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Evaluation of the Financial Performance of Deposit Banks Operating in Turkey by Entropy-supported EDAS Method

Türkiye'de Faaliyet Gösteren Mevduat Bankaların Finansal Performansının Entropi destekli EDAS Yöntemi ile Değerlendirilmesi

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ÖZ

Bu çalışmanın amacı, 2012-2021 döneminde Türkiye ekonomisinde yer alan 18 mevduat bankasının finansal performansını ÇKKV yöntemleri ile analiz etmektir. Çalışmada 18 mevduat bankası, 10 finansal oran ile değerlendirilmiştir. ÇKKV yöntemlerinden Entropi yöntemiyle kriter ağırlıkları belirlenmiş ve EDAS yöntemi ile ilgili bankaların finansal performans sıralaması elde edilmektedir. Bulgulara göre, en önemli performans kriterleri 2021 yılında Duran Varlıklar/Toplam Varlıklar finansal oranı olduğu saptanmaktadır. En düşük performans kriteri ise 2021 yılında Faiz Gelirleri/Toplam Varlıklar olduğu saptanmaktadır. EDAS metodunun bulgularında ise, 2012-2021 döneminde en yüksek finansal performansa sahip olan bankanın Deutsche Bank olduğu ve en düşük ise Denizbank olduğu belirlenmiştir.

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ABSTRACT

The aim of this study is to analyze the financial performance of 18 deposit banks in the Turkish economy in the period of 2012-2021 with MCDM methods. In the study, 18 deposit banks were evaluated with 10 financial ratios. Criterion weights are determined by the Entropy method from the MCDM methods and the financial performance ranking of the banks related to the EDAS method is obtained. According to the findings, the most important performance criteria are the Fixed Assets/Total Assets financial ratio in 2021. The lowest performance criterion is Interest Income/Total Assets in 2021. It was also determined that the bank with the highest financial performance in the period of 2012-2021 was Deutsche Bank and the lowest performance was Denizbank.

1. Introduction

Banks are one of the financial institutions that transfer the capabilities collected from the areas with a surplus of funds in an economy to the areas with a fund deficit with the least

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cost. In other words, banks basically act as intermediaries between those who give surplus capital and those who need capital. Any problems that may occur in the current system of the bank directly affect the overall economy as well as its stakeholders. The growth of the banking system increases in parallel with the degree of monetization of the markets and the developments in the banking sector mutually and deeply affect other sectors of the economy, especially the real economy. The fact that banks have a fragile and risky structure makes it inevitable to constantly monitor their financial structures and activities (Seçme et al., 2009). Therefore, the banking sector is an integral pillar and provider of economic development and sustainability (Kumar & Prakash, 2019).

Considering the structure of the Turkish economy, one of the important institutions of the financial services sector is banks. Regular measurement and evaluation of the performance of these banks can contribute to the sustainable development of the Turkish economy while reducing the risks in the financial markets and preventing possible crises on the other hand (Aydın, 2020). At the same time, financial performance measurements should be made to evaluate the financial structures in order to adapt to the ever-changing economic conditions in Turkey and to progress continuously (Kendirli & Kaya, 2016). This indicates that we have information about whether banks are successful or not.

Since the banking sector generally plays an important role in the development of countries and sustainable economy and is the mileston of the sector, the problem of measuring performance and ranking performance in this sector has recently become one of the important problems (Özcan, 2021; No et al., 2021; Sama et al., 2022). This problem even plays the role of an important bridge between economics and mathematical sciences. To rank a particular set of banks, evaluation criteria such as revenue, cost, efficiency must be taken into account. Due to the variety of these criteria, this ranking problem is often expressed as a multi-criteria decision-making problem. Reasons for difficulty in ranking; (1) criteria selection, (2) data collection, (3) uncertainty of data, (4) determination of criterion weights, (5) multi-criteria solution approach selection (No et al., 2021). On the other hand, banks, which are among the basic institutions of the financial services group, have some reasons to measure performance. These are to measure the level of satisfaction of customers, to position themselves in the sector by making comparisons, to determine whether they are successful for both themselves and their shareholders, and to identify areas in the organization that are open to development and can create advantages (Seçme et al., 2009).

Bank performance is an important issue among researchers. In the literature, many studies take into account some traditional criteria such as return on assets, return on equity, liquidity, capital, etc. to evaluate the banking sector. Important studies considering these criteria are Sufian (2009), Malik et al. (2016), Daly and Frikha (2017) and Bansal et al. (2018). However, in addition to the criteria used to measure the financial performance of banks in many studies in the literature, the multi-criteria approaches applied to carry out the evaluation procedure are interesting. There are various such solution approaches in the literature of operations research and optimization theory. There are studies that apply the most famous and popular multi-criteria decision-making methods (Seçme et al., 2009; Bayyurt, 2013; Dash, 2017; Tüysüz & Yıldız, 2020; Yazdı et al., 2020; Gupta et al., 2021; vNo et al., 2021; Alamoudi & Bafail, 2022; Sama et al., 2022; Öksüzkaya & Atan, 2023; Özdemirci et al., 2023). "Multi-Criteria Decision Making Methods (MCDM)" such as AHP, TOPSIS, ELECTRE, PROMETHEE, CRITIC, MABAC are very popular techniques among researchers and practitioners in the fields of Science, Technology and Management. The reason why these techniques are so popular is that they can be used in various sorting problems, selection problems, sorting problems, and explanation problems when there is more than one criterion that needs to be chosen or sorted (Bandyopadhyay, 2021).

In addition, MCDMs are used as a tool that allows ranking among companies by examining multi-criteria to compare the performance of a company with similar firms, dividing them into various clusters and selecting them (Genç & Masca, 2013). On the other hand, the MCDM, is a branch of decision-making and part of operations research. MCDM techniques are divided into two categories, the first category is multi-purpose decision making and the second category is multi-specialty decision making. In recent days, MCDM has been recognized as one of the best tools for solving complex problems (Sama et al., 2022).

Therefore, in this study, the weights of the performance criteria are determined by using the Entropy method and the EDAS method is also applied and ranking is made among the banks. The EDAS method, which is a multi-criteria decision-making method, is proposed by Keshavarz Ghorabaee et al. (2015). Advantages of this method; has a low calculation time, moderate mathematical and computational complexity, has a flexible structure for decision makers, uses average solution-based normalization, and ranking-based determination is determined by two distance scores depending on the nature of the criteria (Torkayesh et al., 2023). The reason why the EDAS method, which is the MCDM technique, is applied in this study is that this method is very useful when we have some conflicting criteria, and when MCDM methods such as VIKOR and TOPSIS are reconciled, the best alternative is obtained by calculating the distance to the ideal and rare solutions with the EDAS method. It is also found to be the best method for dealing with other MCDM techniques such as VIKOR, TOPSIS, SAW and COPRAS (Keshavarz Ghorabaee et al., 2015). The entropy method is used to determine the importance levels of the criteria without the need to express the decision problem with the help of a hierarchical model. In this study, the reason for choosing the Entropy method is that it is an objective weight determination method that calculates using the available

data, unlike methods such as AHP and Delphi, where index weights are calculated based on the subjective judgments of decision makers (Çakır & Perçin, 2013; Karaatlı, 2016).

In the light of the above evaluations, valuing the performance of firms is an important industrial function. Investors are constantly looking for the right investment areas to benefit from more profit and are also taking initiatives to analyze the difference between successful and unsuccessful firms (Türegü, 2022). The aim of this study is to determine the financial performance of a total of 18 banks in Turkey, including public-owned, privately-owned and foreign-capital over the period of 2012-2021. In the study, first of all, the Entropy method is used to determine the weigth of the criterions and then the EDAS method is applied to determine the performance ranking among the banks. The findings from the study provide important contributions to the literature. The first is to use the EDAS approach, which is a new, popular and multi-criteria decision-making method that has not been used much in the literature, and to obtain findings. Secondly, it is the ranking of banks' financial performance according to their capital groups and in general. Finally, the findings of this study, which examined the sample over a ten-year period, provide important advice to managers and policy makers.

The rest of the study is designed as follows. In the second part, the studies carried out for banks both in Turkey and in other countries are examined and evaluated by using multi-criteria decision-making methods in the literature. In the third part, the study methodology formed by the study data and method is mentioned. In the fourth section, the findings obtained as a result of the analyzes are summarized. In the last section, the result of the study is explained.

2. Literature Review

Multi-Criteria Decision Making Methods are methods that are the subject of application in almost every field. In the literature, these methods are widely used as financial measurement methods. However, since the number of studies conducted as an economic performance measurement is almost non-existent, this study makes an important contribution to the literature (Topçu & Oralhan, 2017). In the other hands, the sustainability of the banking sector, which is the heart of finance, is of vital importance both for the financial sector and the economy and for the realization of the 2030 sustainable development goals (Ecer & Pamucar, 2022). This shows us that it is important to measure the financial performance of banks. First, criteria are used to evaluate banks, and in addition to these, multi-criteria decision-making approaches are applied to carry out the evaluation procedure. Famous and popular multi-criteria solution approaches used in the literature EDAS, AHP, TOPSIS, ELECTRE, PROMETHEE, CRITIC, MABAC (Bayyurt, 2013; Dash, 2017; Tüysüz & Yıldız, 2020; Gupta et al., 2021; No et al., 2021; Sama et al., 2022).

First of all, when we consider the studies conducted for banks in Turkey in the literature, for example, Bayyurt (2013) compares the performance of 17 foreign and 14 local Turkish banks operating in 2010 using multi-criteria decision-making methods. The findings of TOPSIS, ELECTRE III and Data Envelopment Analysis indicate that foreign banks perform better than local banks. Dogan (2015) compares the financial performance of 4 participation banks operating in Turkey's banking sector in the period 2012-2014 using the Grey Relational Analysis method. According to the findings, it is determined that Albaraka Türk ranks first and Bank Asya ranks last. Similarly, in the Yağlı (2020) study, private and public participation banks are used CAMELS and TOPSIS methods for the 2016-2018 period, obtaining that public participation banks perform better than private participation banks. Akçakanat et al. (2017) applies ENTROPI and WASPAS methods to its 9-month data in 2016 and determines that the bank with the best performance is the large-scale Ziraat Bank of the Republic of Turkey, the medium-sized Finansbank and the small-scale Anadolubank. Aras et al. (2017), which measures Garanti Bank's institutional sustainable performance with economic, social, state management and environmental factors, finds that the highest effect economic factor and the lowest effective state management factor in the 2010-2014 period by using TOPSIS and GRI method. Using similar methods TOPSIS and Fuzzy TOPSIS, Title (2020) examines the criteria determined by investigating the criteria affecting the financial performance of the top seven banks in the period 2014-2018. The researcher identifies the banks with the best performance for the sample as Ziraat Bank, İş bank and Garanti Bank and Yapı Kredi Bank as the bank with the worst performance. At the same time, in order to evaluate the regional performance of the banking sector, which has a significant share in the economy, Tüysüz and Yıldız (2020) determines the importance level of each criterion using the HFLTS-AHP method and determines its ranking with the GRA method. According to the findings obtained, according to the ranking of the bank regions, Istanbul Anatolia ranks first and Çukurova region ranks last. Using EDAS, MOORA, OCRA and TOPSIS techniques from the multi-criteria decision-making methods, Özalıcı and Bumin (2020) determine that the best performing banks among the banks operating in Borsa İstanbul are İş Bank and Halk Bank, respectively.

Ic et al. (2021) evaluates the financial performance of five Turkish banks with the AHP method, which is integrated into the VIKOR method. The findings show that the first and third year findings are compatible with each other. Ecer and Pamucar (2022) measures the sustainability performance of banks that contribute to financial stability in the Turkish economy. Researchers use the LOPCOW and MEREC methods in the weighting phase and the DOBI method, which is a multi-criteria decision-making method to calculate the performance scores of banks and determine sustainability rankings. The findings show that the three best performing banks are Garanti BBVA, Vakıfbank and Isbank, while the three worst performing banks are TEB, Halkbank and Şekerbank. In the Öksüzkaya and Atan (2023)

study, it examines and aims to rank the financial performance of investment and development banks operating in the Turkish Banking sector in the period of 2016-2021 by using a total of 6 six criteria in 3 benefit and 3 cost directions. Researchers use the CRITIC method to determine the weight of the criterias and the MABAC method to rank performance. The findings revealed that the Development and Investment Bank of Turkey has the highest performance, while the Iller Bank has the lowest financial performance.

At the same time, when we examine the studies conducted for other countries in the literature, Wu et al. (2009) finds that the ranking are C Bank > U Bank > S Bank by using FAHP and multi-criteria decision-making methods SAW, TOPSIS and VIKOR approaches for 3 banks. Firstly, Mandic et al. (2014) determine the weighting of criteria using the FAHP method to measure the financial performance of Serbia banks and determine the performance ranking of banks by applying the TOPSIS method in the period 2005-2010. The study findings show that Banca Intesa has the highest performance, while Raiffeisenbank and AIK bank also rank second and third. Wanke et al. (2016), who evaluated the effectiveness of Malaysian Islamic banks in the period 2009-2013 using two-stage TOPSIS and artificial neural networks approaches, found that Maybank Islami ranked first in 2013 and Al Rajhi banking & investment firm was the least effective firm in 2012. Dash (2017) aims to measure the performance of private and public banks in India. While the researcher uses the CAMELS model to determine the weights of different criteria, he uses the multi-criteria decision-making model called PROMETHEE to compare and sort the performances of private and public banks. The findings indicate that in terms of capital equity, risk and the ratio of profit after tax to total assets, in the period 2017-2011, Indian private banks outperformed public banks, and in terms of liquidity and return on net worth, public banks performed better than private sector banks. Similarly, Radulescu et al. (2017) investigates the nature of the banking system of the 28 EU members after the Brexit event and within the new Basel III regulations using the multi-criteria analysis method PROMETHEE II approach. The findings suggest that banking systems in Central and Eastern Europe are performing best, with advanced banking systems such as German, Italian, British and French ranking last.

Lahaa and Biswas (2019) determine the criteria weights of banks in India based on five-year period data and the performance ranking of banks with the Entropy method and the Combinative Distance-based Assessment (CODAS) method, one of the MCDM techniques. Researchers find that private sector banks outperform public sector banks. Gupta et al. (2021) aims to rank the performance of Indian private banks on the Bombay Stock Exchange in the period covering 5 years between 2014-15 and 2018-19 using 10 different financial indicators. With the Analytical Hierarchy Process (AHP) technique, the weights of 10 different financial indicators are defined and the rankings of private sector banks are made with the TOPSIS method. The findings show that HDFC bank has the best performance overall, while South Indian Bank has the worst performance. Reig-Mullor & Brotons-Martinez (2021), which used the AHP and TOPSIS method to evaluate the performance of 6 Spanish commercial banks in the period 2015-2017, reveals that Santander is the best performing bank and the worst performing bank is Sabadell. Sama et al. (2022) investigate the performance of 18 India private banks using multi-criteria decision-making methods such as CRITIC, TOPSIS and GROA techniques between 2018 and 2019. According to the TOPSIS and GRA multi-criteria decision-making techniques applied by determining the weights of the performance criteria by the CRITIC method, the first of the performance rankings is determined as HDFC bank and the second as Bandhan Bank.

As a result of the above examinations, it is seen that many studies in the literature use many criteria to determine the financial performance of banks both in Turkey and in other countries. These studies are the main source of motivation in determining the purpose of this study. Therefore, in this study, in determining the financial performance of a total of 18 banks with public capital, private capital and foreign capital in the Turkish economy, firstly, the Entropy method is applied to determine the weight of criterion and then the EDAS method is applied to determine the financial performance ranking of the banks.

3. Methodology

3.1. Study Purpose and Data

In the study, MCDM methods are applied to determine the financial performance of banks in a ten-year period covering the years 2012-2021. In the analysis, firstly, the importance of the 10 financial rations is determined by applying the Entropy method. The financial performance ranking of 18 banks is obtained by integrating the criterion weights obtained as a result of the entropy method into the EDAS method.

The financial ratios of the banks based on the study are collected from the book "Our Annual Banks" published on the official website of the TBB-The Banks Association of Turkey (https:\\www.tbb.org.tr/tr) and the banks examined in the study and the capital group and abbreviations of these banks are reported in Table 1. In addition, the financial ratio variables used in the analysis and their explanations, abbreviations, direction and references are shown in Table 2.

Table 1. Banks Examined within the Scope of Analysis

Capital group	Banks	Abbreviations
State-Owned Deposits Banks	Türkiye Cumhuriyeti Ziraat Banks A.Ş.	KB1
	Türkiye Halk Bankası A.Ş.	KB2
	Türkiye Vakıflar Bankası T.A.O.	KB3
Private Owned Deposits Banks	Akbank A.Ş.	ÖB4
	Anadolubank A.Ş.	ÖB5
	Fibabanka A.Ş.	ÖB6
	Turkish Bank A.Ş.	ÖB7
	Türk Ekonomi Bankası A.Ş.	ÖB8
	Türkiye İş Bankası A.Ş.	ÖB9
	Yapı ve Kredi Bankası A.Ş.	ÖB10
Foreign Capital Banks	Alternatifbank A.Ş.	YB11
	Arap Türk Bankası A.Ş.	YB12
	Citibank A.Ş.	YB13
	Denizbank A.Ş.	YB14
	Deutsche Bank A.Ş.	YB15
	ING Bank A.Ş.	YB16
	QNB Finansbank A.Ş.	YB17
	Türkiye Garanti Bankası A.Ş.	YB18

Table 2. Financial Ratios Included in the Analysis

Rates	Formulas	Abbreviations	Direction of Criterion	Reference
Profitability Rates	Return on Assets	KO1	Max	Wanke et al., (2016); Sezal (2023)
	Return on Equity	KO2	Max	Radulescu et al. (2017); Hidayat et al. (2021)
Liquidity Ratios	Current Assets / Total Assets	LO1	Max	Elmas & Yetim (2021)
	Current Assets / Short-Term Liabilities	LO2	Max	Ertuğrul & Karakaşoğlu, (2009)
Active quality Rates	Total Loans / Total Assets	AK1	Max	Avkiran, (2011); Daly & Frikha (2017)
	Total Loans / Total Deposits	AK2	Max	Reig-Mullor & Brotons-Martinez (2021)
	Fixed Assets / Total Assets	AK3	Min	Yılmaz & Yakut (2021)
Capital Adequacy Ratio	Equity / Total Assets	SY1	Max	Sufian (2009)
Income-Expense Ratios	Interest Income / Total Assets	GO1	Max	Aydın (2020)
	Interest Expenses / Total Assets	GO2	Min	Gupta et al. (2020)

3.2. Method of Study

Multi-Criteria Decision Making Methods are applicable methods for "performance evaluation" in many enterprises (Oralhan & Özsoy, 2019). In this study, the weights of financial performance criteria were determined by using the Entropy method. Financial performance ranking is made among banks by including the criterion weights obtained as a result of the entropy method into the EDAS method. Therefore, first the Entropy method and then the EDAS method are explained.

1) Entropy Method

The most important stage in multi-criteria decision-making problems is to give the right weights to the criteria where the alternatives will be listed (Hussain & Mandal, 2016). The entropy method is used to establish the objective weights of the criteria without taking into account the choice of the decision maker. This method includes first creating the decision matrix by deciding on the goals and then creating the normalized decision matrix, the probability of the formation of the criteria, calculating the entropy value of each criterion, determining the degrees of deviation of each response (the average information it contains), and then determining the entropy weight (Chodha et al., 2022).

The stages of the entropy method are as follows (Wang et al. 2022):

Step 1: The decision matrix is created as shown in Equation (1).

$$X = [x_{ij}]_{mxn} = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1n} \\ X_{21} & X_{22} & \dots & X_{2n} \\ \dots & \dots & \dots & \dots \\ X_{m1} & X_{m2} & \dots & X_{mn} \end{bmatrix}; i = 1,2,\dots,m;\ j = 1,2 \dots n \quad (1)$$

The x_{ij} given in equation (1) refers to the performance of the i alternative relative to criterion j, m the number of alternatives, n the number of criteria.

Step 2: The decision matrix is normalized through the formula specified in equation (2).

$$v_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (2)$$

The v_{ij} given in Equation (2) means the normalized value of the alternative A_i relative to C_j. x_{ij} specifies the exact value of the A_i alternative according to C_j. The total number of alternatives evaluated is indicated by m.

Step 3: Using equation (3), the entropy value of criterion j is calculated.

$$e_j = -k \sum_{i=1}^{m} v_{ij} \ln(v_{ij}) = -\frac{1}{\ln(m)} \sum_{i=1}^{m} v_{ij} \ln(v_{ij}) \quad (3)$$

ln(■) shown in equation (3) represents the logarithm based on e, and e_j is $[0,1]$.

Step 4: The degree of d_j is calculated as given in equation (4).

$$d_j = 1 - e_j, j \in [1, \dots, n] \quad (4)$$

Step 5: The objective weighting of the criterion j given by equation (5) is calculated as follows.

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \quad (5)$$

2) EDAS Method

EDAS (Evaluation based on Distance from Average Solution) method is a distance-based approach that uses positive and negative distances from the average solution so that the available alternatives can be enumerated. Positive and negative distance measurements are calculated according to the type of utility and cost criteria. The alternative with higher PDA (positive distance from the mean) or lower NDA values (negative distance from the mean) is preferred as better (Dhanalakshmi et al., 2020).

The algorithm of the EDAS method can be obtained by following these steps (Keshavarz Ghorabaee et al., 2015; Yazdani et al., 2020):

Step 1: The first decision matrix is created as shown in Equation (6).

$$X = [x_{ij}]_{n*m} = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1m} \\ X_{21} & X_{22} & \dots & X_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ X_{n1} & X_{n2} & \cdots & X_{nm} \end{bmatrix} \quad (6)$$

Step 2: The average solution for each criterion is calculated by Equation (7) and Equation (8).

$$AV = [AV_j]_{1*m} \quad (7)$$

$$AV_j = \frac{\sum_{i=1}^{n} x_{ij}}{n} \quad (8)$$

Step 3: Positive distance from mean (PDA) and negative distance from mean (NDA) are calculated using Equation (9) and Equation (10). If a criterion is a utility criterion, Equation (11) and Equation (12) are used. If a criterion is a cost criterion, Equation (13) and Equation (14) are used.

$$PDA = [PDA_{ij}]_{n*m} \quad (9)$$

$$NDA = [NDA_{ij}]_{n*m} \quad (10)$$

$$PDA_{ij} = \frac{max(0,(x_{ij} - AV_j))}{AV_j} \quad (11)$$

$$NDA_{ij} = \frac{\max(0,(AV_j - x_{ij}))}{AV_j} \quad (12)$$

$$PDA_{ij} = \frac{\max(0,(AV_j - x_{ij}))}{AV_j} \quad (13)$$

$$NDA_{ij} = \frac{\max(0,(x_{ij} - AV_j))}{AV_j} \quad (14)$$

Step 4: Using Equation (15) and Equation (16), the weighted sum of PDA and NDA is calculated for all alternatives.

$$ASP_i = \sum_{j=1}^{m} w_j * PDA_{ij} \quad (15)$$

$$NSN_i = \sum_{j=1}^{m} w_j * NDA_{ij} \quad (16)$$

Step 5: The values obtained in Step 4 are normalized by Equation (17) and Equation (18).

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (17)$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \quad (18)$$

Step 6: Finally, the evaluation score for each alternative is determined as in (AS_i) Equation (19).

$$AS_i = \frac{1}{2}(NSP_i + NSN_i) \quad (19)$$

The best alternative in the decision problem is chosen as the one with the highest evaluation score (AS_i).

4. Findings

4.1. Findings of Criterion Weights by Entropy Method

At this stage of the study, the weight values of the financial ratio variables of the banks are calculated by using the Entropy method. Since the method consists of more than one stage and the evaluation of 10 years within the scope of the study, only the applications for 2021 are presented in detail with the help of tables. In the final stage of the method, the criterion weight values of all relevant years are given in Table 7. The decision matrix, the first stage of the method, is shown in Table 3.

Table 3. Decision Matrix (2021 Year)

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	0,544	6,609	16,199	24,226	56,781	82,051	2,489	7,083	7,440	4,539
KB2	0,191	3,489	14,087	19,572	59,873	86,209	2,014	4,827	9,851	7,059
KB3	0,489	8,483	17,114	28,534	58,777	100,180	1,251	5,158	7,168	5,228
ÖB4	2,100	17,463	20,223	37,002	49,847	85,508	3,321	10,714	6,884	3,663
ÖB5	1,839	14,476	25,242	39,240	54,597	69,942	7,576	12,707	8,879	6,724
ÖB6	1,133	19,432	32,203	52,815	50,771	73,965	1,818	5,194	7,553	5,243
ÖB7	0,312	2,791	38,382	54,881	58,107	74,715	2,869	9,799	5,994	3,210
ÖB8	1,145	15,286	24,411	34,311	55,563	81,784	0,876	7,017	8,084	4,553
ÖB9	1,772	17,421	22,238	33,215	55,496	86,330	5,476	9,372	6,573	3,234

ÖB10	1,753	18,892	19,491	32,034	55,142	101,289	3,174	8,617	7,007	3,927
YB11	0,239	4,139	22,355	45,974	55,286	97,207	2,587	5,235	6,494	5,304
YB12	2,098	12,891	33,120	67,801	27,423	67,480	3,488	13,752	4,012	0,595
YB13	5,280	32,263	45,385	56,419	32,522	41,073	0,263	15,904	7,900	1,921
YB14	1,396	13,709	18,573	34,479	61,325	101,327	10,484	9,347	7,234	3,588
YB15	3,509	20,062	33,720	104,053	48,957	194,127	0,927	16,701	8,450	3,022
YB16	1,668	12,145	27,126	40,222	57,434	89,418	1,867	13,079	7,720	4,463
YB17	1,312	18,992	23,043	37,622	57,286	93,751	1,801	5,963	6,882	3,555
YB18	2,091	18,546	26,488	39,513	56,064	82,779	3,458	10,412	7,535	3,096

In the second stage of the method, the financial ratio variable values in the decision matrix are normalized. The resulting normalized matrix is given in Table 4.

Tablo 4. Normalize Decision Matrix

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	0,019	0,026	0,035	0,031	0,060	0,051	0,045	0,041	0,057	0,062
KB2	0,007	0,014	0,031	0,025	0,063	0,054	0,036	0,028	0,075	0,097
KB3	0,017	0,033	0,037	0,036	0,062	0,062	0,022	0,030	0,054	0,072
ÖB4	0,073	0,068	0,044	0,047	0,052	0,053	0,060	0,063	0,052	0,050
ÖB5	0,064	0,056	0,055	0,050	0,057	0,043	0,136	0,074	0,067	0,092
ÖB6	0,039	0,076	0,070	0,068	0,053	0,046	0,033	0,030	0,057	0,072
ÖB7	0,011	0,011	0,084	0,070	0,061	0,046	0,051	0,057	0,046	0,044
ÖB8	0,040	0,059	0,053	0,044	0,058	0,051	0,016	0,041	0,061	0,062
ÖB9	0,061	0,068	0,048	0,042	0,058	0,054	0,098	0,055	0,050	0,044
ÖB10	0,061	0,073	0,042	0,041	0,058	0,063	0,057	0,050	0,053	0,054
YB11	0,008	0,016	0,049	0,059	0,058	0,060	0,046	0,031	0,049	0,073
YB12	0,073	0,050	0,072	0,087	0,029	0,042	0,063	0,080	0,030	0,008
YB13	0,183	0,125	0,099	0,072	0,034	0,026	0,005	0,093	0,060	0,026
YB14	0,048	0,053	0,040	0,044	0,064	0,063	0,188	0,055	0,055	0,049
YB15	0,122	0,078	0,073	0,133	0,051	0,121	0,017	0,098	0,064	0,041
YB16	0,058	0,047	0,059	0,051	0,060	0,056	0,033	0,077	0,059	0,061
YB17	0,045	0,074	0,050	0,048	0,060	0,058	0,032	0,035	0,052	0,049
YB18	0,072	0,072	0,058	0,051	0,059	0,051	0,062	0,061	0,057	0,042

After the normalized decision matrix, the entropy value of the relevant criteria is calculated e_j. The entropy values are given in Table 5.

Table 5. Entropy Values

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	-0,075	-0,094	-0,118	-0,108	-0,168	-0,152	-0,139	-0,132	-0,162	-0,173
KB2	-0,033	-0,058	-0,107	-0,092	-0,174	-0,157	-0,120	-0,101	-0,194	-0,226
KB3	-0,069	-0,113	-0,123	-0,121	-0,172	-0,173	-0,085	-0,106	-0,158	-0,189
ÖB4	-0,191	-0,183	-0,137	-0,144	-0,155	-0,156	-0,168	-0,174	-0,154	-0,150
ÖB5	-0,175	-0,162	-0,159	-0,150	-0,164	-0,136	-0,271	-0,193	-0,182	-0,220
ÖB6	-0,127	-0,195	-0,186	-0,182	-0,156	-0,142	-0,112	-0,106	-0,164	-0,189
ÖB7	-0,049	-0,049	-0,207	-0,186	-0,171	-0,143	-0,153	-0,164	-0,141	-0,137
ÖB8	-0,128	-0,168	-0,156	-0,137	-0,166	-0,151	-0,065	-0,131	-0,171	-0,173
ÖB9	-0,171	-0,182	-0,147	-0,134	-0,166	-0,157	-0,228	-0,159	-0,150	-0,138
ÖB10	-0,170	-0,192	-0,134	-0,131	-0,165	-0,174	-0,163	-0,151	-0,156	-0,157
YB11	-0,040	-0,066	-0,147	-0,167	-0,165	-0,170	-0,142	-0,107	-0,148	-0,191
YB12	-0,191	-0,150	-0,190	-0,212	-0,102	-0,133	-0,173	-0,203	-0,106	-0,039
YB13	-0,311	-0,260	-0,229	-0,190	-0,115	-0,094	-0,025	-0,221	-0,169	-0,096
YB14	-0,147	-0,156	-0,130	-0,138	-0,177	-0,174	-0,314	-0,159	-0,159	-0,148
YB15	-0,256	-0,199	-0,192	-0,268	-0,153	-0,255	-0,068	-0,227	-0,176	-0,132
YB16	-0,165	-0,144	-0,167	-0,153	-0,169	-0,161	-0,114	-0,197	-0,166	-0,171
YB17	-0,141	-0,192	-0,150	-0,146	-0,169	-0,166	-0,111	-0,117	-0,154	-0,147
YB18	-0,190	-0,190	-0,165	-0,151	-0,167	-0,153	-0,172	-0,170	-0,164	-0,134

At this stage of the method, the d_j values are calculated and the obtained values and the weights (w_j) of the criteria are determined. The relevant results are given in Table 6.

When the w_j values are examined, it is seen that the most important criterion affecting financial performance is Fixed Assets/Total Assets (AK3). The criteria following the relevant ranking are; Return on Assets (KO1), Return on Equity (KO2), Current Assets/Short-Term Liabilities (LO2), Interest Expense/Total Assets (GO2), (Equity/Total Assets) SY1, Current Assets/Total Assets (LO1), Total Loans/Total Assets (AK2), Total Loans/Total Deposits (AK1). The least important criterion is Interest Income/Total Assets (GO1).

Table 6. Criterion Weights for 2021

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
d_j	0,091	0,047	0,016	0,028	0,005	0,016	0,092	0,025	0,005	0,027
w_j	0,258	0,133	0,046	0,079	0,015	0,045	0,261	0,072	0,014	0,077

The weights of the financial ratios for each year are presented in Table 7 and Figure 1.

When the results of Table 7 and Figure 1 are examined; In 2012, it is seen that the most important criteria are KO1, LO2, SY1, and the least important criterion is AK2. In 2013, it was concluded that the most important criteria are KO2, KO1, AK3 and the least important criteria is GO1. In 2014, the most important criteria ranking are LO2, AK3, KO1. The most recent benchmark is GO1, similar to 2013. When the results of 2015 are considered, similar to the results of 2013 year, AK3, KO1, KO2 criteria are the most important criteria, respectively. The criterion with the least significance value is AK1. When the results obtained for 2016 are examined; The ranking of the most important criteria is AK3, KO1 AND KO2, similar to 2015 and 2021. It is concluded that the least important criterion is GO1, similar to 2013 and 2014.

According to the findings of 2017, the most important criteria are AK3, KO1, KO2, which are similar to 2015 and 2016. The least important criterion is determined as AK1, similar to 2015. In 2018, it is concluded that the most important criteria ranking is AK3, LO2 and KO1. The least important criterion among the criteria is determined as AK1, similar to 2015 and 2017. When the results of 2019 are considered, the most important criterion ranking continues as KO1, AK3 and LO2. The criterion with the lowest degree of importance is determined as GO1, similar to 2013, 2014 and 2015.

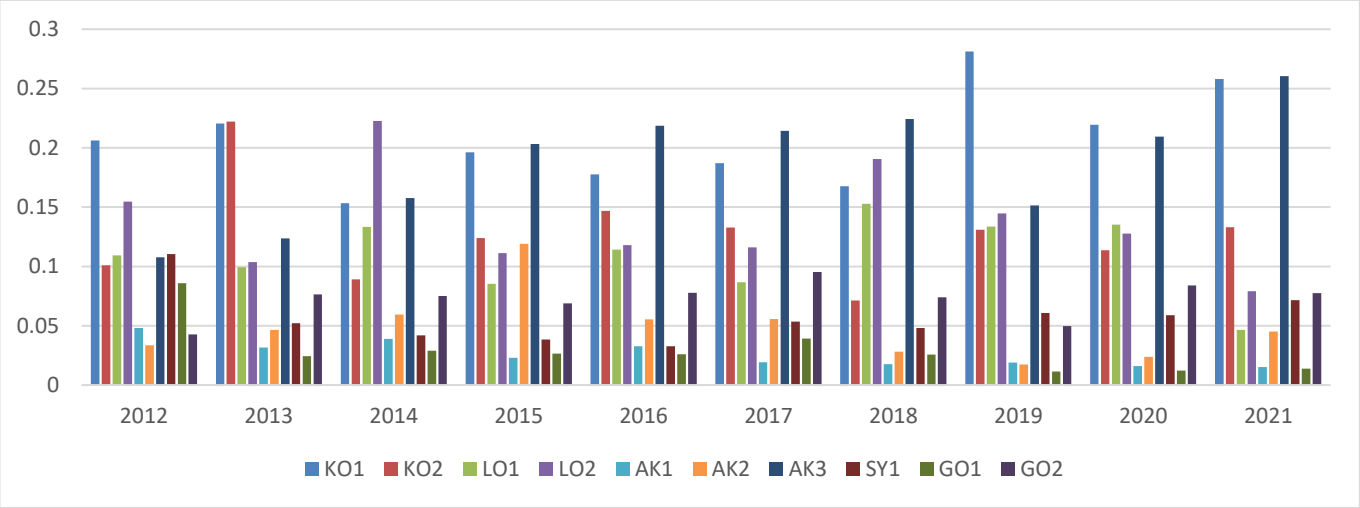
When the findings obtained for 2020 are examined; the most important criteria are KO1, AK3 and LO1. The least important criterion is determined as GO1, similar to 2013, 2014, 2015 and 2019. When the findings of 2021, which is the last year included in the analysis within the scope of the study, are examined, it is concluded that the most important criterion is AK3. The criteria following the relevant ranking are KO1, KO2. This ranking is similar to the results of 2015, 2016 and 2017. Similar to the results of 2013, 2014, 2015, 2019 and 2020, it is concluded that the least important criterion in 2021 is GO1.

Table 7. Criterion Weights for 2012-2021 Years within the Scope of Analysis

YILLAR	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
2012	0,206	0,101	0,109	0,154	0,048	0,033	0,107	0,110	0,086	0,042
2013	0,220	0,222	0,099	0,103	0,031	0,046	0,123	0,052	0,024	0,076
2014	0,153	0,089	0,133	0,222	0,038	0,059	0,157	0,042	0,028	0,075
2015	0,196	0,123	0,085	0,111	0,023	0,119	0,203	0,038	0,026	0,068
2016	0,177	0,146	0,114	0,118	0,032	0,055	0,218	0,032	0,026	0,077
2017	0,187	0,132	0,086	0,116	0,019	0,055	0,214	0,053	0,039	0,095
2018	0,167	0,071	0,152	0,190	0,017	0,028	0,224	0,048	0,025	0,073
2019	0,281	0,130	0,133	0,144	0,019	0,017	0,151	0,060	0,011	0,049
2020	0,219	0,113	0,135	0,127	0,016	0,023	0,209	0,059	0,012	0,084
2021	0,257	0,133	0,046	0,079	0,015	0,045	0,260	0,071	0,013	0,077

Note: Yellow colors represent the largest values, and red colors represent the minimum values.

Figure 1. Criterion Weights for the years 2012-2021



4.2. Findings of Financial Performance Rankings of Banks with EDAS Method

In this section, the weight values of the financial ratios calculated by the Entropy method are integrated into the EDAS method and the financial performance rankings of the banks are obtained. Since the EDAS method consists of many stages and there are separate analyzes for each year, the analyzes for 2021 are presented in detail through tables as in the Entropy method. In the last part of the method, the ranking of banks for all years is given in Table 13. The decision matrix, which is the first stage of the EDAS method, is as shown in Table 3 in the Entropy method. Another stage of the related method, the matrix of positive distance from the mean is in Table 8 and the matrix of negative distance from the mean is in Table 9.

Table 8. Positive Distance from Average Matrix

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	0,000	0,000	0,000	0,000	0,074	0,000	0,196	0,000	0,017	0,000
KB2	0,000	0,000	0,000	0,000	0,133	0,000	0,350	0,000	0,347	0,000
KB3	0,000	0,000	0,000	0,000	0,112	0,121	0,596	0,000	0,000	0,000
ÖB4	0,309	0,223	0,000	0,000	0,000	0,000	0,000	0,129	0,000	0,096
ÖB5	0,146	0,014	0,000	0,000	0,033	0,000	0,000	0,339	0,214	0,000
ÖB6	0,000	0,361	0,262	0,216	0,000	0,000	0,413	0,000	0,033	0,000
ÖB7	0,000	0,000	0,504	0,263	0,100	0,000	0,074	0,032	0,000	0,208
ÖB8	0,000	0,070	0,000	0,000	0,051	0,000	0,717	0,000	0,105	0,000
ÖB9	0,104	0,220	0,000	0,000	0,050	0,000	0,000	0,000	0,000	0,202
ÖB10	0,093	0,323	0,000	0,000	0,043	0,133	0,000	0,000	0,000	0,031
YB11	0,000	0,000	0,000	0,058	0,046	0,087	0,165	0,000	0,000	0,000
YB12	0,308	0,000	0,298	0,561	0,000	0,000	0,000	0,449	0,000	0,853
YB13	2,292	1,259	0,778	0,299	0,000	0,000	0,915	0,675	0,080	0,526
YB14	0,000	0,000	0,000	0,000	0,160	0,133	0,000	0,000	0,000	0,114
YB15	1,188	0,405	0,321	1,395	0,000	1,172	0,701	0,759	0,155	0,254
YB16	0,040	0,000	0,063	0,000	0,087	0,000	0,397	0,378	0,056	0,000
YB17	0,000	0,330	0,000	0,000	0,084	0,049	0,418	0,000	0,000	0,122
YB18	0,303	0,298	0,038	0,000	0,061	0,000	0,000	0,097	0,030	0,236

Table 9. Negative Distance from Average Matrix

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	0,661	0,537	0,365	0,442	0,000	0,082	0,000	0,254	0,000	0,120
KB2	0,881	0,756	0,448	0,549	0,000	0,036	0,000	0,492	0,000	0,742
KB3	0,695	0,406	0,329	0,343	0,000	0,000	0,000	0,457	0,020	0,290
ÖB4	0,000	0,000	0,208	0,148	0,057	0,043	0,072	0,000	0,059	0,000
ÖB5	0,000	0,000	0,011	0,097	0,000	0,218	1,447	0,000	0,000	0,660
ÖB6	0,294	0,000	0,000	0,000	0,039	0,173	0,000	0,453	0,000	0,294
ÖB7	0,806	0,805	0,000	0,000	0,000	0,164	0,000	0,000	0,181	0,000

ÖB8	0,286	0,000	0,044	0,210	0,000	0,085	0,000	0,261	0,000	0,124
ÖB9	0,000	0,000	0,129	0,235	0,000	0,034	0,768	0,013	0,101	0,000
ÖB10	0,000	0,000	0,236	0,263	0,000	0,000	0,025	0,092	0,042	0,000
YB11	0,851	0,710	0,124	0,000	0,000	0,000	0,000	0,449	0,112	0,309
YB12	0,000	0,097	0,000	0,000	0,481	0,245	0,126	0,000	0,451	0,000
YB13	0,000	0,000	0,000	0,000	0,385	0,541	0,000	0,000	0,000	0,000
YB14	0,129	0,040	0,272	0,206	0,000	0,000	2,386	0,015	0,011	0,000
YB15	0,000	0,000	0,000	0,000	0,074	0,000	0,000	0,000	0,000	0,000
YB16	0,000	0,150	0,000	0,074	0,000	0,000	0,000	0,000	0,000	0,102
YB17	0,182	0,000	0,097	0,134	0,000	0,000	0,000	0,372	0,059	0,000
YB18	0,000	0,000	0,000	0,090	0,000	0,074	0,117	0,000	0,000	0,000

In the step of calculating the weighted positive matrix and the weighted negative matrix, which is another stage of the EDAS method, the criterion weights obtained as a result of the Entropy method are included in the EDAS method. The weighted positive matrix is presented in Table 10 and the weighted negative matrix is presented in Table 11.

Table 10. Weighted Positive Matrix

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	0,000	0,000	0,000	0,000	0,001	0,000	0,042	0,000	0,001	0,000
KB2	0,000	0,000	0,000	0,000	0,003	0,000	0,075	0,000	0,014	0,000
KB3	0,000	0,000	0,000	0,000	0,002	0,007	0,128	0,000	0,000	0,000
ÖB4	0,058	0,030	0,000	0,000	0,000	0,000	0,000	0,007	0,000	0,009
ÖB5	0,027	0,002	0,000	0,000	0,001	0,000	0,000	0,018	0,008	0,000
ÖB6	0,000	0,048	0,023	0,025	0,000	0,000	0,089	0,000	0,001	0,000
ÖB7	0,000	0,000	0,044	0,031	0,002	0,000	0,016	0,002	0,000	0,020
ÖB8	0,000	0,009	0,000	0,000	0,001	0,000	0,154	0,000	0,004	0,000
ÖB9	0,020	0,029	0,000	0,000	0,001	0,000	0,000	0,000	0,000	0,019
ÖB10	0,017	0,043	0,000	0,000	0,001	0,007	0,000	0,000	0,000	0,003
YB11	0,000	0,000	0,000	0,007	0,001	0,005	0,035	0,000	0,000	0,000
YB12	0,058	0,000	0,026	0,065	0,000	0,000	0,000	0,024	0,000	0,081
YB13	0,429	0,167	0,068	0,035	0,000	0,000	0,196	0,036	0,003	0,050
YB14	0,000	0,000	0,000	0,000	0,003	0,007	0,000	0,000	0,000	0,011
YB15	0,222	0,054	0,028	0,162	0,000	0,065	0,150	0,041	0,006	0,024
YB16	0,008	0,000	0,005	0,000	0,002	0,000	0,085	0,020	0,002	0,000
YB17	0,000	0,044	0,000	0,000	0,002	0,003	0,090	0,000	0,000	0,012
YB18	0,057	0,040	0,003	0,000	0,001	0,000	0,000	0,005	0,001	0,022

Table 11. Weighted Negative Matrix

2021	KO1	KO2	LO1	LO2	AK1	AK2	AK3	SY1	GO1	GO2
KB1	0,124	0,071	0,032	0,051	0,000	0,005	0,000	0,014	0,000	0,011
KB2	0,165	0,100	0,039	0,064	0,000	0,002	0,000	0,026	0,000	0,071
KB3	0,130	0,054	0,029	0,040	0,000	0,000	0,000	0,024	0,001	0,028
ÖB4	0,000	0,000	0,018	0,017	0,001	0,002	0,016	0,000	0,002	0,000
ÖB5	0,000	0,000	0,001	0,011	0,000	0,012	0,310	0,000	0,000	0,063
ÖB6	0,055	0,000	0,000	0,000	0,001	0,010	0,000	0,024	0,000	0,028
ÖB7	0,151	0,107	0,000	0,000	0,000	0,009	0,000	0,000	0,007	0,000
ÖB8	0,054	0,000	0,004	0,024	0,000	0,005	0,000	0,014	0,000	0,012
ÖB9	0,000	0,000	0,011	0,027	0,000	0,002	0,165	0,001	0,004	0,000
ÖB10	0,000	0,000	0,020	0,031	0,000	0,000	0,005	0,005	0,002	0,000
YB11	0,159	0,094	0,011	0,000	0,000	0,000	0,000	0,024	0,004	0,029
YB12	0,000	0,013	0,000	0,000	0,009	0,014	0,027	0,000	0,018	0,000
YB13	0,000	0,000	0,000	0,000	0,007	0,030	0,000	0,000	0,000	0,000
YB14	0,024	0,005	0,024	0,024	0,000	0,000	0,512	0,001	0,000	0,000
YB15	0,000	0,000	0,000	0,000	0,001	0,000	0,000	0,000	0,000	0,000
YB16	0,000	0,020	0,000	0,009	0,000	0,000	0,000	0,000	0,000	0,010
YB17	0,034	0,000	0,008	0,016	0,000	0,000	0,000	0,020	0,002	0,000
YB18	0,000	0,000	0,000	0,011	0,000	0,004	0,025	0,000	0,000	0,000

In other stages of the method, NSP_i and NSN_i values are calculated. With the obtained values, (AS_i) scores are calculated and the bank with the highest score is evaluated as the most successful in terms of financial performance. These values are summarized in Table 12.

Table 12. NSP_i, NSN_i and (AS_i) Values

2021	NSP_i	NSN_i	AS_i	2021	NSP_i	NSN_i	AS_i
KB1	0,045	0,478	0,262	ÖB10	0,073	0,893	0,483
KB2	0,093	0,208	0,151	YB11	0,049	0,454	0,251
KB3	0,139	0,483	0,311	YB12	0,258	0,863	0,561
ÖB4	0,105	0,904	0,505	YB13	1	0,936	0,968
ÖB5	0,057	0,326	0,192	YB14	0,022	0	0,011
ÖB6	0,189	0,801	0,495	YB15	0,765	0,998	0,881
ÖB7	0,115	0,536	0,326	YB16	0,124	0,935	0,53
ÖB8	0,171	0,81	0,49	YB17	0,152	0,864	0,508
ÖB9	0,07	0,644	0,357	YB18	0,132	0,933	0,532

When the 2021 results in Table 13 are examined, we first consider the ranking of financial performance within the capital groups; among the public owned deposit banks, Vakıflar Bank of Turkey (KB3) ranks first, Ziraat Bank of the Republic of Turkey (KB1) ranks second and Türkiye Halk Bankası (KB2) ranks last. However, when Sakınç (2016) ranks according to its financial performance in the 2010-2013 period using Grey Rational Analysis and TOPSIS method, it is obtained that Halkbank ranks first, Ziraat Bank ranks second and Vakıfbank ranks third. This study is determined that Akbank (OB4) has the highest financial performance among the private capital deposit banks, while the bank with the lowest performance is Anadolubank (OB5). Similarly, in Ünal (2019), it is determined that Akbank has the best performance among the banks with private capital in the period 2014-2018.

When we consider the ranking of financial performance among banks with foreign capital, it is determined that Citibank (YB13) is in the first ranking and Denizbank (YB14) is in the last ranking. Finally, when a total of 18 banks are ranked in terms of financial performance, it is seen that the most successful bank is Citibank (YB13). The banks that follow the relevant success ranking are Deutsche Bank (YB15) and Arab Turkish Bank (YB12). The bank with the lowest success in terms of financial performance is Denizbank (YB14). In Yılmaz and Yakut (2021), using TOPSIS and VIKOR methods, it is determined that Adabank ranks first in the ranking of financial performance, Birleşik Fon Bank ranks second and CITIBANK ranks third.

Table 13. Financial Performance Rankings for 2021 within the scope of the analysis

Capital Groups	Banks	Sorting within a group	Overall Ranking
State-Owned Deposit Money Banks	KB1	2	14
	KB2	3	17
	KB3	1	13
Private Equity Deposit Money Banks	ÖB4	1	7
	ÖB5	7	16
	ÖB6	2	8
	ÖB7	6	12
	ÖB8	3	9
	ÖB9	5	11
	ÖB10	4	10
Foreign Capital Banks	YB11	7	15
	YB12	3	3
	YB13	1	1
	YB14	8	18
	YB15	2	2
	YB16	5	5
	YB17	6	6
	YB18	4	4

Note: Yellow color shows the largest values, red color shows the smallest values, pink color shows public owned deposit banks, blue color shows private capital deposit banks and gray color shows foreign capital banks.

Table 14 and Figure 2 show the results of 18 banks analyzed by the EDAS method for the period 2012-2021 and the results show that there is fluctuation between the EDAS performance rankings of banks. EDAS performance rankings for years are given as follows:

For 2012 : YB15 > YB12 > OB4 > YB18 > OB5 > KB1 > YB14 > KB2 > YB13 > YB17 > OB9 > KB3 > OB8 > OB10 > OB6 > YB16 > YB11 > OB7

For 2013 : YB12 > KB2 > OB10 > KB1 > YB13 > OB4 > YB18 > OB9 > KB3 > YB15 > OB6 > OB8 > OB5 > YB11 > YB17 > YB16 > YB14 > OB7

For 2014 : YB15 > YB12 > YB13 > OB4 > KB1 > OB7 > YB18 > OB9 > KB3 > OB6 > OB10 > OB8 > YB11 > KB2 > OB5 > YB14 > YB16 > YB17

For 2015 : YB15 > YB13 > YB12 > KB1 > OB4 > OB8 > YB18 > OB5 > KB2 > KB3 > OB6 > OB9 > OB10 >YB11 > YB16 > YB14 > YB17 > OB7

For 2016 : YB15 > YB13 > YB12 > OB4 > KB1 > YB18 > OB8 > YB16 > KB3 > OB9 > OB6 > OB5 > KB2 > YB17

> OB10 > YB14 > OB7 > YB11

For 2017 : YB13 > YB15 > YB12 > OB4 > KB1 > YB18 > YB16 > KB3 > OB8 > KB2 > OB6 > YB17 > OB9 > OB10 > OB5 > YB14 > YB11 > OB7

For 2018 : YB15 > YB13 > YB12 > YB16 > OB8 > YB18 > OB4 > YB17 > OB10 > OB7 > OB6 > OB5 > KB3 > KB1 > YB11 > KB2 > OB9 > YB14

For 2019 : YB13 > YB15 > YB12 > YB16 > YB18 > YB17 > OB4 > OB8 > OB10 > OB5 > OB6 > YB11 > OB9 > KB1 > KB3 > KB2 > OB7 >YB14

For 2020 : YB13 > YB15 > YB12 > YB16 > OB8 > YB18 > YB17 > OB4 > OB10 > OB6 > KB3 > KB1 > OB9 > YB11 > OB7 > OB5 > KB2 > YB14

For 2021 : YB13 > YB15 > YB12 > YB18 > YB16 > YB17 > OB4 > OB6 > OB8 > OB10 > OB9 > OB7 > KB3 > KB1 > YB11 > OB5 > KB2 > YB14

When we examine the findings in detail, it is seen that the bank with the highest financial success between 2012 and 2021 is Citibank (YB13). In the same period, Deutsche Bank (YB15) is found to be the second successful bank. The Arab Turkish Bank (YB12) has shown steady success in the period 2012-2021 and is the third most financially successful bank in the period 2015-2021. It is determined that the bank with the lowest financial performance in the 2018-2021 period is Denizbank (YB14).

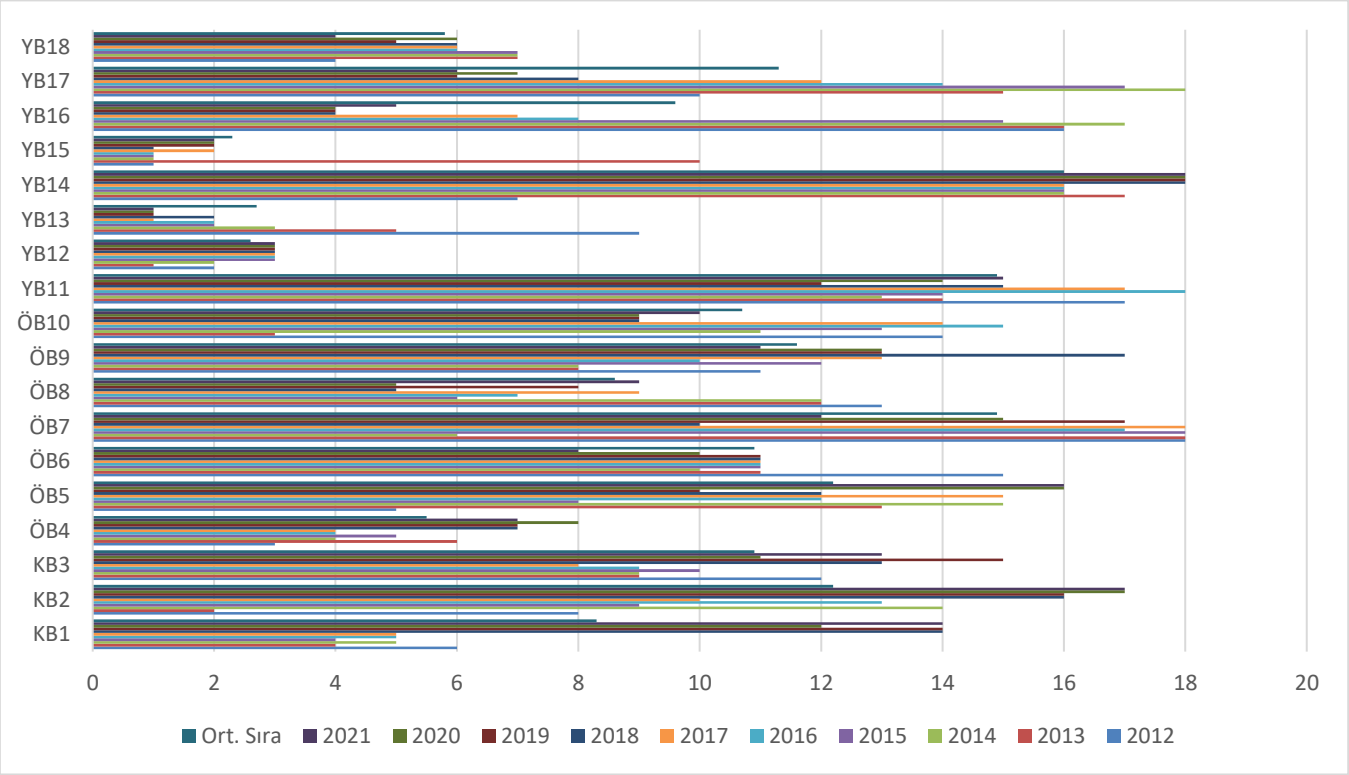
Finally, when we look at the average ranking in the 2012-2021 period, it is seen that the most successful bank is Deutsche Bank (YB15) and the lowest success is Denizbank (YB14).

Table 14. Financial Performance Rankings for 2012-2021 Years within the Scope of Analysis

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average Rank
KB1	6	4	5	4	5	5	14	14	12	14	8,3
KB2	8	2	14	9	13	10	16	16	17	17	12,2
KB3	12	9	9	10	9	8	13	15	11	13	10,9
ÖB4	3	6	4	5	4	4	7	7	8	7	5,5
ÖB5	5	13	15	8	12	15	12	10	16	16	12,2
ÖB6	15	11	10	11	11	11	11	11	10	8	10,9
ÖB7	18	18	6	18	17	18	10	17	15	12	14,9
ÖB8	13	12	12	6	7	9	5	8	5	9	8,6
ÖB9	11	8	8	12	10	13	17	13	13	11	11,6
ÖB10	14	3	11	13	15	14	9	9	9	10	10,7
YB11	17	14	13	14	18	17	15	12	14	15	14,9
YB12	2	1	2	3	3	3	3	3	3	3	2,6
YB13	9	5	3	2	2	1	2	1	1	1	2,7
YB14	7	17	16	16	16	16	18	18	18	18	16
YB15	1	10	1	1	1	2	1	2	2	2	2,3
YB16	16	16	17	15	8	7	4	4	4	5	9,6
YB17	10	15	18	17	14	12	8	6	7	6	11,3
YB18	4	7	7	7	6	6	6	5	6	4	5,8

Note: The yellow color represents the maximum values and the red color represents the smallest values.

Figure 2. Financial Performance Ranking of Banks in 2012-2021



In addition, when the ratio determined between 2012 and 2021 of state-owned, privately owned and foreign-owned banks is evaluated in terms of financial performance according to variables, there are slight changes in the ranking of banks every year.

4.3. Correlation Analysis Findings

On the other hand, Pearson correlation analysis is performed to determine whether the performance ranking results of banks by year are related to each other. As stated in Oralhan and Büyüktürk (2019), the correlation coefficient is valued in the range of [-1;+1]. The Pearson correlation analysis findings of this study are shown in Table 15. The Pearson correlation analysis findings of this study are shown in Table 15. The findings show a strong relationship in the same direction with the 2021 rankings at the 1% significance level between 2020, 2019 and 2018 and between 2020 and 2019 and 2018. At the same time, it is obtained that there is a strong relationship in the same direction at the 1% significance level between the 2019 performance rankings and 2018 outputs, between the 2017 performance rankings and the data of 2016 and 2015, and between the 2016 performance rankings and 2015 outputs.

Table 15. Correlation Coefficients in the Comparison of Financial Performance Ranking Outputs in the Period 2012-2021

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
2012	Pearson Correlation	1									
	Sig. (2-tailed)										
2013	Pearson Correlation	,474*	1								
	Sig. (2-tailed)	,047									
2014	Pearson Correlation	,441	,525*	1							
	Sig. (2-tailed)	,067	,025								
2015	Pearson Correlation	,703**	,662**	,705**	1						
	Sig. (2-tailed)	,001	,003	,001							
2016	Pearson Correlation	,633**	,507*	,688**	,876**	1					
	Sig. (2-tailed)	,005	,032	,002	,000						
2017	Pearson Correlation	,593**	,573*	,624**	,827**	,957**	1				
	Sig. (2-tailed)	,009	,013	,006	,000	,000					
2018	Pearson Correlation	,251	,139	,432	,492*	,672**	,674**	1			
	Sig. (2-tailed)	,316	,581	,073	,038	,002	,002				
2019	Pearson Correlation	,358	,238	,329	,525*	,682**	,688**	,899**	1		

2020	Sig. (2-tailed)	,145	,341	,182	,025	,002	,002	,000			
	Pearson Correlation	,232	,257	,443	,527*	,750**	,771**	,926**	,920**	1	
	Sig. (2-tailed)	,354	,303	,066	,025	,000	,000	,000	,000		
2021	Pearson Correlation	,249	,216	,498*	,441	,697**	,709**	,903**	,905**	,948**	1
	Sig. (2-tailed)	,320	,390	,035	,067	,001	,001	,000	,000	,000	
N		18	18	18	18	18	18	18	18	18	18

Note: **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

4.3. Sensitivity analysis findings

Finally, in this part of the study, sensitivity analysis is carried out to examine the change in the financial performance ranking of alternatives as a result of the change in the criteria weights of the banks in the 2021 period. For this purpose, the criteria weights determined by the Entropy method, which is the current situation, and the weights of the criteria are determined in line with two different scenarios. In the first scenario (CS1), all criteria are evaluated with equal weight (Yavuz & Baki, 2019; Ulutaş, 2019), in the second scenario (CS2), return on Assets (KO1) and fixed assets/total assets (AK3) criteria are determined as 0.20 and the other criteria are determined as 0.075 and are subject to evaluation (Ulutaş, 2019). The findings are in Table 16. According to the findings, although there are very small changes when the weights of the criteria are changed, the bank with the best performance is determined as "Citi Bank". Citi Bank's ranking ranks second in the performance analysis with the equal weights criteria determined in the first scenario and in the first place when traded with different weights criteria. "Deutsche Bank" ranks first according to the first scenario with equal weighting. It ranks second according to the Entropy criteria and second scenario created by weighting Fixed Assets/Total Assets and Return on Assets. "Denizbank" is determined to be the 18th bank with the lowest performance in the entropy and second scenario and the 17th bank according to the first scenario with equal weight. In the first equally weighted scenario, "Türkiye Halk Bankası A.Ş." is determined to be the 18th lowest performing bank, but according to Entropy and the second scenario, it is seen that it ranks 17th. Therefore, according to the results of the sensitivity analysis, it is seen in Table 16 that the positions of "Turkish Bank A.Ş." and "Türkiye İş Bankası A.Ş." banks in the performance ranking have not changed even if the weights have changed. As a result, it is seen that the performance ranking of most banks varies depending on the change in the criteria weights, and this situation tells us that the criteria weights affect the performance ranking.

Table 16. Sensitivity Analysis of Banks for 2021

Capital Groups	Banks	Entropi	CS1	CS2
State-Owned Deposit Money Banks	KB1	14	15	14
	KB2	17	18	17
	KB3	13	14	13
Private Equity Deposit Money Banks	ÖB4	7	6	6
	ÖB5	16	13	16
	ÖB6	8	10	10
	ÖB7	12	12	12
	ÖB8	9	9	8
	ÖB9	11	11	11
	ÖB10	10	8	9
Foreign Capital Banks	YB11	15	16	15
	YB12	3	5	5
	YB13	1	2	1
	YB14	18	17	18
	YB15	2	1	2
	YB16	5	4	3
	YB17	6	7	7
	YB18	4	3	4

Note: Yellow color shows the largest values, red color shows the smallest values

5. Conclusion

The Turkish banking sector, like other developing countries' banking sectors, is undergoing significant financial reforms. Recently, the banking sector has been playing an important role in the development of countries and is becoming the milestone of the economy. In the world of finance, financial and non-financial performances are fundamental elements for the sustainability of banks. Therefore, this points us to the performance evaluation and ranking in the banking sector. In this context, the aim of the study is to evaluate and rank the financial performance of 18 deposit banks in the Turkish economy over the period of 2012-2021. The banks based on the study consist of three groups as public, private and foreign capital banks. There are the 10 financial rations. In addition, in the study, firstly, the Entropy method is applied to determine the importance of financial performance criteria and then the ranking is carried out among the banks using the EDAS method.

According to the findings of the Entropy method applied in the study, it is seen that the most important performance criteria are Return on Assets in 2012, Return on Equity in 2013, Current Assets/Short-Term Liabilities in 2014, Fixed Assets/Total Assets in 2015-2018 and in 2021 and Return on Assets in 2019-2020. The lowest performance criteria are Total Loans/Total Assets in 2012, Interest Income/Total Assets in 2013, 2014, 2016, 2019, 2020 and 2021, and Total Loans/Total Deposits in 2015, 2017 and 2018. Akgül (2019) achieves that in the period of 2010-2018, the criteria of Liquid Assets/Short-Term Liabilities, Fixed Assets/Total Assets and Loans Received / Total Assets are the three most

important performance criteria in the Turkish Banking system.

In addition, the findings of the EDAS method, which is a multi-criteria decision-making method, show that the bank with the best financial performance is Deutsche Bank in 2012, 2014, 2015, 2016 and 2018, while Citibank is in 2017, 2019, 2020 and 2021. In 2013, the most successful bank is the Arab Turkish Bank. On the other hand, when we refer to the banks with low performance, it is Turkish bank in 2012, 2013, 2015 and 2017, QNB Finansbank in 2014 and Alternatif bank in 2016. The bank with the lowest performance in the 2018-2019 period is Denizbank. In general, we can say that the bank with the highest financial performance in the 2012-2021 period is Deutsche Bank and the bank with the lowest performance is Denizbank. Unvan (2020) shows that the most successful bank in the 2014-2018 period is Ziraat Bank of the Republic of Turkey and the bank with the lowest success is Yapı Kredi Bank. Aydın (2020) determines that Garanti Bank is the bank with the best performance in the 2016-2019 period. However, Yetiz and Kılıç (2021) analyze 15 deposit bank data in the 2015-2019 period with the VIKOR method and obtain that Ziraat Bank of the Republic of Turkey for the first three years and ING Bank for the next two years are the most successful bank. In addition, the researchers find that HSBC Bank had the worst performance in the first two years, Alternatif Bank in the next two years and Türkiye Halk Bankası in the last year.

As a result, as stated in the Yetiz and Kılıç (2021) study, the financial performance ranking of Turkish Deposit Banks is stated by applying the EDAS method through the determined financial performance measurement criteria and these results provide important information for the bank management and the bank's current and potential customers. In the light of this information, bank managements can successfully establish profitability and growth targets by taking into account the continuity of banks and determine the necessary arrangements in advance by anticipating the possible risks of the banking sector. Customers who prefer banks for investment and service purposes can make evaluations by considering risk and return factors while making bank choices in the current market conditions.

In addition, in line with these results, banks' credit marketing techniques, profitability targets, structuring of the distribution of loans, liquidity management, asset quality, growth in deposits and loans, rapid adaptability to changing conditions, measuring efficiency in resource utilization, and comparing themselves with their competitors should be reviewed. These findings may offer recommendations for future studies. This study examines the 2012-2021 period and 18 deposit banks, but future studies may both extend the study period and increase its sampling. This study applies the new and popular multi-criteria decision-making method EDAS, but in future studies, alternative MCDM methods such as AHP, TOPSIS, ELECTRE, PROMETHEE, CRITIC, MABAC, which are other new and popular multi-criteria decision-making methods, can be applied. Finally, in this study, the financial performance ranking of banks as state-owned, private-equity, and foreign-owned deposit banks is made, but future studies may determine the sample based on criteria such as asset size and number of branches.

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