

Evaluation of Private Banks Listed on the Tehran Stock Exchange by the Use of SAW, TOPSIS, and VIKOR Methods

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ABSTRACT

Choosing the optimal portfolio to invest has always been investors' one of the main concerns. Investigation of financial statements such as financial ratios, profit and loss management, and balance sheet along with using the stock exchange data of companies in order to select the optimal portfolio has been a suitable strategy for this group of investors. In this study, out of 19 private banks active in the Tehran Stock Exchange, 14 banks (according to the experts' opinions and considering the transparency of financial statements, the openness of the symbol in the trading market, and the clarity of stock exchange data for several days in recent years) have been selected and investigated. First, we calculated the performances of these banks in 9 financial ratios in the financial statements up to March 20, 2019 as well as their stock ratios (Sharpe and Treynor ratios) during the last 10 years. Using 3 evaluation methods of SAW, TOPSIS, and VIKOR, we ranked the banks and finally compared the results with each other. In order to give weights to the indicators, the academic and banking experts' opinions were used, leading to an increase the accuracy and scientific burden of the research. The distinctive feature of this research compared to similar articles and researches is the simultaneous use of financial statements and stock ratios (Sharpe and Treynor ratios and the beta coefficient), leading to more accuracy and reliability of the results obtained in this article. At the end of this study, it was found that the best banks for investors to invest is Sarmayeh Bank.

Keywords: private banks, financial ratios, stock ratios.

Introduction

its groups, but the banking group is one of the groups whose profitability has often been ascending. In Iran, banks are very limited influenced by global market fluctuations and price changes, adding to the benefits of investing in them and, in general, creating a good risk-return ratio for investors. Research show that the banking industry with a market value of 590,000 billion Tomans is the fifth largest market group and has 6.7% of the total market value.

This industry, which in the last one and a half years has faced returns of 407% and 710%, has recorded much higher returns with respect to the overall market index, which is an interesting performance. Considering the situation of financial statements and accumulated losses of many banks, this issue requires a deeper study on this group.

1. Introducing Experts and Indicators for Evaluation

In this article, 9 indicators (financial ratio) available in the audited financial statements of banks up to March 20, 2019 as well as 2 Sharpe and Treynor ratios are used to evaluate banks.

Table 1. Evaluated criteria.

No.	Definition/Calculation Method	Criterion name/Index	Favorable/Unfavorable
1	Equity to total assets ratio	Ownership ratio	Favorable
2	Net profit to total assets ratio	ROA (Return on Assets)	Favorable
3	Net profit to equity ratio	ROE (Return on Equity)	Favorable
4	(Assets/(interest paid on deposits-interest and commitment amount received))	Net profitability ratio	Favorable
5	((Term deposits/interest paid)-(facilities granted/interest and commitment amount))	Performance criteria	Favorable
6		Low-cost deposit to total deposits ratio	Favorable
7		Facilities to deposits ratio	Favorable
8		Non-shared revenues to total revenues ratio	Favorable
9		Costs to revenues ratio	Unfavorable
10	Sharpe ratio is equal to portfolio return minus risk-free interest rate, divided by possible changes in the excess return $\frac{(R_p - R_f)}{\sigma_p}$	Sharpe ratio	Favorable
11	$\frac{(R_p - R_f)}{\beta_p}$	Treynor ratio	Favorable

In order to increase the scientific burden of the content and the accuracy of the results, we have also tried to use the opinions provided by the academic experts and those who are working in the banking industry.

Table 2. Introduction of experts.

No	Name	Education	Position/Job position
1	Gholamreza Askarzadeh	PhD in Financial Engineering and Risk Management	Faculty member of Islamic Azad University, Yazd Branch
2	Homayoun Eshkorjiri	PhD student in Accounting	Head of Omid Entrepreneurship Fund Branch
3	Abbas Moshtaghi	Master of Economics	Marketing expert in Bank Mellat, Yazd province
4	Musa Heydari	Bachelor of Accounting	Head of Planning Department of Bank Mellat, Yazd province

2. Data Extraction and Formation of Evaluation Matrices

In the first step, we extract the data needed to evaluate the banks. These data include the financial statements of the banks up to March 20, 2019 and their performances in the Tehran Stock Exchange transactions during the last 10 years.

2.1. Data Extraction

Referring to the Codal site (www.Codal.Ir) and also the technology management site of the Tehran Stock Exchange (www.Tsetmc.Com), we extract the data related to the indicators provided in Table 1 and, after calculating the indicators (according to Table 1), we place them in the matrix of the values.

Table 3. Matrix of values.

	Ownership ratio	ROA	ROE	Net profitability ratio	Performance criterion	Low cost deposits to total deposits ratio	Facilities to deposits ratio	Non-shared revenues to total revenues ratio	Cost to revenue ration	Sharpe ratio	Treynor ratio
Eghtesad Novin	0.07	0.00	0.02	0.13	0.19	0.17	0.76	0.32	0.99	-5.12	-1.34
Iran Zamin	0.20	0.13	0.65	-0.13	-0.04	0.04	0.11	0.72	0.53	-5.11	2.47
Parsian	0.70	-0.01	-0.12	-0.04	0.03	0.10	0.42	0.37	2.43	-4.67	4.49
Pasargad	0.07	0.02	0.23	0.00	0.05	0.09	0.66	0.24	0.58	-6.10	-0.70
Tejarat	0.06	0.00	0.01	0.00	0.11	0.35	0.31	0.21	0.97	-4.60	-1.83
Khavarmianeh	0.11	0.04	0.40	0.01	0.01	0.32	0.71	0.31	0.29	-6.27	-1.86
Dey	0.45	-0.15	-0.33	-0.16	0.18	0.05	0.14	0.05	2.19	-4.31	-1.16
Resalat	0.00	0.00	0.95	0.02	0.03	1.00	0.59	1.00	0.91	-3.35	7.91
Sarmayeh	0.39	0.11	0.29	-0.04	-0.13	0.03	0.33	0.47	0.41	-4.36	14.68
Sina	0.06	0.01	0.12	0.01	0.03	0.23	0.63	0.12	0.76	-5.02	-0.39
Saderat	0.05	0.00	0.02	0.01	0.05	0.33	0.46	0.25	0.98	-4.61	-14.30
Karafarin	0.08	0.01	0.18	0.00	0.08	0.10	0.47	0.12	0.66	-5.46	-0.78
Gardeshgari	0.01	0.00	0.33	-0.01	0.12	0.04	0.52	0.32	0.94	-2.76	-0.35
Mellat	0.08	0.01	0.07	0.00	-0.03	0.44	0.83	0.46	0.73	-4.50	-2.42

3. Calculating the Weights of the criteria using the AHP Method

In order to form the evaluation matrices in the SAW, TOPSIS and VIKOR methods, we first calculate the weights the criteria by the use the AHP method. According to the survey forms provided to the experts, the matrices of the criteria significance coefficients are formed (the minimum significance coefficient is 1 and the maximum significance coefficient is 8) and, by calculating the geometric mean of the ratios, the final matrix of the criteria significance coefficients is calculated.

Table 4. The final matrix of the criteria significance coefficients.

	Ownership ratio	ROA	ROE	Net profitability ratio	Performance criterion	Low cost deposits to total deposits ratio	Facilities to deposits ratio	Non-shared revenues to total revenues ratio	Cost to revenue ration	Sharpe ratio	Treynor ratio
Ownership ratio	1.00	0.87	0.87	1.00	1.31	2.10	1.39	1.42	1.14	1.37	1.86
ROA	1.15	1.00	1.00	1.15	1.51	2.41	1.59	1.63	1.31	1.58	2.03
ROE	1.15	1.00	1.00	1.15	1.51	2.41	1.59	1.63	1.31	1.58	2.03
Net profitability ratio	1.00	0.87	0.87	1.00	1.31	2.09	1.38	1.41	1.13	1.37	1.76
Performance criterion	0.76	0.66	0.66	0.76	1.00	1.60	1.60	1.80	0.87	1.50	1.34
Low cost deposits to total deposits ratio	0.48	0.41	0.41	0.48	0.62	1.00	0.66	0.67	0.54	0.65	0.84
Facilities to deposits ratio	0.72	0.63	0.63	0.72	0.95	1.52	1.00	1.02	0.82	0.99	1.27
Non-shared revenues to total revenues ratio	0.71	0.61	0.61	0.71	0.93	1.48	0.98	1.00	0.80	0.97	1.25
Cost to revenue ration	0.88	0.77	0.77	0.88	1.16	1.58	1.22	1.25	1.00	1.21	1.55
Sharpe ratio	0.73	0.63	0.63	0.73	0.96	1.53	1.01	1.03	0.83	1.00	1.28
Treynor ratio	0.57	0.49	0.49	0.57	0.74	1.19	0.79	0.80	0.64	0.87	1.00

Then, by dividing the numbers of each cell by the sum of its column and finally by taking the arithmetic mean of the rows, the weight of each criterion is obtained.

Table 5. Weight of criteria.

Indicator	Weight of indicator
Ownership ratio	0.11
ROA	0.13
ROE	0.13
Net profitability ratio	0.11
Performance criterion	0.08
Low cost deposits to total deposits ratio	0.05
Facilities to deposits ratio	0.08
Non-shared revenues to total revenues ratio	0.08
Cost to revenue ration	0.10
Sharpe ratio	0.08
Treynor ratio	0.06

4. Evaluating the Items using the SAW, TOPSIS and VIKOR methods

After calculating the weights of the indicators by the use of the AHP method, we can now evaluate the items (banks) and then rank them.

4.1. The SAW Method

The Simple Additive Weighting (SAW) method or the simple weighted total method is the simplest multi-criteria decision-making method. This method was proposed in 1981 by Hwang and Yoon. Due to its ease of use, the SAW method is the most popular and common method in the Multi-Attribute Decision-Making (MADM) methods. The SAW method can be considered as the simplest and most direct method of dealing with multi-criteria decision making problems.

To use the SAW method, we must first normalize the criterion-item matrix using the linear method (Table 3).

$$\text{Favorable characteristic: } n_{ij} = \frac{x_{ij}}{\max_{i=1:m}(x_{ij})} \quad (1)$$

$$\text{Unfavorable characteristic: } n_{ij} = \frac{\min_{i=1:m}(x_{ij})}{x_{ij}} \quad (2)$$

$$\text{Score of each item: } n_{ij} = \frac{\min_{i=1:m}(x_{ij})}{x_{ij}} \quad (3)$$

Then, using the weights of the criteria (Table 5) and Equation 3, we calculate the score of each item.

Table 6. Evaluation results by the use of the SAW method.

	Ownership ratio	ROA	ROE	Net profitability ratio	Performance criterion	Low cost deposits to total deposits ratio	Facilities to deposits ratio	Non-shared revenues to total revenues ratio	Cost to revenue ration	Sharpe ratio	Treynor ratio	Final score
Sarmayeh	0.868	0.870	0.300	-0.326	-0.644	0.032	0.400	0.466	0.716	0.695	1.000	0.311
Iran Zamin	0.443	1.000	0.682	-1.051	-0.196	0.040	0.131	0.072	0.554	0.815	0.168	0.271
Resalat	0.009	0.290	1.000	0.138	0.153	1.000	0.715	1.000	0.321	0.534	0.539	0.234
Khavarmianeh	0.234	0.32	0.420	0.061	0.034	0.319	0.861	0.307	1.000	1.000	-0.127	0.142
Pasargad	0.150	-0.122	0.246	0.033	0.253	0.091	0.794	0.242	0.501	0.972	-0.047	0.069
Mellat	0.180	0.044	0.073	0.035	-0.143	0.442	1.000	0.460	0.403	0.717	-0.165	0.065
Karafarin	0.168	0.102	0.184	-0.027	0.434	0.098	0.569	0.118	0.447	0.871	-0.053	0.06
Sina	0.134	0.055	0.123	0.118	0.157	0.229	0.768	0.116	0.387	0.800	-0.027	0.055
Gardeshgari	0.023	0.026	0.345	-0.071	0.633	0.037	0.634	0.315	0.312	0.440	-0.024	0.048
Tejarat	0.123	0.006	0.015	-0.024	0.556	0.348	0.381	0.210	0.302	0.734	-0.125	0.039
Eghtesad Novin	0.159	0.012	0.024	1.000	1.000	0.168	0.927	0.316	0.296	0.817	-0.091	0.038
Parsian	0.154	-0.063	-0.123	-0.284	0.174	0.099	0.512	0.370	0.120	0.745	0.306	0.024
Saderat	0.111	0.006	0.016	0.069	0.253	0.327	0.554	0.252	0.299	0.735	-0.974	0.015
Dey	1.000	-1.155	-0.349	-1.246	0.924	0.051	0.168	0.045	0.134	0.687	-0.079	-0.083

According to Table 6, the ranking of the banks based on the points obtained in the SAW method is as follows:

Table 7. Ranking of the banks by the use of the SAW method.

Bank name	Rank
Sarmayeh	1
Iran Zamin	2
Resalat	3
Khavarmianeh	4
Pasargad	5
Mellat	6
Karafarin	7
Sina	8
Gardeshgari	9
Tejarat	10
Eghtesad Novin	11
Parsian	12
Saderat	13
Dey	14

4.2. The TOPSIS Method

The TOPSIS method is one of the techniques used in the Multi-Criteria Decision Making (MCDM). In this decision-making method, there are a number of items and criteria for decision-making, which must be ranked according to the criteria, or each of them should be assigned an efficiency score. The general philosophy of the TOPSIS method is that two hypothetical items are defined using the available items. One of these items is a collection of the best values found in the decision matrix. This item is called the *positive ideal* (the best possible case). Also, another hypothetical item is defined that includes the worst case scenario. This item is called the *negative ideal*. The criteria can be positive or negative in nature, and their units of measurement can also be different.

The criterion for calculating scores in the TOPSIS method is that the items are as close as possible to the positive ideal item and as far from the negative ideal item as possible. Based on this rule, a score is calculated for each item and the items are ranked according to these scores.

Step 1. Create a decision matrix:

First we form the matrix of values according to Table 3.

Step 2. Normalize or descale the matrix:

In this step, we descale the scales in the decision matrix. In this way, each of the values is divided by the vector size of the same index.

$$(4) \quad n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^m x_{ij}^2}}$$

Table 8. Normalized matrix.

	Ownership ratio	ROA	ROE	Net profitability ratio	Performance criterion	Low cost deposits to total deposits ratio	Facilities to deposits ratio	Non-shared revenues to total revenues ratio	Cost to revenue ratio	Sharpe ratio	Treynor ratio
Eghtesad Novin	0.1074	0.0069	0.016	0.5069	0.5396	0.1316	0.3791	0.2205	0.2353	-0.284	-0.0585
Iran Zamin	0.2998	0.5565	0.47	-0.5325	-0.105	0.031	0.0538	0.0503	0.1255	-0.283	0.1076
Parsian	0.1043	-0.035	-0.085	-0.1441	0.0937	0.0771	0.2095	0.2575	0.5777	-0.259	0.1957
Pasargad	0.1013	0.0678	0.169	0.0165	0.1367	0.0713	0.3248	0.1687	0.1388	-0.338	-0.0304
Tejarat	0.0835	0.0035	0.010	-0.0122	0.2999	0.2717	0.1557	0.1464	0.2306	-0.255	-0.0799
Khavarmianeh	0.1581	0.1781	0.289	0.0308	0.0183	0.2491	0.3523	0.2139	0.0696	-0.348	-0.0812
Dey	0.6769	-0.642	-0.240	-0.6313	0.499	0.0397	0.0686	0.0316	0.5207	-0.239	-0.0505
Resalat	0.006	0.0162	0.6896	0.0697	0.0827	0.7806	0.2926	0.6966	0.2166	-0.186	0.3447
Sarmayeh	0.5877	0.484	0.2072	-0.1654	-0.347	0.0249	0.1636	0.3249	0.0973	-0.242	0.64
Sina	0.0909	0.0304	0.0848	0.0596	0.0846	0.179	0.314	0.0809	0.1797	-0.278	-0.0171
Saderat	0.075	0.0033	0.0112	0.035	0.1363	0.2554	0.2267	0.1757	0.2327	-0.255	-0.6237
Karafarin	0.1134	0.0569	0.127	-0.0136	0.2341	0.0766	0.2326	0.0825	0.1558	-0.303	-0.0342
Gardeshgari	0.0157	0.0147	0.2377	-0.036	0.3415	0.0292	0.2593	0.2196	0.2233	-0.152	-0.0152
Mellat	0.122	0.0243	0.0505	0.0179	-0.077	0.3454	0.409	0.3202	0.1726	-0.249	-0.1053

Step 3. Weighting the normalized matrix:

The decision matrix is in fact parametric and needs to be quantized. For this end, the decision-maker assigns a weight to each indicator. Then the sum of weights is multiplied by the normalized matrix.

Table 9. The weighted matrix.

	Ownership ratio	ROA	ROE	Net profitability ratio	Performance criterion	Low cost deposits to total deposits ratio	Facilities to deposits ratio	Non-shared revenues to total revenues ratio	Cost to revenue ration	Sharpe ratio	Treynor ratio
Eghtesad Novin	0.0118	0.0009	0.0021	0.0558	0.0432	0.0066	0.0303	0.0176	0.0235	-0.0227	-0.0035
Iran Zamin	0.033	0.0723	0.0611	-0.058	-0.0085	0.0016	0.0043	0.004	0.0126	-0.0227	0.0065
Parsian	0.0115	-0.004	-0.011	-0.015	0.0075	0.0039	0.0168	0.0206	0.0578	-0.0207	0.0117
Pasargad	0.0111	0.0088	0.022	0.0018	0.0109	0.0036	0.026	0.0135	0.0139	-0.0271	-0.0018
Tejarat	0.0092	0.0005	0.0014	-0.001	0.024	0.0136	0.0125	0.0117	0.0231	-0.0204	-0.0048
Khavarmianeh	0.0174	0.0232	0.0377	0.0034	0.0015	0.0125	0.0282	0.0171	0.007	-0.0278	-0.0049
Dey	0.0745	-0.083	-0.031	-0.069	0.0399	0.002	0.0055	0.0025	0.0521	-0.0191	-0.003
Resalat	0.0007	0.0021	0.0897	0.0077	0.0066	0.039	0.0234	0.0557	0.0217	-0.0149	0.0207
Sarmayeh	0.0647	0.0629	0.0269	-0.018	-0.0278	0.0012	0.0131	0.026	0.0097	-0.0194	0.0384
Sina	0.01	0.004	0.011	0.0066	0.0068	0.009	0.0251	0.0065	0.018	-0.0223	-0.001
Saderat	0.0083	0.0004	0.0015	0.0038	0.0109	0.0128	0.0181	0.0141	0.0233	-0.0205	-0.0374
Karafarin	0.0125	0.0074	0.0165	-0.001	0.0187	0.0038	0.0186	0.0066	0.0156	-0.0242	-0.0021
Gardeshgari	0.0017	0.0019	0.0309	-0.004	0.0273	0.0015	0.0207	0.0176	0.0223	-0.0122	-0.0009
Mellat	0.0134	0.0032	0.0066	0.002	-0.0062	0.0173	0.0327	0.0256	0.0173	-0.02	-0.0063

Step 4. Determine the solutions for the positive ideal and for the negative ideal:

The ideal item (the positive ideal) is the item that has the largest value for the positive indicators and the smallest value for the negative indicators. An anti-ideal (negative ideal) is an item that has the smallest value for the positive indicators and the largest value for the negative indicators.

Table 10. Items for the positive and negative ideals.

	Ownership ratio	ROA	ROE	Net profitability ratio	Performance criterion	Low cost deposits to total deposits ratio	Facilities to deposits ratio	Non-shared revenues to total revenues ratio	Cost to revenue ration	Sharpe ratio	Treynor ratio
Positive ideal	0.0745	0.072	0.089	0.0558	0.0432	0.039	0.0327	0.0557	0.007	-0.012	0.0384
Negative ideal	0.0007	-0.083	-0.03	-0.069	-0.0278	0.0012	0.0043	0.0025	0.0578	-0.0278	-0.034

Step 5. Determine the distance from the positive and negative ideal solutions:

We measure the distance between each item by the Euclidean method, i.e. we find the distance between the items and the positive and negative ideals.

$$S_j^+ = \sqrt{\sum_{i=1}^n (V_{ij} - A_j^+)^2} \quad (5)$$

$$S_j^- = \sqrt{\sum_{i=1}^n (V_{ij} - A_j^-)^2} \quad (6)$$

Table 11. Distances between items and ideals.

Bank name	Positive ideal	Negative ideal
Eghtesad Novin	0. 1461	0. 1799
Iran Zamin	0. 156	0. 1959
Parsian	0. 1803	0. 1177
Pasargad	0. 1468	0. 1478
Tejarat	0. 1614	0. 1347
Khavarmianeh	0. 1311	0. 1647
Dey	0. 2517	0. 1064
Resalat	0. 121	0. 1964
Sarmayeh	0. 1318	0. 2008
Sina	0. 1547	0. 1413
Saderat	0. 1726	0. 1294
Karafarin	0. 1516	0. 144
Gardeshgari	0. 1494	0. 1477
Mellat	0. 1559	0. 1377

Step 6. Calculate proximity to the positive and negative ideal solutions and rank the items:

The final criterion to rank the items is obtained by the following relation:

$$C_i = \frac{S_i^-}{S_i^- + S_i^+} \quad (7)$$

Table 12. Score for each item.

Item	Proximity coefficient
Resalat	0. 6187
Sarmayeh	0. 6037
Iran Zamin	0. 5568
Khavarmianeh	0. 5568
Eghtesad Novin	0. 5519
Pasargad	0. 5018
Gardeshgari	0. 4972
Karafarin	0. 4872
Sina	0. 4773
Mellat	0. 469
Tejarat	0. 455
Saderat	0. 4285
Parsian	0. 3949
Dey	0. 2972

Step 7. Rank the items (banks):

Table 13. Ranking the banks by the use of the TOPSIS method.

Bank	Rank
Resalat	1
Sarmayeh	2
Iran Zamin	3
Khavarmianeh	4
Eghtesad Novin	5
Pasargad	6
Gardeshgari	7
Karafarin	8
Sina	9
Mellat	10
Tejarat	11
Saderat	12
Parsian	13
Dey	14

4.3. The VIKOR Method

The VIKOR method was introduced by Opricovic and Tzang in 1988 and also was developed by them from 2002 to 2007. This method is based on consensual planning of multi-criteria decision-making issues, evaluating issues that are incompatible with the criteria. In situations where the decision-maker is not able to identify and express the advantages of an issue at the time of its initiation and design, this method can be considered as an effective tool for decision-making.

The steps of the VIKOR method

1. Decision matrix formation:

According to the number of criteria, the number of items, and evaluation of all items for different criteria, the decision matrix is formed as follows:

$$X = \begin{bmatrix} x_{11} & \dots & x_{1n} \\ x_{m1} & \dots & x_{mn} \end{bmatrix}$$

Where X_{ij} is the performance of item i in relation to the criterion j .

2. Determining the weight of the standard matrix:

Considering the significance coefficients of different criteria in the decision matrix, this step is defined as follows:

$$W = [w_1, \dots, w_n]$$

3. Determining the best and worst values among the values available for each criterion in the decision matrix:

The best and worst values for the positive and negative criteria are presented in the following table:

Table 14. The best and worst values of the criteria.

Type of criterion	Best	Worst
Positive criterion	$f_i^* = \max f_{ij}$	$f_i^- = \min f_{ij}$
Negative criterion	$f_i^* = \min f_{ij}$	$f_i^- = \max f_{ij}$

4. Calculating R and S:

$$S_i = \sum_{j=1}^n w_j \frac{(f_i^* - f_{ij})}{(f_i^* - f_i^-)} \quad (8)$$

$$R_i = \max \left[w_j \frac{(f_i^* - f_{ij})}{(f_i^* - f_i^-)} \right] \quad (9)$$

In the above relations, W_i is the weight of the i -th criterion, S_i is the relative distance of the i -th item from the positive ideal solution, and R_i is the maximum discomfort of the i -th item from being far from the positive ideal item.

5. Calculating Q:

$$Q_i = V \frac{(S_j - S^*)}{(S^- - S^*)} + (1 - V) \frac{(R_j - R^*)}{(R^- - R^*)} \tag{10}$$

According to relations (8), (9), and (10), we have:

$$Q^* = \min Q_j, \quad R^* = \min R_j, \quad S^* = \min S_j,$$

And parameter V also take the value of 0.5 (majority agreement).

6. Sorting the items based on reducing the values of R, Q, S:

In group Q, an item is selected as the top item if it satisfies the following two conditions:

The first condition: If items A1 and A2 represent the first and second top items in the group, respectively, and n represents the number of items, then the following relation must be satisfied:

$$Q(A^2) - Q(A^1) \geq \frac{1}{n-1} \tag{11}$$

Second condition: Item A1 must be recognized as the top rank in at least one of the groups R and S.

Here, the both conditions are satisfied for Q.

According to the above discussion as well as relations (8), (9), (10), and (11), the following matrices are obtained:

Table 15. R, S, and Q indicators of each item.

Items	Utility Index (Si)	Regret or Dissatisfaction Index (Ri)	VIKOR Index (Qi)
Sarmayeh	0.427	0.080	0.1147
Khavarmianeh	0.495	0.085	0.2504
Resalat	0.335	0.110	0.3000
Eghtesad Novin	0.474	0.094	0.3142
Mellat	0.510	0.091	0.3283
Pasargad	0.555	0.094	0.4176
Karafarin	0.574	0.092	0.4214
Sina	0.562	0.096	0.4431
Iran Zamin	0.548	0.100	0.4705
Tejarat	0.589	0.097	0.4892
Gardeshgari	0.503	0.108	0.4934
Saderat	0.608	0.099	0.5273
Parsian	0.678	0.108	0.7106
Dey	0.736	0.130	1.0000

Table 16. Ranking of the items based on reducing values of Q, S, and R.

Items	Ranking by Utility Index (Si)	Ranking by Regret or Dissatisfaction Index (Ri)	Ranking by VIKOR Index (Qi)
Sarmayeh	2	1	1
Khavarmianeh	4	2	2
Resalat	1	13	3
Eghtesad Novin	3	5	4
Mellat	6	3	5
Pasargad	8	6	6
Karafarin	10	4	7
Sina	9	7	8
Iran Zamin	7	10	9
Tejarat	11	8	10
Gardeshgari	5	12	11
Saderat	12	9	12
Parsian	13	11	13
Dey	14	14	14

Given that both conditions are satisfied in step 6, the ranking of items (banks) can be shown in this way:

Table 17. Final ranking of the banks by the use of the VIKOR method.

Items	Final ranking
Sarmayeh	1
Khavarmianeh	2
Resalat	3
Eghtesad Novin	4
Mellat	5
Pasargad	6
Karafarin	7
Sina	8
Iran Zamin	9
Tejarat	10
Gardeshgari	11
Saderat	12
Parsian	13
Dey	14

4.4. Differences between the TOPSIS and VIKOR Method

In the VIKOR method, in order to rank and find the best item, the concepts of the worst item and the compromise level between the distances of the items from the best item are used, leading this method to be classified as a compromise planning method. Compared to the TOPSIS method, this method considers the importance of the optimal distance from the best and the worst cases when calculating the distances of the items. In the TOPSIS method, the selected item must have the shortest distance from the ideal solution and the farthest distance from the anti-ideal solution. The TOPSIS method introduces two reference items (ideal and anti-ideal) but does not consider the relative importance of the distances from these two points.

The VIKOR and TOPSIS methods use different types of normalization to eliminate the measurement units of the criteria: the VIKOR method uses the linear normalization and the TOPSIS method uses the vector normalization. The value normalized in the VIKOR method does not depend on the measurement unit, while the values normalized by the TOPSIS method may depend on the measurement unit.

5. Comparison of bank evaluation results in three methods

We now compare the bank evaluation results with the use of three methods: SAW, TOPSIS and VIKOR.

Table 18. Comparison of bank rankings with the use of three methods.

Items	Ranking in SAW	Ranking in TOPSIS	Ranking in VIKOR
Sarmayeh	1	2	1
Khavarmianeh	4	4	2
Resalat	3	1	3
Eghtesad Novin	11	5	4
Mellat	6	10	5
Pasargad	5	6	6
Karafarin	7	8	7
Sina	8	9	8
Iran Zamin	2	3	9
Tejarat	9	7	10
Gardeshgari	10	11	11
Saderat	13	12	12
Parsian	12	13	13
Dey	14	14	14

6. Which Banks to Choose for Investment?

Now that we have identified the ranking of the banks by the use of three ways, the question may arise as to which portfolio investors should choose to maximize their returns, considering the different results of the bank evaluations in the above-mentioned methods. Before answering this question, we will first introduce an important indicator in stock trading. This index is called Beta (β). The simplest concept that can be used for beta is: Beta indicates the amount of risk that an investor incurs in relation to the entire market by buying stocks. The beta coefficient is calculated using the following equations:

$$r_i = \alpha + \beta r_m \tag{12}$$

$$\beta = \frac{\text{cov}(r_i, r_m)}{\text{var}(r_m)} \tag{13}$$

If the beta coefficient of a stock is equal to one, the increase and decrease in the price of that stock will be in accordance with the increase or decrease in the market.

If the beta coefficient of a stock is greater than one, the fluctuations in the return of that stock will be greater than the fluctuations in the market; and such a stock is called risky asset or aggressive stock. These stocks have better liquidity and are suitable for swing trading. A stock with a high beta coefficient is a great investment option when prices fall because as systematic risk decreases, stock prices rise more rapidly. Assets with a beta coefficient of less than one will experience less fluctuations compared to the market fluctuations and are called risky or defensive assets. Investors with low risk-taking can choose to invest in such stocks. If the stock beta is greater than one, the fluctuations in the return of that share will be greater than the fluctuations in the market and it is called risky asset or aggressive share. These stocks have better liquidity and are suitable for volatility. A stock with a high beta ratio is a great investment option when prices fall. Because as systematic risk decreases, stock prices rise more rapidly. Assets with a beta of less than one will experience less fluctuations than market fluctuations and are called risky or defensive assets. Investors with low risk-taking can choose to invest in such stocks.

A stock with beta coefficient of zero does not change with market fluctuations, indicating that no relationship can be found between the market growth or decline and the growth or decline of this stock. If a stock has a negative beta coefficient, its behavior is the exact opposite of market behavior. In summary, five modes can be considered for the beta coefficient:

$\beta=1$: In line with the market, and the return is equal to the index;

$\beta=0$: It does not influenced by the index, neutral;

$\beta<0$: Moves in the opposite direction of the market;

$\beta>1$: Sharpe, suitable for swing trading, with high risk and aggressive;

$1<\beta$: Slow, heavy, with low risk, defensive;

The beta coefficients of the banks evaluated in this study are as follows:

Table 19. Beta coefficients of the banks.

Bank	Beta coefficient
Gardeshgari	0.4048
Sina	0.3810
Pasargad	0.2135
Karafarin	0.1908
Dey	0.1275
Eghtesad Novin	0.1113
Tejarat	0.0814
Khavarmianeh	0.0797
Mellat	0.0616
Saderat	0.0103
Sarmayeh	-0.0099
Resalat	-0.0187
Parsian	-0.0333
Iran Zamin	-0.0587

Now that we are familiar with the beta coefficient, we can answer the above question as follows:

If the investor intends to choose a portfolio consisting of different industries and intends to select one or two companies from each level to invest, it is suggested that according to the calculation results, Sarmayeh Bank should be selected as the representative of the banking industry in this person's portfolio because this bank won two first ranks and one second rank in the three methods evaluated in this research and showed the best performance.

But if the investor intends to have a portfolio in the banking industry, five banks of Sarmayeh, Gharzolhasneh Resalat, Khavarmineh, Eghtesad Novin and Iran Zamin are suitable options for investment, and considering whether the person is risk-taking or not, he/she can allocate his/her capital in these 5 banks according to the beta coefficient of each bank. (The weight of each of these banks in this investment is directly related to whether the person is risk-taking or not.)

7. Summary

The aim of this study was to evaluate private banks listed on the Tehran Stock Exchange. In order to evaluate the banks, 11 indicators consisting of 9 financial ratios obtained from the financial statements and 2 ratios obtained from the stock exchange data were used. The evaluation methods are SAW, TOPSIS and VIKOR. At the end, the results obtained in these three methods were compared with each other and Sarmayeh Bank was selected as the best bank.

8. Several Suggestions to be used in Similar Research

The following suggestions are for researchers to use in similar articles:

- Using other financial ratios in the financial statements of banks and companies;
- Direct use of beta coefficient as one of the evaluated indicators ;
- Using the AHP method along with the three evaluation methods used in this article;
- Using more academic experts' opinions

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