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FINANCIAL PERFORMANCE ANALYSIS WITH TOPSIS TECHNIQUE: A CASE STUDY OF PUBLIC UNIVERSITY HOSPITALS IN TURKEY[1]

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ABSTRACT

Financial performance of public university hospitals is frequently discussed today and an overall analysis is required because data resources of hospitals are limited and their specific structures make financial performance assessments difficult. In this respect, the present study carried out a performance analysis using TOPSIS technique in order to help decision makers in the health care system to make better decisions. The study examined the financial performances of 27 public university hospitals which were available in Audit Reports of the Turkish Court of Accounts between the years 2014 and 2015, considering eight financial ratios. As a result, the ranking of hospitals having the best and the worst performance changed dramatically each year. However, it is seen that Atatürk University Hospital remained among those hospitals with the highest three performances hospitals whereas Hacettepe University Hospital had one of the lowest three performances during the study period.

Keywords: *Public University Hospitals, Financial Performance, Financial Analysis of Health Organizations, TOPSIS*

JEL Classification*: I11, I18, C44*

TOPSIS TEKNİĞİ İLE FİNANSAL PERFORMANS ANALİZİ: TÜRKİYE'DEKİ DEVLET ÜNİVERSİTESİ HASTANELERİNİN ÖRNEK BİR İNCELEMESİ

ÖZ

Devlet üniversitesi hastanelerinin finansal performansı günümüzde sıklıkla tartışılmakla birlikte hastanelerle ilgili veri kaynaklarının kısıtlı olması ve özellikli yapılarının finansal performans değerlendirmesini zorlaştırılması genel bir analiz yapmayı gerektirmektedir. Bu bağlamda, bu

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çalışmada sağlık sistemi karar vericilerine daha iyi karar vermede yardımcı olmak amacıyla TOPSIS yöntemini kullanarak bir performans analizi gerçekleştirilmiştir. Bu çalışmada, Sayıştay Denetim raporlarında yer alan 27 Devlet üniversitesi hastanesinin 2014-2015 yılları arasında finansal performansları, sekiz oran göz önünde bulundurularak incelenmiştir. Sonuç olarak, en yüksek ve en düşük performansı gösteren üniversite hastanelerinin sıralaması yıllar itibariyle büyük ölçüde değişiklik göstermektedir. Fakat çalışma süresi boyunca, Atatürk Üniversite Hastanesi en yüksek performansa sahip üç hastane arasındayken Hacettepe Üniversite Hastanesinin en düşük performansa sahip üç hastane arasında olduğu tespit edilmiştir.

Anahtar Kelimeler: *Devlet Üniversitesi Hastaneleri, Finansal Performans, Sağlık İşletmelerinde Finansal Analiz, TOPSIS*

JEL Sınıflandırması: *I11, I18, C44*

1. INTRODUCTION

Health care services are among the most important indicators of development in socio-economic terms. It is an approved fact that health care services includes not only the responsibility to preserve and improve people's health but also to protect individuals from financial risks to offer treatment when confront with any disease (Öztürk & Uçan, 2017). Therefore, the health care industry is one of the fields that is often intervened by the public sector. In Turkey, public health care services at different organizations and institutions offer various health care levels of based on the scope of diagnosis, curative and preventive care services. Primary and preventive health care institutions (first health care level) are family medicine centers, secondary health care level institutions are public hospitals and third health care level institutions are hospitals under the Ministry of Health and university hospitals. The fact that university hospitals are both training and research institutions where investigation on treatment cases requiring special knowledge and skills are conducted. Therefore, it distinguishes them from other hospitals and brings into attention the need for studying their financial sustainability.

The first prerequisite for financial sustainability is to balance income and expenses of institute or organization. The amount of revenues generated and the average cost per patient by university hospitals in 2009 were 2.962 million TL and 179 TL respectively. In 2014 with an increase of 134%, the amount of revenue generated went up to 6.944 million TL and the average costs per patient reached 180 TL with a 0.5% increase. Among the 2nd health care level, 3rd health care level university and private hospitals which are offering health care services, the highest average costs belong to university hospitals. Some of the reasons underlying the high average cost at university hospitals may be listed as a) the complicated structure of the health care services offered at these institutions; b) the high number of the skilled labor

due to being an educational institution; c) the dramatic increase in the number of patient visits to university hospitals and the fixed rate policy; and d) bundle pricing that have been used in university hospitals for the last 9 years (Gülşen & Yıldıran, 2017).

It is seen that recently the number of studies carried out on university hospitals has been on a gradual rise in Turkey. Studies concerning the financial structures of hospitals have revealed different findings on the financial activities and problems of hospitals. It has been found that internal and external factors are effecting the financial sustainability at university hospitals. The most significant external factor is the pay-back system and pricing, on the other hand the major internal factor is the inefficient use of staff, equipment and medical technology (Yiğit & Yiğit, 2016). Similarly, it is stated that the pay-back system and Health Implementation Communiqué (SUT)[2] affect the financial structure of university hospitals negatively and that paying for some services and consumables that are not included in the SUT by the hospital revolving fund instead of Social Security Institutions (SSI) brings along an additional burden on the financial structure (Gülşen & Yıldıran, 2017). It has been found that the debts of university hospitals increase constantly as a natural result of all the above-mentioned factors (Türkmen, 2016).

University hospitals have a pivotal role in the health care system as they offer medical training, raise academicians, are the centers of scientific research and provide continuous health care services. This requires health policy implementers to act highly responsibly when making decisions. Thus, in order to implement accurate health care policies, financial performance of university hospitals must be followed carefully. In this respect, the financial performances in 2014 and 2015 of 27 public university hospitals included in the Reports of the Turkish Court of Audits were analyzed considering eight financial ratios. One of the frequently used methods in multiple criteria decision making (MCDM) problems, the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) was employed as the method of analyses. The distribution of the study is that in the first part of the study a review of the related literature is presented including an explanation of TOPSIS method used in performance assessment. This section is followed by displaying the implementation of TOPSIS methodology in public university hospitals and the finding are discussed; the study is concluded with discussion and recommendations.

2. LITERATURE

A performance assessment method, TOPSIS has a simple and understandable calculation technique, which allows for measuring the relative performance of each alternative over a single mathematical equation (Yeh, 2002). Since it makes decision making easiers, TOPSIS is used in many sectors.

[2] Health Implementation Communiqué abbreviated as SUT (Turkish translation is "Sağlık Uygulama Tebliği").

Currently, to my best knowledge none study in which TOPSIS analysis is used to evaluate public university hospitals; therefore, this section of the study includes examples of studies that used TOPSIS analysis in different fields in Turkey.

In order to develop a model to determine the performance of airline companies Akkaya (2004) has used financial and non-financial performance data of 2002 and carried out a grey relational analysis and TOPSIS analysis. As a result of the analyses, the initial 63 ratios specified for performance assessment were grouped and decreased to 13 ratios and it was recommended that the study should be repeated with different companies. In their study, Ömürbek et al. (2013) used the financial data obtained from the statements of the financial position and performance charts pertaining to 2012 of an airline transport company (ABC) operating in BIST and an airline transport company (XYZ) operating in Frankfurt Stock Exchange and made an evaluation of financial performances of both companies for the given year. Akgün & Soy Temür (2013) used the TOPSIS method to evaluate the 6-year (2010-2015) financial performance of 2 airline transport companies in the İstanbul Stock Exchange transportation index.

In their study on the evaluation of the performance of economy in Turkey, Eleren & Karagül (2008) determined a single performance score for each year with reference to 7 fundamental economic indicators within the 1986-2006 period using TOPSIS. They concluded that the best economic performance occurred in 1986 while the worst performance was seen in 1999 and they tried to reveal the performance changes in economy.

The study carried out on the banking sector in Turkey, Demireli (2010) examined the performances of state-owned banks operating in Turkey comparatively year by year and showed that common state-owned banks working nationwide are effected by national and global crises, their performance scores fluctuate constantly depending on foreign data and that no noticeable improvement has been made in banking sector. In their study on financial industry, Yayar & Baykara (2012) measured the activities and efficiency of participation banks between 2005 and 2011 using TOPSIS technique. Ege, Topaloğlu & Özyamanoğlu (2013) analyzed financial performance with TOPSIS method under 9 criteria while studying the relation between the financial performance and institutional administration scores of 18 companies listed in the Institutional Administration Index. In the study carried out by Taşabat, Cinemre & Şen, (2015) financial performances of the deposit banks operating in the Turkish Banking Industry in 2013 were evaluated by weighting separately with three different weighting techniques known as "equal weight, scoring and Saaty's method" of WSA, MAPPAC, ORESTE, PROMETHEE, VIKOR, TOPSIS and ELECTRE from the MCDM methods. Günay & Kaya (2017) aimed to compare the financial performances pertaining to 2014-2015 period of the brokerage firms traded in Borsa İstanbul as of 2014 and 2015 using ELECTRE, ORESTE and TOPSIS methods from the MCDM making methods and with the help of eleven financial ratios chosen. As a result of the analyses conducted in 2014 and 2015, similar

results were obtained for both years in the study. The analysis has carried out in the study has showed that all the methods employed produce considerable similar results and that they could be used simultaneously.

As for the tourism industry, Yükçü and Atağan (2010) obtained a performance ranking with 4 profitability ratios pertaining to 3 hotels. Ergül (2014) has evaluated the financial performances of 7 companies operating in BIST tourism industry under 11 different criteria using ELECTRE and TOPSIS methods.

Uygurtürk & Korkmaz (2012) used TOPSIS method to evaluate the financial performance of 13 key metal industry companies traded on the exchange with their 2006-2010 financial statements. In order to determine the performance of Turkish manufacturing industry, Yalçın, Bayrakdaroğlu & Kahraman (2012) developed an analytical approach which takes financial ratios as the criteria. In this analytical approach, criteria weights were determined with fuzzy AHP method, firms in the industry were sorted using both TOPSIS and VIKOR methods and the results were presented comparatively. While choosing the performance criteria, both account based ratios and value based modern financial performance measurements were utilized. In another study, Bakırcı, Shiraz & Sattary (2014) carried out financial performance analysis for 14 firms in the traded Iron Steel Metal Key Industry for the years 2009-2011 using the indicators obtained from the firms' financial statements and data envelopment analysis. They used the Data Envelopment Super Activity and TOPSIS methods to rank the firms whose relative activity levels were found according to the data envelopment analysis within themselves. Another recent study carried out by Gümüş et al. (2016) in the metal goods industry have examined 27 firms and have analyzed their 2014-2015 performance using TOPSIS method. As result of the performance analysis has conducted over 11 financial ratios, it was found that no major change occurred in the order by years.

Akyüz & Kaya (2013) examined the performance of life/pension and non-life insurance companies between 2007 and 2011 using TOPSIS. With ten financial ratios as their criteria. The results of the analysis showed that the most successful year for non-life insurance sector 2007 whereas it was 2008 for life/pension sector. In contrast, the most unsuccessful year for non-life insurance sector occurred as 2008 while life/pension sector had its most unsuccessful year in 2009. In their study, İşseveroğlu & Sezer (2015) ranked the performances of 16 individual pension companies operating in Turkey between 2008 and 2012 using TOPSIS method. As a result of the analysis, activity levels of the individual pension companies were examined and performance ranking results were revealed. Aytekin & Karamaşa (2017) analyzed the performances of six insurance companies listed in BIST using financial ratios pertaining to the 2011-2015 period. As a results of the financial applications and the review of the related data; the ratios of currency, cash, debt, net profit margin, return on equity and return on

investment were specified as the criteria. To this end, weights of criteria related to financial ratios were obtained using fuzzy Shannon's entropy based on α-level set in the first place. Following this, firms' final rankings were determined with fuzzy TOPSIS method.

TOPSIS method, which is used in a variety of sectors as a performance evaluation method as seen above, was used in the present study to evaluate the financial performances of 27 public university hospitals in the years 2014 and 2015. There is a major difference in the ranking of successful and unsuccessful hospitals in general; it was that the ratios used in the analyses deteriorated gradually and the worst performance came out in the year 2015. This study is considered to provide an insight for the health policy decision makers about the conditions of public university hospitals.

3. METHODOLOGY AND FINDINGS

3.1TOPSIS

TOPSIS is a useful MDCM technique in dealing with real-world problems (Yoon & Hwang, 1985). It was first offered by Hwang and Yoon (1981). The technique suggests that the best alternative would be the one that is the nearest to the positive ideal solution and the farthest from the negative ideal solution (Benitez, Martin, and Roman, 2007). The positive ideal solution maximizes the benefit criteria while minimizing the cost criteria, whereas the negative ideal solution is the one that maximizes the cost criteria and minimizes the benefit criteria (Wang & Elhag, 2006). In conclusion, all the best values in the criteria make up the positive ideal solution whereas the negative ideal solution includes the worst values attainable of criteria (Wang, 2008). In this paper TOPSIS method is used to analyze the performance of public university hospitals.

The steps of the method are described below (Yoon & Wang 1985; Wang, 2007; Shih, Jhy, & Stanley, 2007).

Step 1. Decision Matrix: The first step in the application of the method is the determination of a decision matrix. The decision matrix contains the decision points to be ranked in the rows and the evaluation factors to be used in the decision making in the columns. The decision matrix is shown as follows:

$$D_{ij} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{22} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad \text{i:1,...,m} \quad \text{j=1,…,n} \qquad (1)$$

In decision matrix D_{ij}, m is the number of decision points, n is the number of evaluation factors.

Step 2. Normalized Decision Matrix: In the second step, decision matrix is normalized via equation (2)

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

Normalized decision matrix R is formed as follows:

$$R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{22} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix} \quad (3)$$

Step 3. Weighted Normalized Decision Matrix: The normalization decision matrix is formed by the multiplication of the weight of the evaluation criteria and the respective values of the normalization decision matrix it can be seen below:

$$\sum_{j=1}^{n} w_j = 1$$

$$v_{ij} = w_i * r_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_2 r_{1n} \\ w_2 r_{22} & w_2 r_{22} & \dots & w_2 r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_2 r_{mn} \end{bmatrix} \quad \text{j=1,2,3….J;} \qquad \text{i:1,2,3…..n} \quad (4)$$

w_j= Weight of the evaluation criteria which shows importance level

v_{ij}= Weighted normalized decision matrix

Step 4. Positive and Negative Ideal Solution: Although positive ideal solution (PIS) is the best performance of the weighted normalized decision matrix, negative ideal solution (NIS) is the worst performance of the weighted normalized decision matrix (Ustasüleyman, 2009). PIS and NIS are determined:

$$A^* = \{(maximum_i v_{ij} | j \in J), (minimum_i v_{ij} \mid j \in J')\} \quad (5)$$

$$A^* = \{v_1^*;\ v_2^*;\ v_3^*; \dots v_n^*\} \quad (6)$$

$$A^- = \{(minimum_i v_{ij} | j \in J), (maximum_i v_{ij} \mid j \in J')\} \quad (7)$$

$$A^- = \{v_1^-;\ v_2^-;\ v_3^-; \dots v_n^-\} \quad (8)$$

A^* =Positive ideal solution

A^- =Negative ideal solution

Step 5. Distance of Each Alternative from PIS and NIS: TOPSIS is a method based on distance so it determines the best solution is the closest position to PIS and worst solution is the farthest position to NIS. The distances to the positive and negative ideal solution of each alternative are calculated by the Euclidean distance approach (equations 9 and 10), using the values in the weighted normalize decision matrix and the values in the positive and negative ideal solution clusters. (Gümüş, et al., 2016).

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2} \qquad \text{j=1, 2…..J} \tag{9}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2} \qquad \text{i=1, 2…..J} \tag{10}$$

S_i^* = Distance of each alternative from PIS

S_i^- = Distance of each alternative from NIS

Step 6. Closeness Coefficient: In the final stage, the closeness coefficient of each alternative is calculated by using equation 11:

$$C_i = \frac{S_i^-}{S_i^- + S_i^*};\ 0 \le C_i \le 1 \tag{11}$$

C_i = The closeness coefficient of each alternative

Then, C_i the ranking of alternatives is determined by comparing values (Ertuğrul & Karakaşoğlu, 2009). The ideal alternative is the one with the highest relative closeness value and should be considered as the best alternative in terms of the related multi-criteria decision making problem.

3.2FINANCIAL RATIOS USED IN ANALYSE

The multi criteria decision making problem defined, aims to evaluate business performances of 27 public university hospitals among all others using their balance sheet and income statement items pertaining to the years 2014 and 2015. Within this scope, financial structure obtain from the financial statements, and 8 different ratios chosen from the activity, profitability and financial structure ratios are included in the evaluation as the performance criteria. The ratios used in the study are presented in Table 1. The first reason for mainly choosing activity and profitability ratios is the fact that TOPSIS method is suitable with the conditions when only “the greatest value is the best one” or “the smallest value is the best one”.

Hospitals are organizations that operate for 24 hours treating emergency patients and providing services to inpatients. For this reason, pharmaceuticals and varying types, medical materials and other supplementary materials must be stored adequately in the hospitals so as to interrupt the service flow**.** For this reason, turnover ratio is included in order to increase the weight of stocks over performance.

Due to their indebtedness, university hospitals have negative equity. Profitability ratios such as *return on equity* and activity ratios such as *equity turnover* are not included in the study because negative equity disturbs to results.

Table 1: Financial Ratios and Explanations

	Ratio	Name	Explanations	Ideal Value
R1	Activity	Receivables Turnover	Net Sales / Short-Term Trade Receivables	max
R2	Activity	Inventory Turnover	COGS / Inventory	max
R3	Profitability	Net Profit Margin	Net Profit or Loss / Net Sales	max
R4	Profitability	Gross Profit Margin	Gross profit/ Net Sales	max
R5	Profitability	Operating Profit Margin	Operating Profit / Net Sales	max
R6	Activity	Current Asset Turnover Ratio	Net Sales / Current Assets	max
R7	Financial Structure	Short-Term Liabilities to Total Liabilities and Equity	Short-Term Liabilities/(Short-term Liabilities+ Long-term Liabilities+ Equity)	min
R8	Profitability	COGS to Net Sales	COGS / Net Sales	min

3.3EMPIRICAL RESULTS

In the present study, public universities that have hospitals among those listed in the Public Administration Audit Reports of the Court of Accounts are included in evaluations. Since public university hospitals are businesses with revolving funds, the income statements and balance sheets pertaining to the revolving fund business included in the audit reports are considered to reflect the financial situation of the hospitals. In the audit reports, 57 universities have hospitals. Among these 57 hospitals, 27 are included within in the study due to data restrictions in the balance sheets and income statements. The names of the universities used in study and their abbreviations, the ones excluded from the study and the reasons for exclusion are summarized in the Appendix 1-2.

Balance sheet and income statements are obtained from Audit Reports of the Turkish Court of Accounts for the years 2014 and 2015 and then Table 2 is formed. The general financial structure of hospitals can be seen below.

Table 2: Overview of Public University Hospitals Financial Statements

	2014	2015
Total Assets	1,834,639,737.51	1,895,337,744.49
Total Assets Liabilities	2,609,094,739.17	3,188,555,094.33
Equity	-774,533,887.84	-1,291,350,434.14
Net Sales	4,870,669,895.28	5,355,965,996.17
Net Profit or Loss	-354,669,522.52	-571,445,969.11

Table 2 indicates that total liabilities of hospital more than their total assets. Also public university hospitals have had negative equity. Although there has been an increase in net sales, it is seen that the net loss has been increasing gradually between the years 2014 and 2015.

For TOPSIS analysis, financial ratios were calculated. Later, the decision matrices are established using these ratios exactly, which can be seen below in order by years[3].

Table 3: Decision Matrix for 2014[4]

	R1	R2	R3	R4	R5	R6	R7	R8
AD	4.908	5.569	-0.119	0.240	-0.122	2.835	1.872	0.760
AFYN	5.226	9.469	-0.114	0.302	-0.108	3.226	1.982	0.698
AKNZ	4.169	18.091	-0.026	0.337	-0.017	3.337	1.936	0.663
ATTRK	3.146	40.347	-0.006	0.362	-0.024	2.031	0.203	0.638
ÇNNKL	3.265	10.673	-0.079	-0.021	-0.079	2.454	0.943	1.021
DCL	4.599	12.615	-0.087	0.524	-0.084	3.152	1.150	0.476
DKZ	6.138	12.302	-0.131	0.080	-0.110	3.547	2.721	0.920
EGE	6.287	5.240	-0.136	0.335	-0.122	3.156	1.743	0.665
FRT	4.415	8.815	0.026	0.170	0.023	2.378	0.573	0.830
GZ	3.088	5.696	-0.030	0.565	-0.033	2.161	1.553	0.435
GZNTP	5.889	11.953	-0.103	0.257	-0.106	4.251	1.346	0.743
HCTTP	1.530	22.017	-0.229	-0.117	-0.182	1.380	1.476	1.117
HRRN	6.019	19.064	-0.153	0.277	-0.152	4.104	1.414	0.723
INN	8.392	14.890	-0.011	0.310	-0.013	5.600	1.510	0.690
ISTNBL	4.235	8.380	-0.010	0.115	-0.032	1.859	1.254	0.885
KMSTC	3.123	5.838	-0.034	0.316	-0.030	2.116	0.591	0.684
KT	3.888	6.318	-0.136	0.334	-0.136	2.532	1.515	0.666
KRKL	5.028	10.254	0.052	0.567	0.047	3.101	1.148	0.433
KCL	13.092	10.752	-0.216	0.263	-0.190	6.539	3.598	0.737
MRSN	3.760	2.740	-0.110	0.380	-0.114	1.861	1.686	0.620
ONDKZM	7.913	8.580	-0.027	0.322	-0.049	3.704	1.190	0.678
OSMNGZI	4.504	6.696	-0.003	0.376	-0.010	2.869	0.972	0.624
PMKKL	6.483	5.709	0.018	0.374	0.060	3.658	0.982	0.626
SCK	4.682	10.166	-0.069	0.290	-0.065	2.698	1.470	0.710
TRY	8.233	8.280	-0.192	0.273	-0.188	3.938	2.861	0.727
ULDG	6.098	5.387	0.012	0.422	0.010	3.315	1.039	0.578
YZNCYL	4.745	15.893	-0.113	0.570	-0.106	3.732	1.338	0.430
Mean	**5.291**	**11.175**	**-0.075**	**0.305**	**-0.072**	**3.168**	**1.484**	**0.695**
Std. Dev.	**2.258**	**7.482**	**0.076**	**0.163**	**0.070**	**1.126**	**0.715**	**0.163**

[3] The values in Table 3-4 show their own values.
[4] Universities is placed in the decision matrix by shortening their names according to the alphabetical order. The expansions of abbreviations are included in Appendix 2.

Table 4: Decision Matrix for 2015

	R1	R2	R3	R4	R5	R6	R7	R8
AD	5.661	15.097	-0.260	0.133	-0.261	3.741	2.993	0.867
AFYN	5.978	8.625	-0.076	0.323	-0.068	3.104	2.028	0.677
AKNZ	4.007	19.924	-0.181	0.227	-0.194	3.131	2.553	0.773
ATTRK	4.424	28.406	0.045	0.623	0.019	1.791	0.122	0.377
ÇNNKL	3.434	2.832	-0.006	0.143	-0.015	1.452	0.893	0.857
DCL	9.241	20.994	0.072	0.486	0.067	4.771	0.825	0.514
DKZ	6.967	13.360	-0.138	0.050	-0.134	3.443	3.084	0.950
EGE	6.336	5.666	-0.213	0.285	-0.190	2.827	2.227	0.715
FRT	5.217	13.085	0.023	0.164	0.016	2.956	0.614	0.836
GZ	2.941	6.018	0.101	0.474	-0.034	2.009	1.269	0.526
GZNTP	7.769	14.768	-0.061	0.304	-0.064	4.833	1.554	0.696
HCTTP	5.784	22.183	-0.304	-0.115	-0.212	3.905	2.216	1.115
HRRN	4.090	11.483	-0.092	0.344	-0.093	2.854	1.546	0.656
INN	8.171	37.223	-0.170	0.161	-0.173	6.056	2.595	0.839
ISTNBL	4.045	14.468	-0.165	-0.011	-0.167	1.752	1.533	1.011
KMSTC	3.498	7.467	-0.146	0.193	-0.135	2.265	0.962	0.807
KT	4.078	5.769	-0.144	0.294	-0.145	2.379	1.796	0.706
KRKL	5.863	11.837	-0.092	0.414	-0.106	3.651	2.016	0.586
KCL	16.680	44.174	-0.099	0.348	-0.094	8.816	4.997	0.652
MRSN	4.570	3.019	-0.202	0.329	-0.129	1.977	1.972	0.671
ONDKZM	8.651	10.540	-0.103	0.254	-0.107	3.668	1.486	0.746
OSMNGZI	5.343	6.270	-0.088	0.298	-0.092	2.873	1.220	0.702
PMKKL	6.739	4.864	-0.006	0.310	0.003	3.064	1.002	0.690
SCK	6.496	7.012	-0.197	0.131	-0.172	3.552	2.857	0.869
TRY	9.522	5.252	-0.181	0.387	-0.107	3.556	3.268	0.613
ULDG	6.145	5.322	-0.020	0.381	-0.024	2.999	1.093	0.619
YZNCYL	4.657	29.150	-0.069	0.379	-0.071	3.834	1.561	0.621
Mean	**6.159**	**13.882**	**-0.103**	**0.271**	**-0.099**	**3.380**	**1.862**	**0.729**
Std. Dev.	**2.759**	**10.607**	**0.100**	**0.159**	**0.079**	**1.493**	**1.018**	**0.159**

When profitability ratios (R3, R4, R5, R8) are examined, it could be seen that public university hospitals have to deal with a problem of profitability and make losses. Profitability ratios (R3, R4, R5, R8) were at highest level in 2014 except from COGS / Net Sales (R8). An increase in the COGS to Net Sales (R8) ratio is undesirable because it shows that costs are on a gradual increase.

Short-Term Liabilities to Total Liabilities and Equity ratio (R7) indicates the debt structures of public university hospitals, it is found that the share of short term foreign resources increased gradually among all the resources and the three-year average came out as 1.8, which can be translated as hospitals are in debt for 1.8 times of their assets. In short, it is seen that hospitals are having great difficulty paying their short-term debts.

As for the examination of activity ratios (R1-R2-R6), inventory turnover (R2) is seen to increase in years. As institutions operating twenty-four hours, it is necessary for hospitals to always keep sufficient amounts of inventory to avoid any failure in health care services; however, financial difficulties make hospitals reduce their stocks. As one can understand from inventory turnover ratio, hospitals are trying to make inventory turnover as quick as possible. That is, in addition to disposing of the stocks in a shorter time in 2015 than 2014, a faster recovery of receivables is another noticeable finding.

In second step, decision matrix is normalized via *Equation 2* and normalized decision matrix is constructed like *Equation 3*. The normalization decision matrices for the years 2014-2015 are given in Appendix 3- 4. *In the third step*, each value of normalize decision matrix is weighted with a value such as w_j. The weighting process should be done according to factor importance. Likewise, financial ratios, the weights given by decisions makers also affect the ranking of the firms. In this study, all factors are weighted equally and weighted normalized decision matrixes can be seen in Appendix 5-6. *In forth step* we need to determine PIS and NIS for each year and it can be seen below:

For the year 2014

A^*= {0.055, 0.073, 0.012, 0.040, 0.014, 0.047, 0.003, 0.014}

A^-= {0.007, 0.005, -0.052, -0.008, -0.046, 0.010, 0.053, 0.038}

For the year 2015

A^*= {0.060, 0.061, 0.017, 0.048, 0.013, 0.058, 0.001, 0.012}

A^-= {0.011, 0.004, -0.051, -0.009, -0.050, 0.009, 0.057, 0.036}

The distance of each alternative from PIS and NIS are found in *step 5* and in *step 6* the closeness coefficient of each alternative is calculated as shown in Appendix 7. Final rankings of public university hospitals according to Ci values between years 2014-2015 are seen below in Table 4. In other words, after performance evaluation of the Turkish public university hospitals by taking 8 financial ratios into consideration, the order of the firms was found as in Table 4.

Table 5: Rankings of Public University Hospitals According to Ci Values between Years 2014-2015

	2014		**2015**	
	Ci	**Rank**	**Ci**	**Rank**
AD	0.334	23	0.249	27
AFYN	0.468	14	0.530	7
AKNZ	0.518	7	0.310	23
ATTRK	0.648	1	0.609	2
ÇNNKL	0.425	17	0.465	11
DCL	0.472	11	0.694	1
DKZ	0.309	25	0.325	21

	2014		2015	
EGE	0.346	21	0.302	24
FRT	0.533	6	0.535	4
GZ	0.478	10	0.531	6
GZNTP	0.417	18	0.515	9
HCTTP	0.276	27	0.277	25
HRRN	0.395	19	0.436	15
INN	0.593	3	0.452	12
ISTNBL	0.453	15	0.315	22
KCL	0.470	12	0.368	18
KMSTC	0.326	24	0.353	19
KRKL	0.604	2	0.451	13
KT	0.366	20	0.583	3
MRSN	0.341	22	0.332	20
ONDKZM	0.512	9	0.445	14
OSMNGZI	0.515	8	0.433	16
PMKKL	0.575	4	0.522	8
SCK	0.430	16	0.273	26
TRY	0.280	26	0.378	17
ULDG	0.547	5	0.512	10
YZNCYL	0.469	13	0.532	5

According to the results in Table 4, the top three hospitals with highest performance in 2014 are; Atatürk University Hospital, Kırıkkale University Hospital, İnönü University Hospital respectively. In 2015, three best performance belongs to Dicle University Hospital, Atatürk University Hospital, Karadeniz Teknik University Hospital. In 2014, hospitals with the lowest performance are Dokuz Eylül University Hospital, Trakya University Hospital, Hacettepe University Hospital. In 2015 hospitals with lowest performance are Hacettepe University Hospital, Selçuk University Hospital, Adnan Menderes University Hospital.

It is found that Atatürk University Hospitals is ranked as the best three performance and Hacettepe University Hospital is ranked as the worst three performance for these 2 years. In general, it has been determined that there are very large changes in the ranking.

4. CONCLUSION AND DISCUSSION

Health care reforms have been gaining importance in Turkey like all around the world and governments are putting intensive effort to improve their health care systems and meet the requirements of their citizens. These reforms, attempted with the conscious to have healthy generations, bring about increased costs as well. Many countries are questioning the sustainability of their health care systems.

Similarly in Turkey, health reforms that have been made since 2003 have caused increases in health expenditures and one of the mostly affected institutions by these reform changes have been public university hospitals. Public university hospitals are facing heavy cost restrictions under the current economic conditions and they are struggling to survive. As a very critical part of the health care system, university hospitals have a major role in raising healthy generations in a country since they provide medical education, train academicians, serve as research centers and offer continuous health care services. Therefore, health policy makers have to follow the performance of university hospitals with utmost care.

The best way to observe financial performance is to follow the financial ratios obtained from financial statements regularly. In the present study, 27 public universities having hospitals are included in analyses and their 2-year performance analyses based on the years 2014-2015 are carried out using TOPSIS method. The method is applied to 8 financial ratios and the hospitals are ranked by performance in the given years.

There are some of limitations to the analysis. Firstly, financial tables of public university hospitals could not be reach directly in this study. As the public university hospitals are the organizations with revolving funds, the financial tables of the revolving fund administration are considered to reflect the financial status of the hospitals. The second limitation of study is that the fixed assets of university hospitals are not included in their financial tables. They are shown in the main financial statements of the university. For this reason, financial ratios including total assets or fixed assets cannot be included in the study. Thirdly, public university hospitals have negative equity, which makes it difficult to interpret the results.

According to the findings obtained, the hospital with the highest performance changes every year and significant differences are observed in the performance orders. It is remarkable that the performances of hospitals changed this much throughout years. For instance, Dicle University Hospital has the 13th best performance in ranking in 2014. It has best performance in 2015.

There is a dramatic changes in the performances of hospitals in following year. One of the reasons of these changes university public hospitals affected by Health Transformation Program since 2003, their financial positions has been deteriorating and Ministry of Health was transferred 55 million TL transferred to hospital as applied training support. Moreover, within the scope of the reimbursement system called Global Budget applied by the Ministry of Health to public hospitals, a similar protocol was signed with Hacettepe, Dicle and Ankara universities in 2015. With this protocol[5], the cost of health services they produced was calculated on the Medula system and a total revenue of 764 million TL was

[5] MEDULA system refers to integrated system that helps to collect electronical bills at perform reimbursement.

allocated to these three universities in 2015. After this revenue increase, Dicle University hospital had the best performance ranking in 2015. Hacettepe University hospital ranking only has increased 2 rang and has 25th performance ranking. It is noteworthy that the changes in the performance of the two universities signed by the protocol are not in the same level.

The analysis and findings are considered to be beneficial for health policy decision makers in analysing the conditions of public university hospitals. It is believed that the dramatic changes occurring in the performances of hospitals year by year must be studied as well. It is also considered that determining the characteristics of hospitals with the best and worst performances in further studies would be beneficial in making health care policies.

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APPENDIX

Appendix-1: Universities not Included in the Study

University Name	Reason
Abant İzzet Baysal	Hospital affiliated with the Public Hospitals Association in 2014
Adıyaman, Ankara, Bozok, Bülent Ecevit, Celal Bayar, Çukurova, Düzce, Erciyes, Erzincan, Hitit, İstanbul Medeniyet, Marmara, Mehmet Akif Ersoy, Mustafa Kemal, Namık Kemal, Necmettin Erbakan, Ordu, Recep Tayip Erdoğan, Süleyman Demirel	There is missing data problem for balance sheets
Ahi Evran	Hospital affiliated with the Public Hospitals Association in 2011
Anadolu	University is not included to the sample because its revolving fund's financial statements include the income and expenses of the Distant Training Program that program generates higher revenue than other units, and distorts the analysis results.
Balıkesir, Dumlupınar, Giresun, Kafkas	Hospitals do not have inventories
Cumhuriyet,	Financial Director is be assigned by Ministry of Health
Muğla Sıtkı Çoban, Sakarya	University have been taken over by the Ministry of Health since 2011

Appendix-2: Abbreviations of Public University Hospitals

University Hospitals	Abb.	University Hospitals	Abb.
Adnan Menderes University	AD	İnönü University Hospital	INN
Afyon University Hospital	AFYN	İstanbul University Hospital	ISTNBL
Akdeniz University Hospital	AKNZ	Karadeniz Teknik University Hospital	KT
Atatürk University Hospital	ATTRK	Kahramanmaraş Sütçü İmam University Hospital	KMSTC
Cumhuriyet University Hospital	CHRYT	Kırıkkale University Hospital	KRKL
Çanakkale Onsekiz Mart University Hospital	ÇNKKL	Kocaeli University Hospital	KCL
Dicle University Hospital	DCL	Mersin University Hospital	MRSN
Dokuz Eylül University Hospital	DKZ	On Dokuz Mayıs University Hospital	ONDKZM
Ege University Hospital	EGE	Eskişehir Osmangazi University Hospital	EOSMNGZ
Fırat University Hospital	FRT	Pamukkale University Hospital	PMKKL
Gazi University Hospital	GZ	Selçuk University Hospital	SCK
Gaziantep University Hospital	GZNTP	Trakya University Hospital	TRY
Hacettepe University Hospital	HCTTP	Uludağ University Hospital	ULDG
Harran University Hospital	HRRN	Yüzüncü Yıl University Hospital	YZNCYL

Appendix-3: Normalized Decision Matrix for 2014

	R1	R2	R3	R4	R5	R6	R7	R8
AD	0.164	0.080	-0.216	0.134	-0.236	0.163	0.219	0.205
AFYN	0.175	0.136	-0.208	0.169	-0.209	0.185	0.232	0.188
AKNZ	0.140	0.260	-0.048	0.189	-0.033	0.191	0.227	0.179
ATTRK	0.105	0.581	-0.011	0.203	-0.047	0.117	0.024	0.172
ÇNNKL	0.109	0.154	-0.143	-0.012	-0.153	0.141	0.111	0.275
DCL	0.154	0.182	-0.159	0.293	-0.164	0.181	0.135	0.128
DKZ	0.206	0.177	-0.238	0.045	-0.214	0.203	0.319	0.248
EGE	0.211	0.075	-0.247	0.187	-0.237	0.181	0.204	0.179
FRT	0.148	0.127	0.047	0.095	0.044	0.136	0.067	0.224
GZ	0.103	0.082	-0.054	0.316	-0.064	0.124	0.182	0.117
GZNTP	0.197	0.172	-0.187	0.144	-0.206	0.244	0.158	0.200
HCTTP	0.053	0.317	-0.417	-0.066	-0.352	0.079	0.173	0.301
HRRN	0.202	0.274	-0.278	0.155	-0.296	0.235	0.166	0.195
INN	0.281	0.214	-0.020	0.174	-0.024	0.321	0.177	0.186
ISTNBL	0.142	0.121	-0.019	0.064	-0.062	0.107	0.147	0.239
KMSTC	0.105	0.084	-0.061	0.177	-0.059	0.121	0.069	0.185
KT	0.130	0.091	-0.247	0.187	-0.265	0.145	0.178	0.180
KRKL	0.168	0.148	0.094	0.318	0.091	0.178	0.135	0.117
KCL	0.438	0.155	-0.394	0.147	-0.368	0.375	0.422	0.199
MRSN	0.126	0.039	-0.200	0.212	-0.220	0.107	0.198	0.167
ONDKZM	0.265	0.123	-0.049	0.180	-0.096	0.212	0.140	0.183
OSMNGZI	0.151	0.096	-0.006	0.210	-0.020	0.165	0.114	0.168
PMKKL	0.224	0.082	0.033	0.209	0.116	0.210	0.115	0.169
SCK	0.157	0.146	-0.126	0.162	-0.126	0.155	0.172	0.191
TRY	0.276	0.119	-0.348	0.153	-0.365	0.226	0.335	0.196
ULDG	0.204	0.078	0.022	0.236	0.020	0.190	0.122	0.156
YZNCYL	0.159	0.229	-0.205	0.319	-0.206	0.214	0.157	0.116

Appendix 4: Normalized Decision Matrix for 2015

	R1	R2	R3	R4	R5	R6	R7	R8
AD	0.162	0.167	-0.352	0.082	-0.399	0.195	0.273	0.224
AFYN	0.171	0.096	-0.103	0.199	-0.104	0.162	0.185	0.175
AKNZ	0.115	0.221	-0.245	0.140	-0.296	0.164	0.232	0.199
ATTRK	0.127	0.315	0.060	0.384	0.029	0.094	0.011	0.097
ÇNNKL	0.098	0.031	-0.008	0.088	-0.023	0.076	0.081	0.221
DCL	0.264	0.233	0.098	0.299	0.102	0.249	0.075	0.133
DKZ	0.199	0.148	-0.186	0.031	-0.204	0.180	0.281	0.245
EGE	0.181	0.063	-0.289	0.175	-0.290	0.148	0.203	0.185
FRT	0.149	0.145	0.031	0.101	0.025	0.154	0.056	0.216
GZ	0.084	0.067	0.137	0.292	-0.052	0.105	0.116	0.136
GZNTP	0.222	0.164	-0.083	0.188	-0.098	0.252	0.142	0.179
HCTTP	0.165	0.246	-0.412	-0.071	-0.324	0.204	0.202	0.288
HRRN	0.117	0.127	-0.125	0.212	-0.142	0.149	0.141	0.169
INN	0.234	0.413	-0.230	0.099	-0.265	0.316	0.236	0.216
ISTNBL	0.116	0.160	-0.223	-0.007	-0.255	0.092	0.140	0.261
KMSTC	0.100	0.083	-0.197	0.119	-0.206	0.118	0.088	0.208
KT	0.117	0.064	-0.195	0.181	-0.222	0.124	0.164	0.182
KRKL	0.168	0.131	-0.124	0.256	-0.161	0.191	0.184	0.151

	R1	R2	R3	R4	R5	R6	R7	R8
KCL	0.477	0.490	-0.134	0.214	-0.144	0.461	0.455	0.168
MRSN	0.131	0.033	-0.273	0.203	-0.196	0.103	0.180	0.173
ONDKZM	0.247	0.117	-0.139	0.156	-0.163	0.192	0.135	0.193
OSMNGZI	0.153	0.070	-0.120	0.184	-0.141	0.150	0.111	0.181
PMKKL	0.193	0.054	-0.007	0.191	0.004	0.160	0.091	0.178
SCK	0.186	0.078	-0.267	0.081	-0.263	0.186	0.260	0.224
TRY	0.272	0.058	-0.245	0.239	-0.163	0.186	0.298	0.158
ULDG	0.176	0.059	-0.027	0.235	-0.036	0.157	0.100	0.160
YZNCYL	0.133	0.323	-0.093	0.233	-0.108	0.200	0.142	0.160

Appendix-5: Weighted Normalized Decision Matrix for 2014

	R1	R2	R3	R4	R5	R6	R7	R8
AD	0.021	0.010	-0.027	0.017	-0.030	0.020	0.027	0.026
AFYN	0.022	0.017	-0.026	0.021	-0.026	0.023	0.029	0.024
AKNZ	0.017	0.033	-0.006	0.024	-0.004	0.024	0.028	0.022
ATTRK	0.013	0.073	-0.001	0.025	-0.006	0.015	0.003	0.022
ÇNNKL	0.014	0.019	-0.018	-0.001	-0.019	0.018	0.014	0.034
DCL	0.019	0.023	-0.020	0.037	-0.020	0.023	0.017	0.016
DKZ	0.026	0.022	-0.030	0.006	-0.027	0.025	0.040	0.031
EGE	0.026	0.009	-0.031	0.023	-0.030	0.023	0.026	0.022
FRT	0.018	0.016	0.006	0.012	0.006	0.017	0.008	0.028
GZ	0.013	0.010	-0.007	0.040	-0.008	0.015	0.023	0.015
GZNTP	0.025	0.022	-0.023	0.018	-0.026	0.030	0.020	0.025
HCTTP	0.007	0.040	-0.052	-0.008	-0.044	0.010	0.022	0.038
HRRN	0.025	0.034	-0.035	0.019	-0.037	0.029	0.021	0.024
INN	0.035	0.027	-0.002	0.022	-0.003	0.040	0.022	0.023
ISTNBL	0.018	0.015	-0.002	0.008	-0.008	0.013	0.018	0.030
KMSTC	0.013	0.011	-0.008	0.022	-0.007	0.015	0.009	0.023
KT	0.016	0.011	-0.031	0.023	-0.033	0.018	0.022	0.022
KRKL	0.021	0.018	0.012	0.040	0.011	0.022	0.017	0.015
KCL	0.055	0.019	-0.049	0.018	-0.046	0.047	0.053	0.025
MRSN	0.016	0.005	-0.025	0.027	-0.028	0.013	0.025	0.021
ONDKZM	0.033	0.015	-0.006	0.023	-0.012	0.027	0.017	0.023
OSMNGZI	0.019	0.012	-0.001	0.026	-0.002	0.021	0.014	0.021
PMKKL	0.028	0.010	0.004	0.026	0.014	0.026	0.014	0.021
SCK	0.020	0.018	-0.016	0.020	-0.016	0.019	0.022	0.024
TRY	0.034	0.015	-0.044	0.019	-0.046	0.028	0.042	0.025
ULDG	0.026	0.010	0.003	0.029	0.002	0.024	0.015	0.019
YZNCYL	0.020	0.029	-0.026	0.040	-0.026	0.027	0.020	0.014

Appendix-6: Weighted Normalized Decision Matrix for 2015

	R1	R2	R3	R4	R5	R6	R7	R8
AD	0.020	0.021	-0.044	0.010	-0.050	0.024	0.034	0.028
AFYN	0.021	0.012	-0.013	0.025	-0.013	0.020	0.023	0.022
AKNZ	0.014	0.028	-0.031	0.018	-0.037	0.020	0.029	0.025
ATTRK	0.016	0.039	0.008	0.048	0.004	0.012	0.001	0.012
ÇNNKL	0.012	0.004	-0.001	0.011	-0.003	0.009	0.010	0.028

	R1	R2	R3	R4	R5	R6	R7	R8
DCL	0.033	0.029	0.012	0.037	0.013	0.031	0.009	0.017
DKZ	0.025	0.019	-0.023	0.004	-0.026	0.022	0.035	0.031
EGE	0.023	0.008	-0.036	0.022	-0.036	0.018	0.025	0.023
FRT	0.019	0.018	0.004	0.013	0.003	0.019	0.007	0.027
GZ	0.011	0.008	0.017	0.037	-0.007	0.013	0.014	0.017
GZNTP	0.028	0.020	-0.010	0.023	-0.012	0.032	0.018	0.022
HCTTP	0.021	0.031	-0.051	-0.009	-0.040	0.026	0.025	0.036
HRRN	0.015	0.016	-0.016	0.027	-0.018	0.019	0.018	0.021
INN	0.029	0.052	-0.029	0.012	-0.033	0.040	0.030	0.027
ISTNBL	0.014	0.020	-0.028	-0.001	-0.032	0.011	0.017	0.033
KMSTC	0.013	0.010	-0.025	0.015	-0.026	0.015	0.011	0.026
KT	0.015	0.008	-0.024	0.023	-0.028	0.016	0.020	0.023
KRKL	0.021	0.016	-0.016	0.032	-0.020	0.024	0.023	0.019
KCL	0.060	0.061	-0.017	0.027	-0.018	0.058	0.057	0.021
MRSN	0.016	0.004	-0.034	0.025	-0.025	0.013	0.022	0.022
ONDKZM	0.031	0.015	-0.017	0.020	-0.020	0.024	0.017	0.024
OSMNGZI	0.019	0.009	-0.015	0.023	-0.018	0.019	0.014	0.023
PMKKL	0.024	0.007	-0.001	0.024	0.001	0.020	0.011	0.022
SCK	0.023	0.010	-0.033	0.010	-0.033	0.023	0.033	0.028
TRY	0.034	0.007	-0.031	0.030	-0.020	0.023	0.037	0.020
ULDG	0.022	0.007	-0.003	0.029	-0.005	0.020	0.012	0.020
YZNCYL	0.017	0.040	-0.012	0.029	-0.014	0.025	0.018	0.020

Appendix-7: The Distances of Each Alternative from $A*$ and $A-$ and Closeness Coefficients

	2014			2015		
	The distance of PIS	The distance of NIS	Closeness Coefficient	The distance of PIS	The distance of NIS	Closeness Coefficient
AD	0.102	0.051	0.405	0.121	0.040	0.249
AFYN	0.094	0.083	0.414	0.089	0.100	0.530
AKNZ	0.072	0.077	0.247	0.106	0.048	0.310
ATTRK	0.060	0.111	0.596	0.068	0.107	0.609
ÇNNKL	0.098	0.073	0.493	0.100	0.087	0.465
DCL	0.082	0.074	0.487	0.052	0.117	0.694
DKZ	0.100	0.045	0.344	0.104	0.050	0.325
EGE	0.100	0.053	0.310	0.111	0.048	0.302
FRT	0.081	0.092	0.595	0.082	0.095	0.535
GZ	0.089	0.081	0.395	0.089	0.101	0.531
GZNTP	0.087	0.062	0.464	0.076	0.080	0.515
HCTTP	0.124	0.047	0.266	0.124	0.047	0.277
HRRN	0.091	0.060	0.428	0.092	0.071	0.436
INN	0.062	0.090	0.414	0.088	0.073	0.452
ISTNBL	0.089	0.074	0.291	0.114	0.052	0.315
KCL	0.089	0.079	0.448	0.106	0.062	0.368
KMSTC	0.104	0.050	0.373	0.105	0.058	0.353

KRKL	0.070	0.106	0.392	0.087	0.072	0.451
KT	0.115	0.066	0.464	0.076	0.106	0.583
MRSN	0.105	0.054	0.219	0.110	0.055	0.332
ONDKZM	0.076	0.080	0.422	0.087	0.070	0.445
OSMNGZI	0.080	0.085	0.384	0.094	0.071	0.433
PMKKL	0.074	0.100	0.359	0.083	0.091	0.522
SCK	0.086	0.065	0.277	0.112	0.042	0.273
TRY	0.113	0.044	0.245	0.099	0.060	0.378
ULDG	0.077	0.092	0.417	0.084	0.088	0.512
YZNCYL	0.083	0.073	0.545	0.074	0.085	0.532