max_i(SP_i) \quad (20)$$

$$NSN_i = 1- (SN_i / \max_i(SN_i) \quad (21)$$

Stage 7: Calculation of Evaluation Scores

In the last step, the evaluation score (AS) is calculated for each alternative. For this purpose, equation (22) is used.

$$AS_i = \frac{1}{2}(NSP_i + NSN_i) \quad (22)$$

Following the completion of this stage, the evaluation scores are ranked from high to low. According to the EDAS method, the alternative with the highest AS value is selected as the most suitable alternative.

6. LITERATURE REVIEW

In the national literature, it is seen that analyzes are made using different MCDM methods to evaluate the financial performance of banks. While hybrid methods are used in some studies, the authors or expert opinions in some studies determine the weights of the evaluation criteria. While CAMELS variables constitute the performance evaluation criteria in some of the studies, the financial ratios selected by the authors are determined as the performance criteria in others. While banks operating in Turkey are included in almost all of the studies, deposit and participation banks are included in a significant part of these studies.

When the studies carried out are evaluated in terms of the results achieved, it is determined that performance rankings for the banks are carried out in a significant part of these studies. In some studies, the groupings are made according to the ownership structures of the banks are compared with each other, and in some of them inferences are made for the banking sector.

Table 1 provides summary information on the studies carried out using MCDM methods in the literature for performance evaluations of banks.

Table 1. Literature Review

Author(s)	Method(s)	Scope	Findings
Amile et al. (2013)	Fuzzy AHP, TOPSIS	Banks in Iran	Performance rankings of public and private banks operating in Iran are made.
Akkoç & Vatansever (2013)	Fuzzy AHP, Fuzzy TOPSIS	Turkish banks	They perform the post-crisis performance rankings of Turkish banks. It is determined that the bank performance rankings made using both methods are similar to each other.
Uzar (2013)	PROMETHEE	3 public banks in Turkey	The study is conducted for two periods, 2002-2007 and 2008-2012, and the results of both periods are compared. It is concluded that the bank rankings for both periods are the same.
Mandic et al. (2014)	Fuzzy AHP, TOPSIS	35 commercial banks in Serbia	While the bank with the best financial performance is Banca Intesa, the bank with the worst financial performance is Moskovskabanka.
Bağcı & Rençber (2014)	PROMETHEE	13 Turkish banks (3 public and 10 private)	Halk Bank and Denizbank were determined as the most profitable banks in their groups. When the data of all banks are taken into account, Halk Bank stands out as the most profitable bank.
Sakınç & Gülen (2014)	GRA	Participation banks in Turkey	Kuveyt Türk is determined as the bank with the highest performance and Bank Asya as the bank with the lowest performance.
Chaudhuri & Ghosh (2014)	Equal weight, TOPSIS, M-TOPSIS	29 Indian commercial banks	In the 2007-2013 period, the state-owned bank with the best financial performance is

			Indian Bank, while the privately owned bank is City Union Bank.
Gökalp (2015)	PROMETHEE	Deposit banks in Turkey	The selected performance criteria are determined as CAMELS ratios. The results reveal that public banks are more affected by the financial crisis than private and foreign banks. While public banks perform better in the period of 2006-2008, there is a decrease in the performance of public banks in 2009-2012 period.
Özbek (2015)	AHP, OCRA	Public banks in Turkey	Vakıfbank displays the highest performance in the period of 2005-2012, and Ziraat Bankası in the period of 2013-2014.
Taşabat et al. (2015)	ORESTE, MAPPAC, ELECTRE, TOPSIS, VIKOR, WSA, PROMETHEE	21 banks in Turkey	The results of the different methods used are compared.
Aras et al. (2016)	ENTROPY, TOPSIS	Traditional and participation banks in Turkey	In the study in which banks are ranked in terms of their sustainability performance, it is concluded that there is no significant difference between traditional and participation banks.
Çalışkan & Eren (2016)	AHP, PROMETHEE	20 largest Turkish banks	In the study in which two applications are made, the importance levels of the criteria are accepted as equal in the first application and the analyzes are carried out with the PROMETHEE method. In the second application, weights of each criteria are calculated with AHP method and the results are analyzed by PROMETHEE method. In both methods, Ziraat Bank displays the highest performance.
Esmer & Bağcı (2016)	TOPSIS	Participation banks in Turkey	Performance rankings of the banks on the basis of years are carried out.
Güneysu et al. (2016)	AHS, GRA	Turkish commercial banks	Ziraat Bank, Adabank and JP Morgan Chase stand out as the top performing banks in their categories.
Kandemir & Karataş (2016)	GRA, TOPSIS, VIKOR	12 publicly traded Turkish banks	In the rankings made by all three methods, it is determined that the results obtained in terms of banks with the highest and the lowest performance differ.
Tezergil (2016)	VIKOR	28 deposit banks in Turkey	In the rankings, Akbank in 2009 and 2010, Ziraat Bank in 2011 and 2012 and Citibank in 2013 are the banks with the highest performance.
Siew et al. (2017)	Equal Weight, TOPSIS	8 publicly traded banks in Malaysia	CIMB Group Holdings Berhad has the best financial performance for the period 2011-2015.
Ömürbek et al. (2017)	ENTROPY, COPRAS, MOOSRA, ARAS	7 Turkish banks	Different success rankings were obtained in the analyzes using different methods.

Dash (2017)	PROMETHEE, CAMELS	35 banks in India	Public banks outperform private banks in terms of liquidity. Private banks, on the other hand, perform better in terms of capital adequacy and risk sensitivity.
Özkan (2017)	TOPSIS	7 publicly traded Turkish banks	There is no significant difference between banks when their performance ratings are compared. On the other hand, Garanti Bank has the highest performance and Akbank the lowest in average performance grades.
Topak & Çanakçıoğlu (2017)	ENTROPY, COPRAS	11 deposit banks in Turkey	The bank with the highest performance is Ziraat Bank, and the bank with the lowest performance is Şekerbank.
El Sayed et al. (2017)	ENTROPY, TOPSIS	Main banks in Saudi Arabia	Riyad Bank, Al-Bilad, Al-Rajhi Bank and Al-Inmaa Bank are the best performing banks.
Alsu et al. (2018)	TOPSIS	18 participation banks operating in 6 countries	Performance of participation banks operating in Saudi Arabia and Qatar are better than the others. Among Turkish participation banks, Albaraka Türk displays the best performance.
Gündoğdu (2018)	GRA	Participation banks in Turkey	Participation banks perform unstable performance rankings for the specified period.
Roy & Das (2018)	ENTROPY, TOPSIS	19 commercial banks in Bangladesh	Foreign and private banks perform better than the state-owned banks.
Uludağ & Ece (2018)	TOPSIS	28 deposit banks in Turkey	In the analyzes carried out after the classification made according to the ownership structures of the banks, performance rankings for each group are included.
Ural et al. (2018)	ENTROPY, WASPAS	3 public banks in Turkey	Vakıfbank displays the best performance in the period of 2012-2013, and Ziraat Bank in the period of 2014-2016.
Pala et al. (2018)	AHP, TOPSIS	29 Turkish banks	Foreign banks perform better than other bank groups.
Laha & Bisvas (2019)	ENTROPY, CODAS	10 Indian banks	Public banks perform worse than the private banks.
Akbulut (2019)	CRITIC, EDAS	İş Bankası	İş bank exhibits the highest performance in 2009 and the lowest performance in 2018.
Akgül (2019)	ENTROPY, SAW, MAUT, ARAS	Turkish banking sector	Banking sector shows the highest performance in 2018, while the performance in 2010 is the lowest.
Ayçin & Orçun (2019)	ENTROPY, MAIRCA	Turkish deposit banks	Ziraat Bank is the most successful and Vakıflar Bank is the most unsuccessful bank.
Gezen (2019)	ENTROPY, WASPAS	Participation banks in Turkey	Türkiye Finans and Kuveyt Türk participation banks exhibit the highest performance for different years within the specified period.
Işık (2019)	ENTROPY, ARAS	Deposit banks in Turkey	Deposit banks have the highest performance in 2010.

Kanat (2019)	GRA	6 Turkish banks (3 public and 3 private)	Ziraat Bank ranked the first in the performance ranking.
Gözkonan & Küçükbay (2019)	TOPSIS, GRA	Traditional and participation banks in Turkey	Traditional banks perform better than participation banks.
Karaca et al. (2019)	TOPSIS	Banks in BIST30 index	According to 2017 data, Garanti Bank ranked the first.
Kendirli et al. (2019)	TOPSIS	13 Turkish banks (10 commercial and 3 participation)	Participation banks perform better in the crisis period and commercial banks in the pre-crisis and post-crisis periods.
Özkan (2019)	TOPSIS	Publicly traded deposit banks in Turkey	The most successful banks are QNBFinansbank and Halk Bank.
Ünal (2019)	SD, WASPAS	Private commercial Turkish banks	Akbank exhibits the highest performance, while Türk Ekonomi Bank and Yapı Kredi Bank shows the lowest performance in certain years.
Banu & Santhiyavalli (2019)	TOPSIS	40 Indian banks	In the period 1999-2005, Citibank, Deutsche Bank, State Bank of Travan-Core, South Indian Bank and Bank of Baroda show the best performance.
Apan (2020)	ENTROPY, TOPSIS, GRA	Turkish public banks	Ziraat Bank ranked the first in the rankings made by TOPSIS and GRA methods.
Daver (2020)	TOPSIS	12 Turkish banks	In the analyzes made using CAMELS components, it is determined that Akbank displays the highest performance and Şekerbank displays the lowest performance.
Erdi (2020)	CRITIC, PROMETHEE	5 participation banks in Turkey	Ziraat Katılım Bank is determined as the most successful bank in terms of performance.
Eş & Kök (2020)	ENTROPY, WASPAS	8 Turkish banks	Garanti Bank displays the highest performance in 2015, Ziraat Bank in 2016-2017 and Yapı Kredi Bank in 2018-2019.
Karavardar & Çilek (2020)	MULTIMOORA	Participation banks in Turkey	Vakıf Katılım Bank exhibits the highest performance.
Kartal (2020)	VIKOR	Participation banks in Turkey	Kuveyt Türk performs better than the other participation banks.
Kaygusuz et al. (2020)	TOPSIS	10 Turkish banks	Performance grades of the banks are determined and the performance rankings of the banks are made.
Koçak & Çalık (2020)	AHP, TOPSIS	5 commercial banks in Turkey	Performance rankings of the selected banks are made.
Çelik (2020)	CRITIC, MABAC	Participation banks in Turkey	Ziraat Katılım Bank exhibits the highest performance and Albaraka Türk the lowest performance.
Odabaş & Bozdoğan (2020)	ELECTRE	Participation banks in Turkey	Vakıf Katılım performs better than the other participation banks.
Özkan (2020)	TOPSIS	Participation banks in Turkey	Türkiye Finans Katılım Bank displays the highest performance in the specified period.

Öndeş et al. (2020)	ELECTRE	Commercial and participation banks in Turkey	Performance comparisons of banks are made with each other and banks with higher performance are determined.
Sarı (2020)	PROMETHEE, TOPSIS	11 Turkish banks	The results show that the top 4 banks with the highest performance in the ranking according to both methods are the same.
Şahin & Tetik (2020)	TOPSIS	Participation banks in Turkey	Türkiye Finans Katılım Bank performs better than the other banks.
Guru & Mahalik (2021)	AHP, TOPSIS	26 state-owned banks in India	State Bank of India performs the best in 2014.
Yörük Evren et al. (2021)	MULTIMOORA, MAUT	Participation banks in Turkey	In the analyzes made using CAMELS ratios, Vakıf Katılım ranked the first in 2018, and Kuveyt Türk ranked the first in 2019.
Elmas & Yetim (2021)	TOPSIS	Participation banks in 6 countries	Turkey ranked the fifth in the ranking among countries.
Gençtürk et al. (2021)	CRITIC, MARCOS	Participation banks in Turkey	Vakıf Katılım shows the best performance compared to other banks.
Karadağ (2021)	ENTROPY, TOPSIS	Publicly traded deposit banks in Turkey	QNBFinansbank ranked the first and Yapı Kredi Bank ranked the second.
Bayram (2021)	CRITIC, EDAS	Participation banks in Turkey	Albaraka Türk has the highest performance among private banks.
Yetiz (2021)	TOPSIS	Participation banks in Turkey	It is determined that a different participation bank shows the highest performance for each year.
Sakarya & Gürsoy (2021)	ARAS, COPRAS	Publicly traded 9 Turkish banks	The same results are obtained in the bank performance rankings made according to both methods.
Demir (2021a)	ROC, ITARA, CODAS	Turkish banking sector	In the 2009-2019 period, the best performance of the Turkish banking sector is in 2009, while the worst performance is in 2018.
Demir (2021b)	SWARA, RAFSI	Private deposit banks in Turkey	In the 2014-2019 period, Akbank displays the best financial performance in the first five years and Yapı Kredi Bank in the last year.

7. APPLICATION

Within the scope of this study, performance of deposit banks operating in Turkey in 2020, which is the the first year of the pandemic, is analyzed. There are 27 deposit banks in total in Turkey. In the examinations made, it is determined that 10 of these banks have less than 40 branches (www.tbb.org.tr). The banks in question are not included in the scope of the study in order to give healthier results by performing the analyzes on banks with close number of branches. The list of 17 banks included in the scope and their codes to be used during the analysis are given in the table below. These banks constitute the alternatives of the study.

Table 2. Deposit Banks to be Analyzed and Their Codes

Code	Banks	Code	Banks
B-1	Ziraat Bankası	B-10	Yapı ve Kredi Bankası
B-2	Halk Bankası	B-11	Alternatifbank

B-3	Vakıflar Bankası	B-12	Denizbank
B-4	Akbank	B-13	HSBC Bank
B-5	Anadolubank	B-14	ING Bank
B-6	Fibabanka	B-15	Odea Bank
B-7	Şekerbank	B-16	QNB Finansbank
B-8	Türk Ekonomi Bankası	B-17	Garanti Bankası
B-9	İş Bankası		

In the study, some criteria are determined for the evaluation of the performance of the banks included in the scope. These criteria consist of some financial ratios calculated with the data obtained from the financial statements of the banks. For this purpose, 10 financial ratios used in similar academic studies in the literature regarding the profitability, balance sheet structure, asset quality, liquidity, capital adequacy, income-expense structure and activity ratios of banks are used. The data on the ratios are obtained from the reports of the Banks Association of Turkey. The determined rates are analyzed for the year 2020.

Financial ratios used as evaluation criteria in the study and the objective functions of these ratios are given in the table below. As it can be seen from Table 3, eight of the financial ratios used have beneficial and the remaining two have non-beneficial objective functions.

Table 3. Evaluation Criteria

Code	Criteria	Objective Function
C-1	Equity / Total Assets	Maximum (Beneficial)
C-2	Loans Received / Total Assets	Minimum (Non-beneficial)
C-3	Non-Performing Loans / Total Loans	Minimum (Non-beneficial)
C-4	Liquid Assets / Total Assets	Maximum (Beneficial)
C-5	Average Return on Assets	Maximum (Beneficial)
C-6	Average Return on Equity	Maximum (Beneficial)
C-7	Interest Income / Total Assets	Maximum (Beneficial)
C-8	Interest Income / Interest Expenses	Maximum (Beneficial)
C-9	Net Profit (Loss) for the Period / Paid in Capital	Maximum (Beneficial)
C10	Total Revenues / Total Expenses	Maximum (Beneficial)

The study consists of four stages. First, the weights of the evaluation criteria are determined by using the Entropy method, one of the objective MCDM methods. In the second stage, the criteria are weighted using the SWARA method, one of the subjective MCDM methods. In the third stage, the weights obtained from the Entropy and SWARA methods are combined using Bayesian approach and optimal criteria weights are obtained. The final weights thus obtained are calculated by considering the objective and subjective criteria together. In the fourth and the final stage, the performance analyzes of the banks are carried out using the EDAS method using the weights calculated in the third stage.

7.1. Calculation of Criteria Weights by Entropy Method

Before proceeding to the determination of the importance levels of the determined criteria using the Entropy method, the values of the performance criteria are determined for each bank. The values of the performance criteria for 2020 on bank basis are given in the table below. Table 4 constitutes the decision matrix of the study.

Table 4. Decision Matrix

Bank/ Criteria	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
B-1	9.90	3.92	2.31	9.66	0.98	9.58	7.37	199.29	59.73	167.13

B-2	6.31	1.53	3.76	9.65	0.46	6.92	7.90	153.60	105.10	134.69
B-3	6.65	6.72	3.97	13.73	0.90	12.60	6.76	172.65	128.29	165.27
B-4	14.10	8.13	6.83	12.91	1.55	10.69	7.50	240.25	120.52	202.90
B-5	12.69	1.43	8.79	13.85	1.93	13.84	8.08	139.26	69.22	157.33
B-6	6.88	4.24	3.17	15.51	0.94	13.02	8.01	178.14	24.42	165.39
B-7	7.03	1.74	9.91	13.87	0.15	2.28	8.69	194.14	2.83	148.60
B-8	8.15	6.96	4.22	21.18	0.95	11.14	8.03	220.67	53.41	155.47
B-9	11.41	6.81	5.57	14.22	1.28	10.76	7.16	246.12	151.35	197.87
B-10	10.35	8.33	6.41	14.75	1.20	11.45	7.20	205.37	60.13	191.60
B-11	6.53	24.98	4.58	16.56	0.30	4.08	6.27	137.40	4.68	131.38
B-12	11.49	11.73	8.86	13.46	1.01	8.83	7.95	234.48	31.48	207.36
B-13	8.04	4.44	2.37	24.04	1.10	13.09	5.58	211.52	65.99	176.25
B-14	14.62	8.65	5.70	25.30	1.06	7.29	8.00	233.74	17.97	179.07
B-15	8.63	3.51	10.73	16.01	0.37	3.97	6.58	169.33	4.08	163.94
B-16	8.46	8.89	6.11	12.86	1.22	13.85	7.42	240.53	74.24	179.72
B-17	12.60	5.16	4.56	15.87	1.41	10.77	7.55	276.58	148.52	242.40

The first step after the creation of the decision matrix according to Entropy method is the calculation of normalized decision matrix. Aim of the normalization process is to express the values for each criterion in the decision matrix with a standard value between 0 and 1. For this purpose, the normalization process is performed by means of the equation (1) stated in the previous parts of the study and the normalized decision matrix below is obtained. According to this equation, each value in the decision matrix is divided by its column sum and normalization is performed.

Table 5. Normalized Decision Matrix

Bank/ Criteria	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**	**C-6**	**C-7**	**C-8**	**C-9**	**C-10**
B-1	0.0604	0.0335	0.0236	0.0367	0.0585	0.0584	0.0585	0.0577	0.0532	0.0563
B-2	0.0385	0.0130	0.0384	0.0366	0.0272	0.0422	0.0627	0.0445	0.0937	0.0454
B-3	0.0406	0.0574	0.0406	0.0521	0.0533	0.0768	0.0537	0.0500	0.1143	0.0557
B-4	0.0861	0.0694	0.0698	0.0490	0.0925	0.0651	0.0595	0.0696	0.1074	0.0684
B-5	0.0775	0.0122	0.0899	0.0526	0.1151	0.0843	0.0641	0.0403	0.0617	0.0530
B-6	0.0420	0.0362	0.0324	0.0589	0.0557	0.0793	0.0635	0.0516	0.0218	0.0558
B-7	0.0429	0.0148	0.1012	0.0526	0.0092	0.0139	0.0689	0.0562	0.0025	0.0501
B-8	0.0497	0.0594	0.0431	0.0804	0.0566	0.0679	0.0637	0.0639	0.0476	0.0524
B-9	0.0697	0.0581	0.0569	0.0540	0.0763	0.0655	0.0568	0.0713	0.1349	0.0667
B-10	0.0631	0.0711	0.0655	0.0560	0.0714	0.0697	0.0571	0.0595	0.0536	0.0646
B-11	0.0399	0.2132	0.0468	0.0628	0.0176	0.0249	0.0497	0.0398	0.0042	0.0443
B-12	0.0701	0.1001	0.0905	0.0511	0.0600	0.0538	0.0631	0.0679	0.0281	0.0699
B-13	0.0491	0.0379	0.0242	0.0913	0.0653	0.0797	0.0442	0.0613	0.0588	0.0594
B-14	0.0893	0.0739	0.0583	0.0960	0.0630	0.0444	0.0634	0.0677	0.0160	0.0604
B-15	0.0527	0.0300	0.1096	0.0608	0.0220	0.0242	0.0522	0.0490	0.0036	0.0553
B-16	0.0516	0.0758	0.0624	0.0488	0.0724	0.0844	0.0589	0.0697	0.0662	0.0606
B-17	0.0769	0.0441	0.0466	0.0602	0.0840	0.0656	0.0599	0.0801	0.1324	0.0817

After the normalized decision matrix is created, Entropy values are found by using equation (2). The Entropy values for the criteria are calculated as in the table below.

Table 6. Entropy Values

Bank/ Criteria	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
B-1	-0.1695	-0.1137	-0.0885	-0.1212	-0.1660	-0.1658	-0.1660	-0.1646	-0.1561	-0.1621
B-2	-0.1255	-0.0566	-0.1253	-0.1211	-0.0981	-0.1335	-0.1736	-0.1385	-0.2218	-0.1404
B-3	-0.1301	-0.1640	-0.1300	-0.1540	-0.1563	-0.1971	-0.1569	-0.1498	-0.2480	-0.1609
B-4	-0.2111	-0.1851	-0.1859	-0.1478	-0.2202	-0.1778	-0.1679	-0.1854	-0.2397	-0.1835
B-5	-0.1981	-0.0538	-0.2165	-0.1548	-0.2488	-0.2085	-0.1762	-0.1295	-0.1719	-0.1558
B-6	-0.1332	-0.1202	-0.1112	-0.1668	-0.1608	-0.2010	-0.1751	-0.1529	-0.0833	-0.1610
B-7	-0.1351	-0.0625	-0.2319	-0.1550	-0.0431	-0.0594	-0.1844	-0.1618	-0.0151	-0.1500
B-8	-0.1492	-0.1677	-0.1356	-0.2026	-0.1626	-0.1826	-0.1754	-0.1758	-0.1449	-0.1545
B-9	-0.1856	-0.1653	-0.1632	-0.1576	-0.1964	-0.1785	-0.1629	-0.1883	-0.2702	-0.1806
B-10	-0.1744	-0.1879	-0.1785	-0.1614	-0.1884	-0.1857	-0.1635	-0.1678	-0.1568	-0.1770
B-11	-0.1285	-0.3295	-0.1432	-0.1739	-0.0711	-0.0919	-0.1493	-0.1283	-0.0229	-0.1381
B-12	-0.1863	-0.2304	-0.2175	-0.1520	-0.1688	-0.1572	-0.1743	-0.1826	-0.1003	-0.1860
B-13	-0.1480	-0.1240	-0.0900	-0.2185	-0.1782	-0.2016	-0.1379	-0.1711	-0.1666	-0.1677
B-14	-0.2157	-0.1925	-0.1656	-0.2250	-0.1742	-0.1383	-0.1750	-0.1823	-0.0662	-0.1695
B-15	-0.1551	-0.1052	-0.2423	-0.1702	-0.0839	-0.0901	-0.1541	-0.1479	-0.0204	-0.1600
B-16	-0.1530	-0.1956	-0.1732	-0.1474	-0.1901	-0.2086	-0.1668	-0.1856	-0.1797	-0.1699
B-17	-0.1972	-0.1376	-0.1430	-0.1693	-0.2080	-0.1787	-0.1687	-0.2022	-0.2677	-0.2047

After finding the Entropy values, equation (3) is used, the degrees of differentiation (d_j) of the criteria are calculated and the results in the table below were obtained.

Table 7. Differentiation Degrees

C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
0.0133	0.0853	0.0324	0.0122	0.0417	0.0271	0.0019	0.0067	0.1065	0.0042

Finally, criteria weights calculated according to the Entropy method are determined by using equation (4). The results obtained are presented in Table 8.

Table 8. Criteria Weights According to Entropy Method

C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
0.0402	0.2576	0.0979	0.0368	0.1260	0.0818	0.0057	0.0201	0.3213	0.0126

When the results in the table above are examined, the most important criteria is calculated as Net Profit (Loss) / Paid in Capital with a weight of 0.3213. This criterion is followed by the Credits Received / Total Assets criteria with a weight of 0.2576. The least important criteria is determined as Non-performing Loans / Total Loans with a weight of 0.0057.

7.2. Calculation of Criteria Weights by SWARA Method

In the second stage of the application, criteria weights are determined by the SWARA method. SWARA method makes use of the opinions of decision makers while determining the weights of the criteria. In this respect, while the SWARA method is applied in this study, the author of the study, as a decision maker, made evaluations in the light of his own professional and academic knowledge and experience.

When starting the SWARA method, it is necessary to choose the evaluation criteria and decision makers first. As evaluation criteria, 10 criteria explained in the previous parts of the study are used in the same way. The author's views are used as the decision maker and the order of importance and s_j values are determined by the author. The order of importance of the criteria

performed by the author is given in the table below. In the table, "1" denotes the most important criteria and "10" denotes the least important criteria.

Table 9. Order of Importance of the Criteria

Criteria	Order of Importance (Decision maker – author)
C-1	2
C-2	10
C-3	1
C-4	6
C-5	3
C-6	4
C-7	9
C-8	8
C-9	5
C-10	7

Following the ranking of the criteria according to their importance, Average Values of Comparative Importance (s_j) are determined by the author as presented in Table 10.

Table 10. Average Values of Comparative Importance

Criteria	s_j
C-3	
C-1	0.20
C-5	0.10
C-6	0.05
C-9	0.05
C-4	0.10
C-10	0.15
C-8	0.05
C-7	0.05
C-2	0.10

Then, calculations were made using equations (5), (6) and (7) and the results in the table below are obtained regarding k_j, q_j and w_j values.

Table 11. Results of SWARA Method

Criteria	Order of Importance	s_j	k_j	q_j	w_j
C-3	1		1.00	1.00	0.1509
C-1	2	0.20	1.20	0.83	0.1258
C-5	3	0.10	1.10	0.76	0.1143
C-6	4	0.05	1.05	0.72	0.1089
C-9	5	0.05	1.05	0.69	0.1037
C-4	6	0.10	1.10	0.62	0.0943
C-10	7	0.15	1.15	0.54	0.0820
C-8	8	0.05	1.05	0.52	0.0781
C-7	9	0.05	1.05	0.49	0.0744
C-2	10	0.10	1.10	0.45	0.0676

As can be seen from the table above, the weights (w_j) of each criterion are determined finally. When the results in the table above are examined, the most important criterion is calculated as non-performing loans / total loans with a weight of 0.1509. The equity / total assets follows this

criterion, which has weight of 0.1258. The least important criterion is determined as loans received / total assets with 0.0676.

7.3. Recalculation of Criteria Weights by Bayesian Approach

In the first two applications of the study, the weights of the evaluation criteria are determined by first using Entropy and then SWARA methods. In this section, the weights obtained as a result of both methods are combined and recalculated by the Bayesian approach.

By using equations (8) and (9), criteria weights obtained as a result of Entropy and SWARA methods are recalculated, and optimal criteria weights are reached. The new criteria weights (α_j) obtained by applying the Bayesian approach are presented in Table 12.

Table 12. New Criteria Weights Obtained by Bayesian Approach

Criteria	Entropy (w_i)	SWARA (w_i)	Multiplication	α_j
C-1	0.0402	0.1258	0.0051	0.0504
C-2	0.2576	0.0676	0.0174	0.1735
C-3	0.0979	0.1509	0.0148	0.1472
C-4	0.0368	0.0943	0.0035	0.0346
C-5	0.1260	0.1143	0.0144	0.1435
C-6	0.0818	0.1089	0.0089	0.0888
C-7	0.0057	0.0744	0.0004	0.0042
C-8	0.0201	0.0781	0.0016	0.0156
C-9	0.3213	0.1037	0.0333	0.3320
C-10	0.0126	0.0820	0.0010	0.0103

When the table above is examined, it is seen that the most important performance criteria are Net Profit (Loss) for the Period / Paid in Capital, Loans Received / Total Assets and Non-Performing Loans / Total Loans. The least important criteria are Interest Income / Total Assets, Total Revenues / Total Expenses and Interest Income / Interest Expenses.

Since the EDAS method will be used for the performance rankings of banks in the study, these determined weights will constitute an input to the EDAS method to be carried out in the next stage of the study.

7.4. Application of EDAS Method

After determining the importance levels of the criteria with the Bayesian approach, the performance analyzes of the banks selected by the EDAS method will be carried out in this section. The first step of the EDAS method is to determine the criteria. As stated in the previous sections, 10 criteria are used in the study.

In the second and third stages of the method, the decision matrix is created and the mean solution values (AV_j) for each criterion are determined by using equation (11). The following table includes the decision matrix and the AV_j values of the criteria.

Table 13. Decision Matrix and AV_j Values

Min./Max.	Max.	Min.	Min.	Max.	Max.	Max.	Max.	Max.	Max.	Max.
Bank/ Criteria	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**	**C-6**	**C-7**	**C-8**	**C-9**	**C-10**
B-1	9.90	3.92	2.31	9.66	0.98	9.58	7.37	199.29	59.73	167.13
B-2	6.31	1.53	3.76	9.65	0.46	6.92	7.90	153.60	105.10	134.69
B-3	6.65	6.72	3.97	13.73	0.90	12.60	6.76	172.65	128.29	165.27
B-4	14.10	8.13	6.83	12.91	1.55	10.69	7.50	240.25	120.52	202.90

B-5	12.69	1.43	8.79	13.85	1.93	13.84	8.08	139.26	69.22	157.33
B-6	6.88	4.24	3.17	15.51	0.94	13.02	8.01	178.14	24.42	165.39
B-7	7.03	1.74	9.91	13.87	0.15	2.28	8.69	194.14	2.83	148.60
B-8	8.15	6.96	4.22	21.18	0.95	11.14	8.03	220.67	53.41	155.47
B-9	11.41	6.81	5.57	14.22	1.28	10.76	7.16	246.12	151.35	197.87
B-10	10.35	8.33	6.41	14.75	1.20	11.45	7.20	205.37	60.13	191.60
B-11	6.53	24.98	4.58	16.56	0.30	4.08	6.27	137.40	4.68	131.38
B-12	11.49	11.73	8.86	13.46	1.01	8.83	7.95	234.48	31.48	207.36
B-13	8.04	4.44	2.37	24.04	1.10	13.09	5.58	211.52	65.99	176.25
B-14	14.62	8.65	5.70	25.30	1.06	7.29	8.00	233.74	17.97	179.07
B-15	8.63	3.51	10.73	16.01	0.37	3.97	6.58	169.33	4.08	163.94
B-16	8.46	8.89	6.11	12.86	1.22	13.85	7.42	240.53	74.24	179.72
B-17	12.60	5.16	4.56	15.87	1.41	10.77	7.55	276.58	148.52	242.40
AV_j	**9.64**	**6.89**	**5.76**	**15.49**	**0.99**	**9.66**	**7.41**	**203.12**	**66.00**	**174.49**

After the decision matrix is formed and the AV_j values are determined, PDA and NDA matrices are formed by using equations (12) and (13). The matrices formed as a result of the calculations made considering whether the criteria are benefit or cost-based are given in Table 14 and Table 15.

Table 14. PDA Matrix

Bank/ Criteria	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
B-1	0.03	0.43	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-2	0.00	0.78	0.35	0.00	0.00	0.00	0.07	0.00	0.59	0.00
B-3	0.00	0.02	0.31	0.00	0.00	0.31	0.00	0.00	0.94	0.00
B-4	0.46	0.00	0.00	0.00	0.57	0.11	0.01	0.18	0.83	0.16
B-5	0.32	0.79	0.00	0.00	0.96	0.43	0.09	0.00	0.05	0.00
B-6	0.00	0.38	0.45	0.00	0.00	0.35	0.08	0.00	0.00	0.00
B-7	0.00	0.75	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00
B-8	0.00	0.00	0.27	0.37	0.00	0.15	0.08	0.09	0.00	0.00
B-9	0.18	0.01	0.03	0.00	0.30	0.11	0.00	0.21	1.29	0.13
B-10	0.07	0.00	0.00	0.00	0.21	0.19	0.00	0.01	0.00	0.10
B-11	0.00	0.00	0.20	0.07	0.00	0.00	0.00	0.00	0.00	0.00
B-12	0.19	0.00	0.00	0.00	0.02	0.00	0.07	0.15	0.00	0.19
B-13	0.00	0.36	0.59	0.55	0.11	0.36	0.00	0.04	0.00	0.01
B-14	0.52	0.00	0.01	0.63	0.07	0.00	0.08	0.15	0.00	0.03
B-15	0.00	0.49	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
B-16	0.00	0.00	0.00	0.00	0.23	0.43	0.00	0.18	0.12	0.03
B-17	0.31	0.25	0.21	0.02	0.43	0.12	0.02	0.36	1.25	0.39

Table 15. NDA Matrix

Bank/ Criteria	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10
B-1	0.00	0.00	0.00	5.84	0.01	0.08	0.04	3.83	6.27	7.36
B-2	3.33	0.00	0.00	5.85	0.53	2.74	0.00	49.52	0.00	39.80
B-3	2.99	0.00	0.00	1.76	0.09	0.00	0.65	30.48	0.00	9.22
B-4	0.00	1.24	1.08	2.58	0.00	0.00	0.00	0.00	0.00	0.00
B-5	0.00	0.00	3.04	1.65	0.00	0.00	0.00	63.87	0.00	17.16
B-6	2.76	0.00	0.00	0.00	0.05	0.00	0.00	24.98	41.58	9.10
B-7	2.61	0.00	4.15	1.63	0.83	7.38	0.00	8.99	63.17	25.90
B-8	1.49	0.07	0.00	0.00	0.04	0.00	0.00	0.00	12.59	19.02

B-9	0.00	0.00	0.00	1.28	0.00	0.00	0.26	0.00	0.00	0.00
B-10	0.00	1.43	0.65	0.75	0.00	0.00	0.22	0.00	5.87	0.00
B-11	3.10	18.08	0.00	0.00	0.69	5.57	1.15	65.72	61.32	43.11
B-12	0.00	4.84	3.10	2.03	0.00	0.83	0.00	0.00	34.52	0.00
B-13	1.60	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.01	0.00
B-14	0.00	1.76	0.00	0.00	0.00	2.36	0.00	0.00	48.02	0.00
B-15	1.01	0.00	4.97	0.00	0.62	5.68	0.83	33.79	61.92	10.55
B-16	1.18	1.99	0.35	2.64	0.00	0.00	0.00	0.00	0.00	0.00
B-17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

After the PDA and NDA matrices are formed, the weighed sum of PDA and weighed sum of NDA are calculated by equations (18) and (19), and the results in Table 16 and Table 17 were obtained.

Table 16. Weighted Sum of PDA

Min./ Max.	Max.	Min.	Min.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	**SP_i**
Weights	0.0504	0.1735	0.1472	0.0346	0.1435	0.0888	0.0042	0.0156	0.3320	0.0103	
Bank/ Criteria	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	
B-1	0.0013	0.0748	0.0881	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1642
B-2	0.0000	0.1351	0.0510	0.0000	0.0000	0.0000	0.0003	0.0000	0.1967	0.0000	0.3831
B-3	0.0000	0.0043	0.0457	0.0000	0.0000	0.0271	0.0000	0.0000	0.3133	0.0000	0.3904
B-4	0.0234	0.0000	0.0000	0.0000	0.0821	0.0095	0.0000	0.0029	0.2743	0.0017	0.3937
B-5	0.0160	0.1375	0.0000	0.0000	0.1372	0.0385	0.0004	0.0000	0.0162	0.0000	0.3457
B-6	0.0000	0.0667	0.0661	0.0000	0.0000	0.0309	0.0003	0.0000	0.0000	0.0000	0.1641
B-7	0.0000	0.1298	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	0.0000	0.1305
B-8	0.0000	0.0000	0.0392	0.0127	0.0000	0.0137	0.0003	0.0013	0.0000	0.0000	0.0673
B-9	0.0093	0.0021	0.0047	0.0000	0.0427	0.0101	0.0000	0.0033	0.4294	0.0014	0.5030
B-10	0.0037	0.0000	0.0000	0.0000	0.0306	0.0164	0.0000	0.0002	0.0000	0.0010	0.0519
B-11	0.0000	0.0000	0.0302	0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0325
B-12	0.0097	0.0000	0.0000	0.0000	0.0029	0.0000	0.0003	0.0024	0.0000	0.0019	0.0172
B-13	0.0000	0.0617	0.0867	0.0191	0.0158	0.0316	0.0000	0.0006	0.0000	0.0001	0.2156
B-14	0.0261	0.0000	0.0014	0.0219	0.0102	0.0000	0.0003	0.0024	0.0000	0.0003	0.0625
B-15	0.0000	0.0850	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0862
B-16	0.0000	0.0000	0.0000	0.0000	0.0331	0.0386	0.0000	0.0029	0.0415	0.0003	0.1163
B-17	0.0155	0.0436	0.0305	0.0008	0.0614	0.0102	0.0001	0.0056	0.4151	0.0040	0.5868

Table 17. Weighted Sum of NDA

Min./ Max.	Max.	Min.	Min.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	**SN_i**
Weights	0.0504	0.1735	0.1472	0.0346	0.1435	0.0888	0.0042	0.0156	0.3320	0.0103	
Bank/ Criteria	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	
B-1	0.0000	0.0000	0.0000	0.2019	0.0008	0.0068	0.0002	0.0598	2.0803	0.0758	2.4256
B-2	0.1676	0.0000	0.0000	0.2022	0.0762	0.2429	0.0000	0.7725	0.0000	0.4100	1.8715
B-3	0.1506	0.0000	0.0000	0.0611	0.0133	0.0000	0.0027	0.4754	0.0000	0.0950	0.7980
B-4	0.0000	0.2145	0.1586	0.0893	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4624
B-5	0.0000	0.0000	0.4471	0.0570	0.0000	0.0000	0.0000	0.9963	0.0000	0.1768	1.6772
B-6	0.1389	0.0000	0.0000	0.0000	0.0075	0.0000	0.0000	0.3897	13.8041	0.0938	14.4339
B-7	0.1315	0.0000	0.6111	0.0564	0.1197	0.6550	0.0000	0.1402	20.9725	0.2667	22.9531
B-8	0.0752	0.0117	0.0000	0.0000	0.0053	0.0000	0.0000	0.0000	4.1803	0.1959	4.4684
B-9	0.0000	0.0000	0.0000	0.0442	0.0000	0.0000	0.0011	0.0000	0.0000	0.0000	0.0453
B-10	0.0000	0.2489	0.0962	0.0259	0.0000	0.0000	0.0009	0.0000	1.9473	0.0000	2.3192
B-11	0.1564	3.1377	0.0000	0.0000	0.0994	0.4950	0.0048	1.0252	20.3580	0.4441	25.7206
B-12	0.0000	0.8396	0.4569	0.0704	0.0000	0.0733	0.0000	0.0000	11.4597	0.0000	12.9000

B-13	0.0804	0.0000	0.0000	0.0000	0.0000	0.0000	0.0077	0.0000	0.0026	0.0000	0.0907
B-14	0.0000	0.3057	0.0000	0.0000	0.0000	0.2100	0.0000	0.0000	15.9441	0.0000	16.4597
B-15	0.0507	0.0000	0.7315	0.0000	0.0889	0.5048	0.0035	0.5271	20.5568	0.1087	22.5720
B-16	0.0595	0.3457	0.0521	0.0913	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5486
B-17	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Afterwards, the normalization process is carried out with the help of equations (20) and (21), evaluation scores are calculated using equation (22) and their rankings were performed. The results of the EDAS method are given in the table below.

Table 18. Normalized Values and Results of EDAS

Bank	NSP	NSN	AS_i	Rank
B-1	0.280	0.906	0.593	8
B-2	0.653	0.927	0.790	5
B-3	0.665	0.969	0.817	4
B-4	0.671	0.982	0.826	3
B-5	0.589	0.935	0.762	6
B-6	0.280	0.439	0.359	12
B-7	0.222	0.108	0.165	15
B-8	0.115	0.826	0.470	11
B-9	0.857	0.998	0.928	2
B-10	0.088	0.910	0.499	10
B-11	0.055	0.000	0.028	17
B-12	0.029	0.498	0.264	13
B-13	0.367	0.996	0.682	7
B-14	0.107	0.360	0.233	14
B-15	0.147	0.122	0.135	16
B-16	0.198	0.979	0.588	9
B-17	1.000	1.000	1.000	1

When the results obtained from the table above are examined, the first three banks (B-17, B-9, B-4) with the highest financial performance as a result of the calculations made by considering the determined criteria come to the fore as Garanti Bankası, İş Bankası and Akbank, respectively. First three banks with the lowest performance (B-11, B-15, B-7) are Alternatif Bank, Odea Bank and Şekerbank, respectively.

The rankings in Table 18 are obtained as a result of recalculating the criteria weights obtained by Entropy and SWARA methods using the Bayesian approach and using the optimal weights reached as input in the EDAS method.

In this study, the combined Entropy-EDAS and the combined SWARA-EDAS methods are also calculated using the steps described in the previous sections. Although the calculation details of these two analyzes are not included in the study, the results obtained by applying these three methods separately are presented in Table 19.

Table 19. Ranking Results

Bank	Combined Weights-EDAS	ENTROPY-EDAS	SWARA-EDAS
B-1	8	8	8
B-2	5	3	12
B-3	4	6	6
B-4	3	4	2
B-5	6	5	5

B-6	12	12	13
B-7	15	14	15
B-8	11	11	11
B-9	2	2	3
B-10	10	10	10
B-11	17	17	17
B-12	13	13	14
B-13	7	7	4
B-14	14	15	9
B-15	16	16	16
B-16	9	9	7
B-17	1	1	1

When the results in Table 19 are examined, it is seen that the results obtained as a result of double and triple comparisons of the applied methods differ. When the results are evaluated in terms of the top three banks with the highest performance, B-17 is the most successful bank in all three methods. On the other hand, it is determined that the banks in the second and third rank differ. When the banks with the lowest performance are analyzed, it is determined that the first two banks with the lowest performance are the same in all methods, while the third lowest performing banks differ. When the other rankings are analyzed, there are differences between the results of these methods.

In analyzes performed with MCDM methods, criteria weights can be determined by objective and subjective methods. As it can be seen from the application above, which evaluation method is used is a factor that causes the rankings to change. While objective methods calculate on observation values, subjective methods take into account the opinions of decision makers. It is thought that instead of performing the analyzes by applying only objective or subjective methods, the combined use of these methods and the determination of the optimal criterion weights can yield more meaningful results for the decision makers.

8. CONCLUSION

MCDM methods are one of the methods frequently used by researchers in all disciplines and in the field of banking recently. There are different studies in the literature to evaluate the performance of banks using different MCDM methods. In these studies, the evaluation criteria used, the methods for determining the importance of the evaluation criteria, and the analysis methods differ. In addition, studies mainly focus on analyzes made on banking groups such as deposit, public, private, foreign, participation banks, etc.

The aim of this study is to evaluate the financial performance of deposit banks in 2020 by using the determined financial ratios as evaluation criteria, using ENTROPY, SWARA and EDAS methods. For this purpose, 10 evaluation criteria are determined, and the weights of these criteria are calculated using the ENTROPY and SWARA methods. Then, the weights obtained from both methods are combined with the Bayesian approach and the optimal weights are reached. These calculated weights are transferred to the EDAS method and the financial performance rankings of 17 deposit banks included in the sample are made.

It is determined that the most important criteria are Net Profit (Loss) for the Period / Paid in Capital, Loans Received / Total Assets and Non-Performing Loans / Total Loans, respectively. On the other hand, three least important criteria are Interest Income / Total Assets, Total Revenues / Total Expenses, and Interest Income / Interest Expenses, respectively. As a result

of the bank performance rankings made by applying the EDAS method, the top three most successful banks in 2020 are Garanti Bankası, İş Bankası and Akbank, respectively. While three most unsuccessful banks are Alternatif Bank, Odea Bank and Şekerbank.

When the reasons for the said situation of the banks, which are determined to perform poorly in the rankings made as a result of the study, are examined, it is concluded that the low performance of the banks in terms of profitability-related criteria compared to other banks negatively affected their rankings. It is recommended to examine the reasons why the profitability ratios of these banks are at these levels, which are lower compared to other banks, and to plan remedial actions for the coming periods.

The results show that the top three banks with the highest performance in 2020 are the ones in the top 10 in terms of asset size in the banking sector. According to the data of 2020, none of the deposit banks, which ranked in the top three in terms of asset size, could rank in the top three in terms of financial performance. When the banks with the lowest performance in 2020 are evaluated, it can be said that these banks are smaller-scale banks in terms of asset size compared to other banks. As a result, it is determined that large-scale banks performed better than small-scale banks in 2020, which is the first year of the pandemic.

The results obtained in this study are important for shareholders, investors, senior management of the banks' and regulatory and supervisory authorities. Based on the results of this study, it will be possible to have an idea about the impact of the first year of the pandemic on the financial performance of deposit banks, and some actions can be taken by examining the reasons for the low-performing banks' performance in this direction. In addition, data on the financial performance of deposit banks in the first year of the pandemic will also enable some predictions to be made for the following years of the pandemic.

As in studies conducted in different fields, evaluations can be made by using objective and subjective criteria weighting methods in bank performance evaluations. Although objectively weighting the performance criteria of banks is important in terms of reflecting the reliability of the analysis results, including the opinions of the right decision makers in the model will increase the validity of the results. Here, the correctly chosen decision makers can be expert academics and bank senior executives. For this reason, objective and subjective methods can be used together in academic studies to be conducted on bank performance, and the criteria weights of subjective methods can be determined by interviews with expert academics and bank senior managers or by questionnaires. In addition, studies that will be carried out in the future can also compare the results to be achieved with the calculations of importance degrees to be determined by objective and subjective methods separately.

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