# Chapter 6

# A MULTI-CRITERIA PERFORMANCE EVALUATION OF TURKISH ISLAMIC BANKS FROM THE EFFICIENCY PERSPECTIVE

**Neşe YALÇIN**[1]
**Ulaş ÜNLÜ**[2]

## INTRODUCTION

The Islamic banking system, which operates on a profit and loss basis and envisages risk sharing, is called more interest- free-banking in the world and is known as the Participation Banking in Turkey. In order to be able to mention the Islamic banking system in a country, all the economic structure in that country must be suitable for it. In this context, the use of the title of participation banks (PBs) in Turkey for banks engaged in Islamic banking would be more accurate. However, interest-free banks operate not only in Islamic countries but also in other countries. The main feature that distinguishes Islamic banking and interest-free banking or Participation Banking stems from the fact that transactions and services are conducted in strict accordance with Islamic principles. PBs are financial institutions that carry out interest-free banking transactions established as an alternative to commercial banks based on Islamic finance rules. The main purpose of participation banking is to ensure that the funds of individuals who have a defense against interest and therefore do not evaluate their savings in commercial banks are brought into the economy. However, at the same time, participation banking in Turkey is also important in terms of ensuring the entry of funds to Turkey from the oil-rich Arab countries, such as Saudi Arabia, Kuwait, and the United Arab Emirates. The first participation bank operating in Turkey is Albaraka Turk founded in 1984. Currently in the participation banking system of Turkey, a total of five banks that are Albaraka Turk (AT), Kuveyt Turk (KT), Turkiye Finans (TF), Ziraat Katilim (ZK), Vakif Katilim (VK) operates as participation bank.

[1] Prof. Dr., Adana Alparslan Türkeş Bilim ve Teknoloji Üniversitesi, Mühendislik Fakültesi, Endüstri Mühendisliği Bölümü, nyalcin@atu.edu.tr

[2] Doç. Dr., Akdeniz Üniversitesi, Uygulamalı Bilimler Fakültesi, Bankacılık ve Finans Bölümü, ulasunlu@akdeniz.edu.tr

The banking sector has two main functions that are fund raising and fund allocation. The participation banking system operates in the same way and the difference between the activities of commercial banks is only interest-free and attention to Islamic sensitivities. PBs are institutions that create value for the economy of Turkey for reasons, such as providing savings to the holders by introducing idle funds that cannot be included in the system due to interest sensitivity, contributing to the development of the economy by transferring resources to the real sector, increasing public revenues through tax revenues, and contributing to employment. Participation banking in Turkey as well as all over the world in recent years has shown a big improvement. This study is motivated to eliminate the lack of evaluation of PBs from the efficiency perspective, as the number of studies emphasizing the effectiveness of banks is very limited.

Although there is no common method for evaluating the performance of banks, the use of different MCDM methods has become widespread in the literature (Kosmidou & Zopounidis, 2008; Secme, Bayrakdaroglu & Kahraman, 2009; Amile, Sedaghat & Poorhossein, 2013; Taş, Önder & Hepşen, 2013). When the literature is examined, it can be seen that there are many studies on the performance of Islamic banks. In recent years, the following methods have been used: panel regression analysis, Z-Score analysis, DEA, Regression fixed effect, SFA & SUR, SFA & regression, Regression (random effect), GLS regression, random effect model, GMM (Doumpos, Hasan & Pasiouras, 2017; Rashid & Jabeen, 2016; Ali & Azmi, 2016; Miah & Sharmeen, 2015; Mobarek & Kalonov, 2014; Bourkhis & Nabi, 2013; Beck, Demirgüc¸-Kunt & Merrouche, 2013; Yahya, Muhammad & Hadi, 2012; Masood, Niazi & Ahmad, 2011; Cihák & Hesse, 2010). It is seen that DEA and Stochastic Boundary Approach (SFA) are preferred as the method in efficiency studies (Hardianto & Wulandari, 2016; Belanès, Ftiti & Regaïeg, 2015; Rahim, Rahman & Rosman, 2013; Sufian, Kamarudin & Noor, 2014; Ismail, Abd. Majid & Ab. Rahim, 2013; Olson & Zoubi, 2011; Yahya, Muhammad & Hadi, 2012). When the studies on the performance of Islamic banks are examined, it is seen that the number of studies using MCDM methods is quite low (Sufian & Kamarudin, 2014; Wnake et al., 2016a; Wanke, Azad & Barros, 2016b).

Islamic banks (participation banks), starting their banking operations in Turkey for the first time with the name of the private financial institutions, have been continuing its assets for more than 30 years in the Turkish banking sector and have a 5% market share in the sector. In this context, it is essential to evaluate the performance of Islamic banks from the efficiency perspective in order to ensure long-term financial sustainability in the sector. The main goal of this study is to evaluate the performance of the PBs operating in Turkey from the efficiency

perspective by using an integrated multi-criteria decision making (MCDM) approach for the objective weight calculation of the criteria and ranking of the alternatives. To accomplish the purpose of this study, the Entropy (objective weighting method) based VIKOR method (compromise ranking method) is employed as an integrated MCDM approach in order to evaluate the performance of five PBs operating in Turkey for the year 2018.

The remaining sections of the article are organized as follows. The second section gives the information about the participation banking in Turkey and the world. The third section explains the methodology including the integrated MCDM methods and the evaluation procedure of the study. The next section applies the integrated approach presented and gives the results obtained. Lastly, the section five concludes the paper.

## PARTICIPATION BANKING IN TURKEY AND THE WORLD

The fact that the savings holders living in Muslim countries did not use their money in the commercial banking system, however, the rise in oil prices in the 1970s led to a significant accumulation of capital, especially in oil producing Muslim countries. In 1963, the Savings Bank was first established in Egypt for interest-free banking services. Later, in 1975, thanks to the efforts of Muslim countries in search of Islamic capital, the Islamic Development Bank was established and the Islamic Banking system spread rapidly throughout the world. The fact that large banks in many countries have established interest-free transactions with their interest in the sector leads to a positive outlook on the future of the Islamic Banking sector.

In the traditional banking system where interest is used, the capital owner knows how much interest he will receive with the principal at the end of the period and this becomes his acquired right. On the other hand, in the interest-free banking system, the owner of the capital puts his money and the owner of the capital does not know what the outcome will be at the end of the term or operation. In the interest-free banking system, capital receives a share of the positive value increase in the existing financial assets as a result of the conversion of profit from money to goods, from goods to money or another structure. That is, PBs do not only make money from money movements; it tries to obtain a commercial profit by evaluating the money in economic activity and if the profit is realized, it shares it with the participation account holders who are partners.

In order to benefit from the Islamic banking system in Turkey, interest-free banks were permitted to be established with the name of "Special Finance Institutions" in 1983. Upon this, Albaraka Türk started its operations in 1984.

After that, the banks offering interest-free banking services became known as PBs. In Turkey, the PBs are realized the participation fund finding function through special current accounts and participation accounts, Sukuk (interest-free bills) and syndicated loans based on Murabaha (forward sales). The funds collected by the PBs are being used today through corporate funding support, individual funding support, profit and loss partnership, financial leasing, purchase, and sale of goods against goods, Sukuk and income indexed instruments.

Within the Islamic Banking system in the world, the biggest countries in terms of asset structure for 2018 are as follows: Iran (34.4%), Saudi Arabia (20.4%), UAE (9.3%), Malaysia (9.1%), Kuwait (6%) and Qatar (6%). Turkey's share is only 2.6%. (Islamic Financial Services Industry Stability Report, 2018). It can be said that the banking system is completely Islamic Banking system in Iran and Sudan and there is no share of commercial banks in total assets. The other countries where Islamic banks dominate the total banking system assets are Brunei, Saudi Arabia, Kuwait, Qatar, and Malaysia, respectively. In addition, the assets of Islamic banks have increased significantly since 2008 and the biggest contribution to this increase is GCC and MENA countries. For the first time, the total assets of Islamic finance exceeded $2 trillion in 2018. In almost all regions where Islamic finance is important and in many other countries, Islamic banks have been able to increase their market share. The future of Islamic finance, however, depends not only on market shares, but also on the development of the market volume determined by the fundamentals of the economies in which Islamic finance institutions operate. The Islamic finance industry is not yet an integrated global market, but a national market community with different legal and regulatory environments and governance systems. Over time, this diversity increased. A better analysis of market players and regulators and greater standardization can lead to the development of the sector.

## METHODOLOGY

Since the purpose of the study is to evaluate the performance of five PBs operating in Turkey in terms of efficiency perspective, an integrated approach including two MCDM methods are used. The first of these methods is Entropy, which is used to obtain criteria weights, and the other method is VIKOR, which is used to evaluate and rank alternatives.

Entropy, one of the best known objective weighting methods, is a commonly used tool for determining the objective weights of the criteria. In the evaluation process, firstly the Entropy method is used to determine the objective weights of criteria which are needed to estimate as an input for any MCDM method used in

any multi-criteria problem. Then, VIKOR method is applied for evaluating and ranking of alternatives using criteria weights.

Suppose there is an initial decision matrix $X = \left[ x_{ij} \right]_{mxn}$ with $m$ alternatives and $n$ criteria, where $x_{ij}$ $\left( i = 1,2,\ldots,m;\ j = 1,2,\cdots,n \right)$ presents the performance rating of $i$th alternative on $j$th criterion. The decision matrix $X$ of a decision problem including multiple criteria can be described as follows:

$$X = \begin{array}{c} \\ C_1 \\ A_1 \\ A_2 \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} w_1 & w_2 & \cdots & w_n \\ C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{array} \tag{1}$$

In a decision matrix, $wj$ is the weight of criterion $Cj$ and determined as $W_j = \left( w_1, w_2, \ldots, w_n \right)$ and $\sum_{j=1}^{n} w_j = 1$. The integrated methods are explained in the following, respectively.

**Entropy method**

Entropy whose concept first appeared in information theory is a statistical parameter that measures how much information is produced on average for each letter of a text in a particular sense and language (Shannon, 1951). In addition, Entropy has a useful meaning in information theory when it measures the expected information content of a particular message. It is based on the Shannon's (1948) entropy concept as a measurement of uncertainty. Since the decision matrix of an MCDM problem contains a certain amount of information; entropy can be used as a tool for criteria evaluation (Zeleny, 1974; Nijkamp, 1977). Shannon's entropy is utilized to obtained objective weights of criteria in many MCDM problems in many articles, such as Chan, Kao & Wu (1999), Wang and Lee (2009), Shemshadi & et al. (2011), Wu and Liu (2011), Lee, Lin & Shin (2012), Fedajev & et al. (2019), and so on.

The entropy procedure has the following steps (Wang and Lee, 2009):

***Step 1.*** The decision matrix $X = \left[ x_{ij} \right]_{mxn}$ constructed as in Eq.(1) is normalized for each criterion $Cj$ as

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}, \quad \forall_{i,j} \tag{2}$$

Thus, a normalized decision matrix (*pij*) representing the relative performance of the alternatives is created as follows:

$$p_{ij} = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & \cdots & \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & p_{nm} \end{bmatrix} \tag{3}$$

***Step 2.*** The entropy *Ej* for a set of outcomes (*m* decision alternatives) at a decision criterion *j* is defined as

$$E_j = -k \sum_{i=1}^{m} \left[ \left( p_{ij} \right) \left( \ln \left( p_{ij} \right) \right) \right], \quad \forall i, j \tag{4}$$

The constant value *k* in the method can be calculated as $k = 1/ln(m)$.

***Step 3.*** The degree of diversification *dj* of the information provided by a decision criterion *j* is defined as

$$d_j = 1 - E_j \tag{5}$$

***Step 4.*** The objective weight for each criterion *j* is calculated as

$$w_j = d_j \Big/ \sum_{j=1}^{n} d_j \tag{6}$$

**VIKOR Method**

The compromise ranking method VIKOR (VIsekriterijumska optimizacija optimizacija i KOmpromisno Resenje) has been originally developed by Opricovic (1998) for application in multi-criteria complex systems. In this method, ranking and selecting from a set of alternatives in the presence of conflicting criteria is the

main focus to obtain a compromise solution (Opricovic, 2011). Since VIKOR has the advantage of providing a compromise solution by reflecting the attitude of most decision makers for the decision making problem, it is implemented in many different fields of the multi-criteria decision problems (Opricovic, 1998; Chang & Hsu, 2009; Azimi & et al., 2011; Opricovic & Tzeng, 2004, 2007; Bayrakdaroğlu & Yalçın, 2012; Hsu, 2015; Yalçın & Ünlü, 2018).

In this method, the various *I* alternatives are denoted as $a_1, a_2, \ldots, a_I$. For alternative $a_i$, the rating of the *j*th aspect is denoted by $f_{ij}$, i.e. $f_{ij}$ is the value of *j*th criterion function for the alternative $a_i$; *n* is the number of criteria. The VIKOR method has the follow steps (Opricovic & Tzeng, 2004, 2007):

***Step 1.*** Determine the best $f_j^*$ and the worst $f_j^-$ values of all criterion functions. If the *j*th function represents a benefit then:

$$f_j^* = \max_i f_{ij} \quad f_j^- = \min_i f_{ij} \tag{7}$$

***Step 2.*** Compute the values $S_i$ and $R_i$ of each alternative, by the relations:

$$S_i = \sum_{j=1}^{n} w_j \left(f_j^* - f_{ij}\right) \Big/ \left(f_j^* - f_j^-\right) \tag{8}$$

$$R_i = \max_j \left[ w_j \left(f_j^* - f_{ij}\right) \Big/ \left(f_j^* - f_j^-\right) \right] \tag{9}$$

where, *Si* and *Ri* represent the utility measure and regret measure, respectively, and $w_j$ is the weight (relative importance) of the *j*th criterion.

***Step 3.*** Compute the values $Q_i$ for each alternative, by the relation

$$Q_i = v\left(S_i - S^*\right) \Big/ \left(S^- - S^*\right) + \left(1 - v\right)\left(R_i - R^*\right) \Big/ \left(R^- - R^*\right) \tag{10}$$

where, $S^* = \min_i S_i$, $S^- = \max_i S_i$, $R^* = \min_i R_i$, $R^- = \max_i R_i$

*v* is the introduced as a weight for the strategy of *maximum group utility*, whereas (1–*v*) is the weight of the *individual regret*, in general, the value of *v* is taken as 0.50.

***Step 4.*** Rank the alternatives according to the decreasing values of $S_i$, $R_i$, and $Q_i$ as a results of three ranking lists.

***Step 5.*** Propose as a compromise solution, $A_1$ which is the best ranked alternative by the measure *Q* if the two conditions are satisfied: **C1.** "Acceptable advantage": $Q(A_2) - Q(A_1) \geq DQ = (1/(m-1))$; where $A_2$ is the second alternative in the ranking list by $Q$. **C2.** "Acceptable stability in decision making": $A_1$ alternative must also be the best ranked by *S* or/and *R*. This compromise solution is stable within a decision making process, which could be the strategy of maximum group utility (when $v > 0.5$ is needed), or "by consensus" $v$ about 0.5, or "with veto" $v < 0.5$).

If either of the two conditions is not satisfied, a set of compromised solutions is recommended as: (i) Alternatives $A_1$ and $A_2$ if only the condition C2 is not satisfied, or (ii) Alternatives $A_1$, $A_2$,..., $A_k$ if the condition C1 is not satisfied ( $A_k$ is determined by the relation $Q(A_k) - Q(A_1) < DQ$ for maksimum *k*).

**The evaluation procedure of the study**

In the present study, an evaluation procedure (Figure 1) is proposed to evaluate and rank the performance of the PBs acting in Turkey under the criteria from the efficiency perspective based on the Entropy-VIKOR integrated approach. The detailed explanation of each phase is given in the following sections.

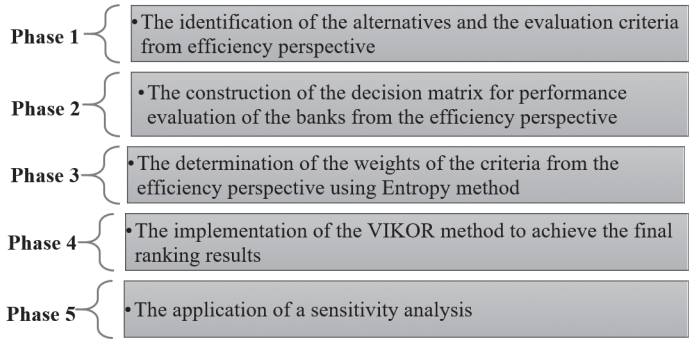


**Figure 1.** The evaluation procedure of the study

## ANALYSIS AND RESULTS

In this study, the performance of the five PBs operating in Turkey is evaluated in terms of the efficiency perspective for 2018 by using the Entropy-VIKOR integrated approach. The evaluation framework given in the methodology section of the study is explained in the following.

***Phase 1.*** *The identification of the alternatives and the evaluation criteria from efficiency perspective*: In the first phase of the study, five Turkish PBs that are Albaraka Turk (AT), Kuveyt Turk (KT), Turkiye Finans (TF), Ziraat Katilim (ZK), Vakif Katilim (VK) have been identified as alternatives since there are only five banks currently operating in Turkey. In order to evaluate the performance of the PBs, the evaluation criteria identified from the efficiency perspective of this study are those used by Yayar and Baykara (2012) to measure the efficiency of PBs. As seen in Table 1, there are six criteria in the efficiency perspective, two of which (E2 and E4) are non-beneficial and the remaining four (E1, E3, E5 and E6) are beneficial.

| **Table 1: The evaluation criteria from the efficiency perspective** |
|---|
| **E1**: Shareholders' Equity/(Amount subject to credit+market+operational risk) |
| **E2**: Non-Performing Loans (net) / (Total Loans + Leasing) |
| **E3**: (Loans + Leasing) / Assets |
| **E4**: Profit Share Expenses / (Funds Collected + Loans Received) |
| **E5**: Profit Share Income / Expense |
| **E6**: Profit Share Income / Shareholders' Equity |

***Phase 2.*** *The construction of the decision matrix for performance evaluation of banks from the efficiency perspective*: In the second phase, the decision matrix of the five PBs alternatives in terms of the evaluation criteria from efficiency perspective is constructed. Therefore, the initial set of data for the year 2018 of the PBs is collected from the Participation Banks Association of Turkey's official website (http://www.tkbb.org.tr) and the decision matrix is rearranged by taking inverse values of criteria E2 and E4 to be able to use in the MCDM analysis. Thus, the decision matrix from the efficiency perspective the performance evaluation problem is constructed as seen in Table 2.

| **Table 2: The decision matrix from the efficiency perspective of the five PBs** | | | | | | |
|---|---|---|---|---|---|---|
| **PBs** | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| **AT** | 1.1700 | -0.4149 | 0.0957 | -15.2275 | 1.5097 | 0.9259 |
| **KT** | 17.6800 | 0.6098 | 0.1859 | -22.5010 | 2.1045 | 1.1028 |
| **TF** | 16.6100 | -0.0906 | 0.0626 | -17.7368 | 1.7965 | 0.9108 |
| **ZK** | 13.0600 | -5.5556 | 0.0916 | -14.0279 | 1.5841 | 0.9423 |
| **VK** | 13.6000 | -3.0303 | 0.1017 | -17.0761 | 1.5551 | 1.1254 |

***Phase 3.*** *The determination of the weights of the criteria from the efficiency perspective using Entropy method*: In the third phase, the weights of criteria from the efficiency perspective are determined by using the calculation steps of the Entropy method and the obtained results are given in Table 3.

**Tablo 3: The calculation steps of the Entropy method for the criteria weights**

| | ***Step 1*** | | | | | |
|---|---|---|---|---|---|---|
| **PBs** | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| **AT** | 0.0188 | 0.0489 | 0.1780 | 0.1759 | 0.1766 | 0.1849 |
| **KT** | 0.2846 | -0.0719 | 0.3459 | 0.2599 | 0.2461 | 0.2202 |
| **TF** | 0.2674 | 0.0107 | 0.1164 | 0.2049 | 0.2101 | 0.1819 |
| **ZK** | 0.2102 | 0.6550 | 0.1704 | 0.1620 | 0.1853 | 0.1882 |
| **VK** | 0.2189 | 0.3573 | 0.1892 | 0.1973 | 0.1819 | 0.2248 |
| | ***Step 2*** | | | | | |
| **PBs** | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| **AT** | -0.0748 | -0.1476 | -0.3072 | -0.3057 | -0.3062 | -0.3121 |
| **KT** | -0.3577 | 0.0000 | -0.3672 | -0.3502 | -0.3451 | -0.3332 |
| **TF** | -0.3527 | -0.0485 | -0.2504 | -0.3248 | -0.3278 | -0.3100 |
| **ZK** | -0.3279 | -0.2771 | -0.3015 | -0.2949 | -0.3124 | -0.3143 |
| **VK** | -0.3326 | -0.3677 | -0.3150 | -0.3202 | -0.3100 | -0.3355 |
| **Total** | -1.4456 | -0.8410 | -1.5414 | -1.5958 | -1.6014 | -1.6052 |
| ***Ej*** | 0.8982 | 0.5225 | 0.9577 | 0.9915 | 0.9950 | 0.9974 |
| | ***Step 3*** | | | | | |
| | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| ***dj*** | 0.1018 | 0.4775 | 0.0423 | 0.0085 | 0.0050 | 0.0026 |
| | ***Step 4*** | | | | | |
| | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| ***wj*** | 0.1596 | 0.7488 | 0.0663 | 0.0133 | 0.0078 | 0.0041 |

***Phase 4.*** *The implementation of the VIKOR method to achieve the final ranking results*: In this phase, firstly the positive ideal solution and negative ideal solution are obtained using Eq. (7), as shown in Table 4.

| Table 4: Positive ideal solutions $f_j^*$ and negative ideal solutions $f_j^-$ | | | | | | |
|---|---|---|---|---|---|---|
| | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| $f_j^*$ | 17.6800 | 0.6098 | 0.1859 | -14.0279 | 2.1045 | 1.1254 |
| $f_j^-$ | 1.1700 | -5.5556 | 0.0626 | -22.5010 | 1.5097 | 0.9108 |

Next, the $w_j\left(f_j^* - f_{ij}\right)/\left(f_j^* - f_j^-\right)$ term in Eq. (8) is calculated as shown in Table 5.

| Table 5: The scores of $w_j\ (f_j^* - f_{ij})/(f_j^* - f_j^-)$ | | | | | | |
|---|---|---|---|---|---|---|
| **PBs** | **E1** | **E2** | **E3** | **E4** | **E5** | **E6** |
| **AT** | 0.1596 | 0.1244 | 0.0485 | 0.0019 | 0.0078 | 0.0039 |
| **KT** | 0.0000 | 0.0000 | 0.0000 | 0.0133 | 0.0000 | 0.0004 |
| **TF** | 0.0103 | 0.0851 | 0.0663 | 0.0058 | 0.0041 | 0.0041 |
| **ZK** | 0.0447 | 0.7488 | 0.0507 | 0.0000 | 0.0069 | 0.0035 |
| **VK** | 0.0395 | 0.4421 | 0.0453 | 0.0048 | 0.0072 | 0.0000 |

Based on the Table 5, Eq. (8), Eq. (9), and Eq.(10) results, *Si*, *Ri* and *Qi* could be obtained for each PB. The *Qi* value of each PB for $v$=0.5 can be calculated as shown in Table 6.

| Table 6: The obtained results from the VIKOR method ($v$ = 0.5) | | | | | | |
|---|---|---|---|---|---|---|
| **PBs** | ***Sj*** | **Rank** | ***Rj*** | **Rank** | ***Qj*** | **Rank** |
| **AT** | 0.3462 | 3 | 0.1596 | 3 | 0.2972 | 3 |
| **KT** | 0.0137 | 1 | 0.0133 | 1 | 0.0000 | 1 |
| **TF** | 0.1757 | 2 | 0.0851 | 2 | 0.1451 | 2 |
| **ZK** | 0.8545 | 5 | 0.7488 | 5 | 1.0000 | 5 |
| **VK** | 0.5388 | 4 | 0.4421 | 4 | 0.6038 | 4 |

The ranking results of the performance evaluation of the PBs obtained by the the Entropy based VIKOR approach are presented in Table 6. According to the obtained results, the best ranked PB is KT (Kuveyt Turk). However, since it does not satisfied the condition C1 (with respect to the result of $Q_{[2]} - Q_{[1]} = 0.1451 \leq DQ = 0.2500$ ), it cannot be allocated as a compromise solution. So, KT (Kuveyt Turk) and TF (Turkiye Finans) are the two best ranked PBs as a set of compromise solutions.

***Phase 5.*** *The application of a sensitivity analysis*: Since the *v* parameter is an important factor in the ranking of alternatives in this method, a sensitivity analysis is performed for the *v* values in the [0,1] range to verify the results obtained. The relevant results according to the value of *v* are shown in Table 7. As can be seen, the best ranked bank is KT (Kuveyt Turk) and the worst ranked bank ZK (Ziraat Katilim) for all values of *v*. According to this analysis, the results obtained from the proposed methodology are reliable.

**Tablo 7: Ranking results for different values of v**

| | PBs | | | | |
|---|---|---|---|---|---|
| ***Qj*** | **AT** | **KT** | **TF** | **ZK** | **VK** |
| ***v=0*** | 0.1990 | 0.0000 | 0.0976 | 10.000 | 0.5830 |
| | 3 | 1 | 2 | 5 | 4 |
| ***v=0.25*** | 0.2481 | 0.0000 | 0.1214 | 10.000 | 0.5934 |
| | 3 | 1 | 2 | 5 | 4 |
| ***v=0.5*** | 0.2972 | 0.0000 | 0.1451 | 10.000 | 0.6038 |
| | 3 | 1 | 2 | 5 | 4 |
| ***v=0.75*** | 0.3463 | 0.0000 | 0.1689 | 10.000 | 0.6141 |
| | 3 | 1 | 2 | 5 | 4 |
| ***v=1*** | 0.3954 | 0.0000 | 0.1927 | 10.000 | 0.6245 |
| | 3 | 1 | 2 | 5 | 4 |

The final solution obtained by sensitivity analysis is shown in Table 8. Despite different values of *v*, the best ranked PB is KT in all replacements.

**Tablo 8: The obtained solutions for different values of v**

| | ***Qj (v=0)*** | ***Qj (v=0.25)*** | ***Qj (v=0.5)*** | ***Qj (v=0.75)*** | ***Qj (v=1)*** |
|---|---|---|---|---|---|
| **PBs** | KT<br>TF<br>AT | KT<br>TF<br>AT | KT<br>TF | KT<br>TF | KT<br>TF |

According to the evaluation results, as shown in Table 8, the best ranked bank is KT, however, it cannot be allocated as a compromise solution because it does not meet the C1 for different *v* values. As a results, the best ranked bank is KT with the compromise solution results that are three PBs (KT, TF and AT) for $v<0.50$, and two PBs (KT and TF) for $v\geq0.50$.

## CONCLUSION

The more important the financial stability of banks is for the national economy, the more important it is for banks to work efficiently for their financial stability. Therefore, performance analysis of banks from an efficiency perspective may be important as it will provide information about their financial stability.

In this paper, an integrated MCDM approach has been applied to evaluate the performance of the five PBs operating in Turkey from the efficiency perspective. With the help of the integrated MCDM approach, the objective weights of ciriteria are first determined by the Entropy method and then the alternative PBs are ranked by the VIKOR method. According to the analysis results of the VIKOR method, Kuveyt Turk in 2018 as the top-most ranked among the five PBs in Turkey. When the results are compared according to the value of *v* parameter, it is notable that the two PBs that are the state-owned PBs are not in any compromise solution.

As the results of this study will reveal the status of PBs in the sector in terms of their effectiveness, they can be seen as a very important parameter for both the real sector and the national economy. As an inefficient participation banking sector will negatively affect financial markets of any country, this study may have significant contributions from both practical and theoretical aspects.

As a future study, performance evaluation from the efficiency perspective of PBs can be solved by using different MCDM methods such as AHP, TOPSIS, ARAS, CODAS, ELECTRE, and PROMETHEE as comparatively.

## REFERENCES

Ali, M. & Azmi, W. (2016) Religion in the boardroom and its impact on Islamic banks' performance. *Review Financial Economics, 31*, 83–88.

Amile, M., Sedaghat, M. & Poorhossein, M. (2013) Performance evaluation of banks using fuzzy AHP and TOPSIS case study: state-owned banks, partially private and private banks In Iran. *Caspian Journal of Applied Sciences Research, 3*, 128-138.

Azimi, R., Yazdani-Chamzini, A., Fooladgar, M.M. & Hossein, M. (2011) Evaluating the strategies of the Iranian mining sector using a integrated model. *International Journal of Management Science and Engineering Management, 6*(6), 459–466.

Bayrakdaroğlu, A. & Yalçın, N. (2012) Strategic financial performance evaluation of the Turkish Companies Traded on ISE. *Ege Academic Review, 12*(4), 529–539.

Beck, T., Demirgüc¸ -Kunt, A. & Merrouche, O. (2013) Islamic vs. conventional banking: Business model, efficiency and stability. *Journal of Banking and Finance, 37*, 433–447.

Belanès, A., Ftiti, Z. & Regaïeg, R. (2015) What can we learn about Islamic banks efficiency under the subprime crisis? Evidence from GCC region. *Pacific-Basin Finance Journal, 33*, 81–92.

Bourkhis, K. & Nabi, M. S. (2013) Islamic and conventional banks' soundness during the 2007–2008 financial crisis. *Review of Financial Economics, 22*, 68–77.

Chan, L. K., Kao, H. P. & Wu, M. L. (1999) Rating the importance of customer needs in quality function deployment by fuzzy and entropy methods. *International Journal of Production Research, 37*(11), 2499-2518.

Chang, C. L. & Hsu, C. H. (2009) Multi-criteria analysis via the VIKOR method for prioritizing land-use restraint strategies in the Tseng-Wen reservoir watershed. *Journal of Environmental Management, 90*(11), 3226–3230.

Cihák, M. & Hesse, H. (2010) Islamic banks and financial stability: an empirical analysis. *Journal Financial Services Research, 38*, 95–113.

Doumpos, M., Hasan, I. & Pasiouras, F. (2017) Bank overall financial strength: Islamic versus conventional banks. *Economic Modelling, 64*, 513–523.

Fedajev, A., Stanujkicet, D., Karabašević, D., Brauers, W. K. M. & Zavadskas, E. K. (2020) Assessment of progress towards "Europe 2020" strategy targets by using the MULTIMOORA method and the Shannon Entropy Index. *Journal of Cleaner Production, 244*, 1-12.

Hardianto, D. S. & Wulandari, P. (2016) Islamic bank vs conventional bank: intermediation, fee based service activity and efficiency. *International Journal of Islamic and Middle Eastern Finance and Management Information, 9*, 296–311.

Hsu, L.-C. (2015) Using a decision-making process to evaluate efficiency and operating performance for listed semiconductor companies. *Technological and Economic Development of Economy, 21*(2), 301-331.

Ismail, F., Abd. Majid, M. S. & Ab. Rahim, R. (2013) The efficiency of Islamic and conventional banks in Malaysia. International Journal of *Islamic and Middle Eastern Finance and Management, 11*, 92–107.

Kosmidou, K. & Zopounidis, C. (2008) Measurement of Bank Performance in Greece. *South-Eastern Europe Journal of Economics, 6*, 79-95.

Lee, P. T. W., Lin, C. W. & Shin, S. H. (2012) A comparative study on financial positions of shipping companies in Taiwan and Korea using entropy and grey relation analysis. *Expert Systems with Applications, 39*(5), 5649–5657.

Masood, O., Niazi, G. S. K. & Ahmad, N. (2011). An analysis of the growth and rise of smaller Islamic banks in last decade. *Qualitative Research in Financial Markets Information, 3*, 105–116.

Miah, M. D. & Sharmeen, K. (2015) Relationship between capital, risk and efficiency. *International Journal Islamic and Middle Eastern Finance and Management, 8*, 203–221.

Mobarek, A. & Kalonov, A. (2014) Comparative performance analysis between conventional and Islamic banks: Empirical evidence from OIC countries. *Applied Economics, 46*, 253–270.

Nijkamp, P. (1977) Stochastic quantitative and qualitative multicriteria analysis for environmental design. *Papers for the Regional Science Association, 39*(1), 175-199.

Olson, D. & Zoubi, T. A. (2011) Efficiency and bank profitability in MENA countries. *Emerging Market Review, 12*, 94–110.

Opricovic, S. & Tzeng, G. H. (2004) Compromise solution by MCDM methods: a comparative analysis of VIKOR and TOPSIS. *European Journal of Operational Research, 156*(2), 445–455.

Opricovic, S. & Tzeng, G. H. (2007) Extended VIKOR method in comparison with outranking methods. *European Journal of Operational Research, 178*(2), 514–529.

Opricovic, S. (1998). *Multi-criteria optimization of civil engineering systems*. Faculty of Civil Engineering, Belgrade.

Rahim, A., Rahman, A. & Rosman, R. (2013) Efficiency of Islamic banks: a comparative analysis of MENA and Asian countries. *Journal of Economic Cooperation and Development,* 34, 63–92.

Rashid, A. & Jabeen, S. (2016) Analyzing performance determinants: Conventional versus Islamic banks in Pakistan. *Borsa Istanbul Review, 16*, 92–107.

Secme, N.Y., Bayrakdaroglu, A. & Kahraman, C. (2009) Fuzzy performance evaluation in the Turkish Banking Sector using Analytic Hierarchy Process and TOPSIS. *Expert Systems with Applications, 36*, 11699–11709.

Shannon, C. E. (1948) A mathematical theory of communication. *Bell System Technical Journal, 27*(3), 379-423.

Shemshadi, A., Shirazi, H., Toreihi, M. & Tarokh, M. J. (2011) A fuzzy VIKOR method for supplier selection based on entropy measure for objective weighting. *Expert Systems with Applications, 38*(10), 12160-12167.

Sufian, F., Kamarudin, F. & Noor, N. H. H. M. (2014) Revenue efficiency and returns to scale in Islamic banks: Empirical evidence from Malaysia. *Journal of Economic Cooperation and Development,* 1, 47–80.

Taş, N., Önder, E. & Hepşen, A. (2013) Performance Evaluation of Turkish Banks Using Analytical Hierarchy Process and TOPSIS Methods. *Journal of International Scientific Publication: Economy & Business, 7*, 470-503.

Wang, T. C. & Lee, H. D. (2009) Developing a fuzzy TOPSIS approach based on subjective weights and objective weights. *Expert Systems with Applications, 36*(5), 8980-8985.

Wanke, P., Azad, M. A. K., Barros, C. P. & Hassan, M. K. (2016a) Predicting efficiency in Islamic banks: an integrated multicriteria decision making (MCDM) approach. *Journal of International Financial Markets, Institutions and Money, 45*, 126–141.

Wanke, P., Azad, M. D. A. K. & Barros, C. P. (2016b) Predicting efficiency in Malaysian Islamic banks: a two-stage TOPSIS and neural networks approach. *Research in International Business and Finance, 36*, 485–498.

Yahya, M. H., Muhammad, J. & Hadi, A. R. A. (2012) A comparative study on the level of efficiency between Islamic and conventional banking systems in Malaysia. *International Journal Islamic Middle Eastern Finance and Management, 5*, 48–62.

Yalçın, N. & Ünlü, U. (2018) A multi-criteria performance analysis of initial public offering (IPO) firms using critic and vikor methods. *Technological and Economic Development of Economy, 24*(2), 534–560.

Zadeh Sarraf, A., Mohaghar, A. & Bazargani, H. (2013) Developing TOPSIS method using statistical normalization for selecting Knowledge management strategies. *Journal of Industrial Engineering and Management, 6*(4), 860–875.

Zeleny, M. (1974) *Linear Multi-objective Programming*. Berlin: Springer Verlag.