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Analysis of Financial Performances of Hospital Services Subsector By ELECTRE Method

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ABSTRACT

Measuring and evaluating financial performance in healthcare enterprises is important for decision makers to evaluate the past and comment on the future. In this study, Turkey hospital services of the sub-sectors of evaluate the financial performance are aimed. For this purpose, the Republic of Turkey's financial performance with ELECTRE method that the Central Bank released was that the industry's financial performance between the data with the help of hospital services sub-sectors of the 2008-2016 years are taken from the balance sheet of the multi-criteria decision-making methods were measured. As a result, Turkey hospital services sub-sectors of the 9-years financial performance is evaluated, starting from the years of exchange between hospital services sub-sectors will contribute to the users about the results we have tried to be included.

Keywords: Financial Performance, Hospital Services, ELECTRE Method.

Introduction

Performance evaluation is crucial for health institutions since it is a source for the identification, measurement, and evaluation of the operations performed in line with the objectives and targets set as well as making decisions for the future (Karaman, Karatepe, & Kuşcu, 2019:153). When measuring the financial performance of institutions, data obtained from balance sheets, income statements, and other financial reports are analyzed. Using financial statements for financial performance measurement is a three-step process. The first step is to make financial statements of health institutions suitable for analysis. The second step is to develop quantitative measures used

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in developing an idea about the financial status and performance of health institutions. The final step is the hardest step involving gathering the data from the first two steps and then commenting on the financial performance (Berman Weeks, & Kukla, 1990). Financial performance measurement is an analysis using financial and operational data to evaluate the financial position, reliability of investments, and risks of health institutions. This analysis helps management to evaluate the past, make investment and financing decisions, and planning for the future (Özgülbaş, 2005:128).

Several methods are used to measure financial performance in health institutions. However, regression analysis, data envelopment, and value-added analysis are the most commonly used financial performance measurement methods. In the study, it was aimed to evaluate the financial performances of the hospital services subsector in Turkey. In line with this purpose, first, a literature review was conducted and then the studies conducted in the healthcare field and measurements of financial performances were presented. The financial performance of the hospital services subsector for the period of 2008-2016 was analyzed using the ELECTRE method, which has never been used for financial performance measurement in the healthcare field, and then comments were provided.

Literature Review

The studies conducted using various methods in the measurement of the financial performance of the hospitals supplying healthcare service are as follows:

In the study they conducted in 2017, Alper and Biçer measured the financial performance of the Sivas Numune Hospital, which is a public hospital, by ratio analysis using the liquidity, financial structure, activities, and profitability ratios for the period 2012-2014. As a result of the study, it was found that the hospital's liquidity status was fair, net working capital was sufficient, receivables were collectible, stocks were convertible in sales rapidly than the sector, the financial structure was rigid, and the profitability ratios of the first two years were negative but the third year's profitability ratios showed an increase.

Ercan, Dayı, and Akdemir (2013) measured the financial performances of 12 public health institutions across Kastamonu province by ratio analysis method using the financial statements for the period 2008-2012. As a result of the analysis, it was found that the asset utilization showed an increase but they could not achieve the same success in profitability ratios in resource utilization for the period 2008-2012. The increases in general administrative and especially operational expenses negatively affect the resource management performance.

Karadeniz (2016) examined the financial statements of the hospital services subsector for the period 2011-2013 by ratio method. As a result of the evaluation, it was determined that the sector's asset structure was mainly fixed, liquidity status was low, financial structure mainly consisted of foreign resources, equity was poor and financial risk was high. It was found out that the enterprises in the sector could not utilize their stocks efficiently and the sector's profitability performance was poor.

Karadeniz and Koşan (2017) examined the three-period (2012-2014) return on assets and equity profitability performances of the hospital services subsector by DuPont financial analysis technique. As a result of the analysis, the sector's return on assets and equity profitability between 2012 and 2014 were found to be positive while negative in 2013. It was found out that the sector's cost and expense items were high, the asset turnover ratio was not at the desired level and the sector was financing its active investments with mainly foreign resources.

In their study they conducted in 2019, Çil Koçyiğit and Kocakoç compared the financial performances of the hospitals affiliated with the ministry of health in Ankara province before and after the Public Hospital Association General Secretariat period, measuring the financial performances by ratio analysis method using the 10-year financial statements including the period 2008-2017. It was seen that by years the liquidity ratios showed a decrease, such decreases increased in the general secretariat period, foreign resources and especially short term foreign resources increased, shareholder's equity substantially decreased and this progress accelerated especially in the general secretariat period, the risk level in terms of financial structure ratios increased, the tangible fixed assets and fixed assets were over utilized and the desired profitability success could not be achieved.

As a result of the study aiming to cluster the selected organizational and financial performance indicators of 514 hospitals affiliated with the Ministry of Health, Avcı, and Çınaroğlu (2015) concluded that the financial status of midsize hospitals was fair. Özer (2012) evaluated the financial status of a Training and Research Hospital for the years 2008, 2009, and 2010 by ratio analysis and comparative financial statements analysis. According to the results, it was observed that the hospital had great difficulties in collecting the receivables and fluctuations in 3-year profitability ratios.

Akca and Somunoğlu İkinci (2014) evaluated the financial structure of a private medical center in Ankara province based on the ratio analysis results, and found that the liquidity status of the healthcare institution was higher than in previous years, the institution could not collect its receivables on time and the health institution had positive increases in certain ratios from year to year. In 2017, Bülüç, Özkan, and Ağırbaş evaluated the financial status of a private hospital, which was traded in ISE, for the period 2013-2016 by ratio analysis method. As a result of the analysis, it was concluded that the hospital had positive liquidity ratios, almost half of the assets were financed with foreign resources, long term foreign resource utilization showed an increase over the years, stock turnover was increasing, profitability ratios were positive and increasing year by year.

In 2017, Bülüç, Özkan, and Ağırbaş evaluated the financial performances of 43 public university hospitals by ratio analysis method for the years 2013, 2014 and 2015. As a result of the analysis, it was concluded that the hospital was under a high debt burden, having difficulties in paying its short term debts, stock turnover and accounts receivable turnover were low and the income could not cover the expenses. In the study titled "Effects of Economic Crisis Periods on Private Hospitals: Overview of Financial Performance of a Private Hospital by Using Ratio Analysis" and conducted by Gider (2011), measuring the financial performance of Acıbadem

Sağlık Hizmetleri ve Ticaret A.Ş. for 6 operating periods between 1998 and 2003 was aimed. As a result of the study, it was concluded that the institution achieved most of the desired financial ratios, it was negatively affected by the November 2000 and February 2001 economic crises but this negativity did not continue in the following years.

Özgülbaş N, Koyuncugil A. S., Duman R, Hatipoğlu B. (2008). In the study that aimed to perform the financial evaluation of the private hospital sector in Turkey and to determine the factors affecting the financial performance, the financial data of 797 private hospitals in total in the registry of the Central Bank of the Republic of Turkey for the years 1994-2005 were used. As a result of the study, it was concluded that the private hospitals utilized mainly equity, their liquidity statuses were fair, they were capable of paying their short term debts but their profitability levels were not good.

Studies aiming to measure the financial performance in hospital services sector have been conducted using various methods but the fact that no study has been conducted using the ELECTRE method, which is one of the multi-criteria decision-making models, in Turkey suggests the specificity of this study in terms of the method used.

Data and Method

The up-to-date sector balance sheets for the period 2008-2016 of the “Hospital Services Subsector” under the sector balance sheets published by the Central Bank of the Republic of Turkey (CBRT) were utilized. The data published by the CBRT reflecting the real sector balance sheets is limited to the data provided by the participating companies based on the voluntary participation of the companies in the sector. After the literature review, liquidity, financial structure, asset utilization, and profitability ratios, which are the four main ratios used in the measurement of financial performance, were utilized and nine ratios in total related to these ratios were used. The significance levels and weights of the ratios used in the study were determined through expert opinions. In the light of the data obtained, necessary analyzes were performed and comments on the performance levels of the hospital services subsector including the years 2008-2016 were provided.

ELECTRE Method

The ELECTRE (Elimination Et Choice Translating Reality) Method was first announced to researchers by Bernard Roy at a conference held in 1965 and then in a study that he conducted in 1968. ELECTRE is one of the multi-criteria decision-making methods which performs binary superiority comparisons between multiple alternatives and criteria. With ELECTRE, it is possible to weight criteria using various qualitative and quantitative data and then to select the optimum alternative based on the weighted sum (Şahin, 2018:155). The process of analysis of the data set obtained using the following formulas and following the steps below is as follows (Çağıl, 2011: 71-71; Soner & Önüt, 2006: 111-113).

Step 1:

Preparation of the Decision Matrix

In the first step of the method,

$$A = (a_{ij}) = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

A decision matrix where alternatives are located in the rows and criteria are located in the columns is prepared.

Step 2:

Preparation of the Normalized Decision Matrix

Separate normalization formula is used for the Cost (min) and Benefit (max) criteria. where $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$, for the benefit criteria

$$x_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^n a_{ij}^2}} \quad (1)$$

formula, and for the cost criteria;

$$x_{ij} = \frac{1}{\sqrt{\sum_{i=1}^m \left(\frac{1}{a_{ij}}\right)^2}} \quad (2)$$

formula is used and then

$$X = (x_{ij}) = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}$$

X normalized decision matrix is obtained.

Step 3:

Preparation of the Weighted Normalized Decision Matrix

First of all, the weight vector W should be determined where the sum of the weights of the

evaluation criteria is 1, i.e. $\sum_{j=1}^n w_j = 1$. The components at each column of the X normalized decision matrix are multiplied by the corresponding component of the weight vector W and then the weighted normalized decision matrix is obtained.

$$V = (v_{ij}) = \begin{pmatrix} w_1x_{11} & w_2x_{12} & \dots & w_nx_{1n} \\ w_1x_{21} & w_2x_{22} & \dots & w_nx_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ w_1x_{m1} & w_2x_{m2} & \dots & w_nx_{mn} \end{pmatrix} \quad (3)$$

Step 4: Determination of the Concordance and Discordance Sets

In order to create the concordance and discordance sets, each alternative pair is compared and the criteria are grouped in two separate sets. In the A_p and A_q ($p, q = 1, 2, \dots, m$ ve $p \neq q$) concordance set, the A_p alternative is preferred instead of A_q .

$$C(p, q) = \{j, v_{pj} \geq v_{qj}\} \quad (4)$$

If the A_p alternative is worse than the A_q alternative, the “discordance” set is created.

$$D(p, q) = \{j, v_{pj} < v_{qj}\} \quad (5)$$

Step 5: Preparation of the Concordance and Discordance Matrices

The concordance sets are utilized to create the concordance matrix C .

$$C_{pq} = \sum_{j^*} w_{j^*} \quad (6)$$

Here the concordance index C_{pq} shows the level of certainty of the result of the binary comparison.

They are the criteria included in the concordance set J^* . Similarly, the discordance matrix D is created utilizing the discordance set.

$$D_{pq} = \frac{(\sum_{j^0} |v_{pj^0} - v_{qj^0}|)}{(\sum_j |v_{pj} - v_{qj}|)} \quad (7)$$

they are the criteria in the discordance set j^0 .

Step 6: Preparation of the Concordance, Superiority and Discordance Matrices.

After the concordance and discordance indices are calculated, their members are detected in a certain way and then the discordant alternatives are eliminated. The degree of superiority of the A_p alternative to the A_q is determined by how big is the C_{pq} in the concordance index and how small is the D_{pq} in the discordance matrix. Firstly, the average (\bar{C} ve \bar{D}) of the values C and D is calculated. If $C_{pq} \geq \bar{C}$ and $D_{pq} \leq \bar{D}$, the alternative A_p is preferred over the alternative A_q .

The alternatives selected by ELECTRE method form a core (K). The core is created according to the following two cases:

A decision point (alternative) in the K is not superior over another decision point (alternative) in the K .

A decision point (alternative) in the K is behind at least one point in the K in preference ranking.

Step 7: Calculation of the Net Concordance and Net Discordance

The net concordance index is the highest, the net discordance index is the lowest alternative solution set. The C_p 's are sorted from large to small, and D_p 's from small to large. The final sorting is obtained using the net concordance and discordance indices.

The net concordance and discordance indices;

$$C_p = \sum_{\substack{k=1 \\ k \neq p}}^m C_{pk} - \sum_{\substack{k=1 \\ k \neq p}}^m C_{kp} \quad (8)$$

$$D_p = \sum_{\substack{k=1 \\ k \neq p}}^m D_{pk} - \sum_{\substack{k=1 \\ k \neq p}}^m D_{kp} \quad (9)$$

Analysis and Results

The financial performance criteria, the weighting of these criteria, benefit (max) and cost (min) properties used in the study related to the measurement of the financial performance are given in Table 1.

Table 1. Financial Performance Criteria and Weights

Criteria	Benefit/ Cost	Main Weight	Sub- Weight	Tot. Weight Dist.
A. Liquidity		20%		
A1 Current ratio	max		30	6
A2 Acid-test ratio	max		45	9
A3 Cash ratio	max		25	5
B. Financial structure		30%		
B1 Foreign resource total/total assets	min		14	4
B2 Equity/total assets	max		26	8
B3 Equity/foreign resources total	max		14	4
B4 Stfr/total liabilities	min		16	5
B5 Ltfr/total liabilities	min		20	6
B6 Tangible assets/long term foreign resources	max		10	3

C. Turnover ratios			20%	
C1	Stock turnover	max	35	7
C2	Accounts receivable turnover	max	35	7
C3	Tangible assets turnover ratio	max	10	2
C4	Assets turnover	max	20	4
D. Profitability ratios			30%	
D1A	Net profit/equity	max	13	4
D1B	Net profit/total assets	max	13	4
D2A	Operating profit/net sales	max	24	8
D2B	Gross profit on sales/net sales	max	17	5
D2C	Net profit/net sales	max	17	5
D3A	Earnings before interest and tax/interest expenses	max	16	4
SUM			100%	100

In the study, the Decision Matrix was prepared by using the ratios of the last 9 years (2008-2016) published by the CBRT for the hospital services sector (Table 2). Table 2 shows the financial performances of the hospital services subsector in terms of liquidity, financial structure, resource utilization, and profitability yearly. When the financial performance in terms of liquidity was examined, the best performance was found to be achieved in 2010 based on the A1(170.4), A2(144.3), and A3(26.3) ratios. When the equity utilization was examined, the best performance was found to be achieved in 2009 based on the B1(51.6), B2(48.4), B3(138.6), and B5(19.8) ratios. The year 2008 had the best financial performance in terms of profitability performance while the years 2011 and 2012 had the best financial performances based on the D4(26.1) and D6 (394.4) ratios.

Table 2: Decision Matrix

Years	A1	A2	A3	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	D1	D2	D3	D4	D5	D6
2008	168.1	136.8	13.9	52.6	47.4	128.3	28.3	22	342.4	54.9	5.4	4.6	1.1	15.3	7	12.5	21.7	7.5	385
2009	163.2	128	20.1	51.6	48.4	138.6	30.01	19.8	277.2	28.3	5	3.9	1	7.2	3.1	7.5	18.4	2.8	233.6
2010	170.4	144.3	26.3	55	45	128.2	32.4	27.7	230	19.6	5.1	3.3	0.9	5.1	2.2	4	15.1	2.1	164.6
2011	166.1	132.8	25.9	63.1	36.9	84.6	35.3	27.4	210.1	34.6	4.5	2.6	0.9	10.6	4.4	10.2	26.1	5.2	17.9
2012	150.7	111.7	15.7	62	38	82.3	34.4	27.2	212	28.6	4.6	2.8	0.9	11.9	3	6.4	18.4	4.5	394.4
2013	139.2	111.5	20.3	66.1	33.9	80.2	36	29.4	216.1	28.9	5.1	1.9	0.8	7.5	1.2	6.5	18.6	2.1	184
2014	125.6	97.1	17.1	68.2	31.8	66.7	36	30.7	172.6	33.3	4.6	3	0.9	7.1	1.1	7.5	15	0.9	169
2015	126.5	96.8	15.2	68.6	31.4	32.5	38.9	29.7	205.1	28.9	4.8	3	0.9	8	2.3	8.3	17.1	2.7	267.1
2016	109.9	79.1	13.4	71.2	28.8	57.3	41.8	29.4	217	21.6	5.2	2.7	0.8	0.6	1.2	5.5	13.7	1.6	87.2

The formula (3) was used to prepare the Weighted Decision Matrix which is the second step of the analysis process. Table 3 shows the weighted decision test data.

Table 3. Weighted Decision Matrix

Years	A1	A2	A3	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	D1	D2	D3	D4	D5	D6
2008	.023	.035	.01	.01	.03	.019	.013	.02	.015	.04	.026	.01	.02	.02	.03	.04	.02	.03	.025
2009	.022	.033	.02	.01	.03	.02	.014	.01	.012	.02	.024	.008	.01	.01	.01	.02	.02	.01	.015
2010	.023	.037	.02	.01	.03	.019	.015	.02	.01	.01	.024	.007	.01	.01	.01	.01	.01	.01	.011
2011	.022	.034	.02	.01	.02	.012	.016	.02	.009	.02	.021	.005	.01	.02	.02	.03	.02	.02	.001
2012	.02	.029	.01	.01	.03	.012	.016	.02	.009	.02	.022	.006	.01	.02	.01	.02	.02	.02	.026
2013	.019	.029	.02	.01	.02	.012	.016	.02	.009	.02	.024	.004	.01	.01	0	.02	.02	.01	.012
2014	.017	.025	.01	.02	.02	.01	.016	.02	.007	.02	.022	.006	.01	.01	0	.02	.01	0	.011
2015	.017	.025	.01	.02	.02	.005	.018	.02	.009	.02	.023	.006	.01	.01	.01	.03	.02	.01	.018
2016	.015	.02	.01	.02	.02	.008	.019	.02	.009	.02	.025	.006	.01	0	0	.02	.01	.01	.006

To determine the concordance matrix, the concordance and discordance sets were created using the formula (4) and formula (5). The following concordance matrix was obtained using the formula (6) (Table 4).

Table 4. Concordance Matrix

YEARS	2008	2009	2010	2011	2012	2013	2014	2015	2016
2008	NA	0.728	0.8	0.9	0.9	0.95	0.95	0.95	1
2009	0.272	NA	0.73	0.48	0.79	0.72	0.93	0.77	0.93
2010	0.2	0.27	NA	0.62	0.57	0.72	0.771	0.63	0.788
2011	0.101	0.522	0.42	NA	0.57	0.852	0.862	0.86	0.832
2012	0.098	0.259	0.47	0.48	NA	0.657	0.788	0.77	0.9
2013	0.05	0.28	0.4	0.15	0.34	NA	0.798	0.69	0.88
2014	0.05	0.142	0.27	0.18	0.32	0.25	NA	0.48	0.75
2015	0.05	0.229	0.41	0.18	0.27	0.379	0.58	NA	0.798
2016	0	0.07	0.21	0.17	0.1	0.259	0.25	0.2	NA

The Discordance Matrix is obtained using the formula (7) as shown in Table 5.

Table 5. Discordance Matrix

YEARS	2008	2009	2010	2011	2012	2013	2014	2015	2016
2008	NA	0.257	0.42	0.43	0.08	0.231	0.094	0.05	0
2009	1	NA	0.51	0.75	1	0.048	0.322	0.15	0.072
2010	1	1	NA	1	1	0.897	0.872	0.92	0.271
2011	1	1	0.52	NA	1	0.795	0.521	1	0.285
2012	1	0.78	0.61	0.46	NA	0.287	0.211	0.68	0.14
2013	1	1	1	1	1	NA	0.592	0.78	0.169
2014	1	1	1	1	1	1	NA	1	0.334
2015	1	1	1	0.68	1	1	0.628	NA	0.307
2016	1	1	1	1	1	1	1	1	NA

To determine the superiority of the alternatives over each other, the Total Superiority Matrix was obtained using the formula (8) and formula (9) as shown in Table 6.

Table 6. Total Superiority Matrix

YEARS	Net Concordance Superiority	Net Discordance Superiority	Concordance Rank	Discordance Rank	Average Rank
2008	6.358	-6.4340138	1	1	1
2009	3.123	-3.1806467	2	2	2
2010	0.853	0.903751	4	5	5
2011	1.876	-0.1953737	3	4	3
2012	0.549	-2.919361	5	3	4
2013	-1.196	1.2858004	6	7	6.5
2014	-3.488	3.0940973	8	8	8
2015	-2.458	1.0241587	7	6	6.5
2016	-5.617	6.4215878	9	9	9

As seen in the Total Superiority Matrix, the alternatives were sorted, and number 1 represents the year showing the best performance while number 9 represents the year showing the worst performance (Table 6).

Conclusion and Recommendations

As a result of the study, when the financial performances of the hospital services subsector covering the years 2008-2016 were examined based on the data and ratios used, it was seen that there were fluctuations in the sector. In the light of the data obtained, it can be said that the hospital services subsector showed the greatest financial performance in 2008 while the poorest performance was observed in 2016. When examined based on ratio, it was seen that the hospital services subsector showed the best performance in 2010 based on the liquidity ratios compared to the other years. 2010 was the year with the best cash flow performance compared to the other years. 2009 was the year with the highest equity utilization and the lowest sectoral risk in the hospital services subsector. In 2009, utilization of equity was preferred rather than foreign resource utilization.

Besides the fluctuations yearly in stock utilization, the most effective year was 2008. In terms of profitability, the best performance with the ratio of the Gross Sales to the Net Sales was seen in 2011 while the best performance with the ratio of the Earnings Before Interest and Tax to the Interest Expenses was seen in 2012. Given all the ratios showing the profitability performance, the best year was 2008 compared to the other years.

Consequently, the best performance was seen in 2008 based on four main ratios and nine ratios in total. Significant differences may occur in the financial performance results if the method, ratios, and weights used in the study change. In this respect, using different methods, techniques, ratios, and weights may be the subject of a new study.

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