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Comparative Study of Affiliated and Non-Affiliated Hospitals: DEA Based Analysis in Turkey

Dursun BALKAN*

Industrial Engineering Department, University of Turkish Aeronautical Association, Ankara, Turkey
*Corresponding author: dursunbalkan@gmail.com

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Abstract Measuring and comparing efficiency of healthcare organizations is critical for improved and uninterrupted service quality. The main objective of the study is to compare technical efficiency between affiliated and non-affiliated hospitals of Turkey. Totally, 25 affiliated hospitals and 53 non-affiliated hospitals were analyzed using input-oriented Data Envelopment Analysis (DEA) model under variable return to scale assumptions. There are six output variables and four input variables to evaluate hospitals efficiencies using with Ministry of Health (MoH) data from 2013 to 2017. The study results that, affiliated hospitals efficiency scores are higher than non-affiliated training and research hospitals. These results showed us the application of the affiliation system is successful in Turkey. Furthermore, this is the first study which has been performing whole affiliated and non-affiliated hospital efficiency measures together in Turkey and it offers an original contribution to literature with this direction.

Keywords: *affiliated hospitals, data envelopment analysis, health services, efficiency, Turkey*

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1. Introduction

The restructuring of health systems with the effect of neo-liberal reforms after 1980 has become the main subject of the countries' political agendas. This development was triggered by demographic, socio-economic and political factors as well as advances in the field of new drugs and medical technology, qualitative and quantitative increase in health manpower, and better service expectation of patients. Special reforms with competition, profitability, efficiency and flexibility in health care have led to fundamental changes in the quality and organization of services [1].

The policies and practices for improving the efficiency of hospitals were used with Health Transformation Program (HTP), which has been ongoing since 2003 in Turkey [2]. Before 2003, Turkish healthcare services had disorganized with regard to the financing, operating and insurance systems which divided by five parts. These parts has different opportunities and have a big inequalities for accessing the services and a quality of services with their individual networks. After 2003, Turkey has broadened the financial protection with health reforms for expanding service deliveries and accessing health services despite of the high population increments and high health insurance costs [3,4]. So that, HTP in Turkey was intended to promote important results and enhance healthcare system performance and improve equal attainment to health services as in other countries [5].

In 2009, the new program, which called 'affiliation system', is the establishment of cooperation among institutions for common purposes and there are similar applications in various fields and different ways in the world [6]. This system in the health care services means that hospitals and universities are expected to carry out their duties and services, and to act together in the fields of training, delivering medical care to patients, technical and cooperation in order to realize their common goals and interests in Turkey. It is given the opportunity to be affiliated with Ministry of Health (MoH) hospitals and relevant faculties of universities in Turkey to benefit from each other. Education in physicians is provided in medical faculties and training and research hospitals which is related to health ministries. With this dual structure both its lecturers and institutional culture and quality of medical training has been the subject of controversy over the years. Various problems have arisen with the insufficiency of educational staff and the opening of many new medical faculties. Besides, transferring to the university that lecturers, who are not already enough in public hospitals, has started to hinder the medical education in many of the training and research hospitals. For all these reasons, there is a need for affiliation system for providing efficient and stable utilization of manpower of university and the technical potentiality of the training and research hospitals in Turkey [7].

In this study, technical efficiencies of affiliated and non-affiliated hospitals are examined by several dimensions using an input-oriented DEA model under the variable return-to-scale assumption. There are 78 training

and research hospital in Turkey. The 25 of them are affiliated and 53 of them are non-affiliated hospitals. Therefore, this study using data collected from MoH Public Hospitals Directorate General from 2013 to 2017 for providing to evaluate the efficiency of 78 training and research hospital in Turkey with affiliated and non-affiliated discrimination.

This study answers the following research questions: a) Is there any overall performance difference between affiliated and non-affiliated hospitals in Turkey. b) how does the performance of these hospitals change in time. c) how does the performance of individual performance change in time.

Section structure for the rest of the article is as follows: literature review is provided in section 2. Section 3 includes the DEA methodology. Section 4 contains DEA results including, descriptive statistics, technical efficiency results for affiliated and non-affiliated hospitals, trend analysis. Discussion and conclusion parts are provided in Sections 5 and 6, respectively.

2. Literature Review

There are some important studies in the literature about affiliation systems in the health care services. Such as, Ulger et al. [8] was examined effect of affiliation on employee satisfaction It was emphasized that there were conflicts between the doctors of the public and university hospitals participating in the study due to the application of affiliation. In general, hospital workers suggested that due to the insufficient number of staff, employees were working overtime and human resources could not be used effectively. It was emphasized that conflicts arise in the state hospital and university hospital doctors participating in the study due to the affiliation application. Also, employees complained of the affiliation system that they increased the workload and motivation. A study was published by Uğurluoğlu [9] regarding the affiliation model within the scope of management models applied in university hospitals It is argued that university hospitals should be managed with a personalized and flexible organization model that envisages functional independence from each other.

The studies for assessing work performance of affiliated hospitals relative to the other hospitals. The findings of these research point to little or no operational efficiency benefit for affiliated hospitals [10,11,12,13]. Nevertheless, there is increasing concern that this type of consolidation will boost hospital prices increased hospital debates about healthcare programs [14,15,16]. Owing to giving better results of affiliation system in hospitals without strong proof led to an increase in the antitrust review of establishment and expansion of the health system [17].

Ciliberto and Dranove [18] examined the effect of the affiliation hospital system which interacts between physicians on hospital pricing in the 1990s. According to the study, it is revealed that labour force affiliation has no direct effect on hospital pricing. However, in some rural hospitals, large price decreases have been observed. In a study by Cutler and Morton [15], it was revealed that the accounts of providing health care service enlargement by hospitals which have been affiliated in the United States and this has positive effects on the profitability of hospitals. It was argued that in the Kirchhoff [19] study, the affinity between physician and health institution contributed to increase the integration in the institution, to provide price control of the state and to decrease health expenditures.

Zepeda et al. [20]. examined the possible impacts of survivability of hospital affiliation system handling with the efficiency of inventory operations. The findings indicate that national level, regional parts arrangements in affiliation system is counteracting results behind the poor resources of logistics facilities, the reducing consequence is highest for local system membership. Also, these outcomes lead to opportunities for enhanced performance of affiliation structure and not regarded the policy debates in hospital system formation.

Most of the studies on the effects of the affiliation system has appeared in Iran. Rafiei and Pourreza [21] examined the job satisfaction of corporate culture of hospitals affiliated with Tehran University. Ebrahimipour et al. [22] analysed the patients' complaints with big training hospital which was affiliated to Mashhad University. Mahdavi et al. [23] evaluated the health service quality of 700 affiliated hospitals of Iran for understanding the impact of the Iranian Health System Reform program. Farzianpour et al. [24] studied the assesment of performance of affiliated hospitals of Tehran University using with Baldrige Excellence Model. Goudarzi et al. [25] calculated the technical efficiency of affiliated hospitals in Iran between 1999-2011 using with Stochastic Frontier Analysis. Farzianpour et al. [26] analyzed performance of affiliated hospitals in Tehran University with DEA.

İlgün et al. [27] worked on training and research hospital in Turkey. They examined only 47 units training and research hospitals, in spite of being 78 training research hospital in Turkey. Another study in Turkey is realized by Küçük et al. [28]. In this study, they did the provincial and regional analysis with the efficiency of 669 public hospitals of Turkey with DEA and present the relationship between health reform program and their analysis results.

Related with the hospital performance measurement literature shows the use of different methods in different countries for hospitals of different sizes. Some of the important publications interested in hospital efficiencies are examined to understand hospital performance better. The country, number of hospitals and years information are reviewed to comprehend the time period, country coverage and working size of the studies. Also, method and orientation which is used for analysing the efficiency of the hospitals is presented in Table 1.

The table supports that in healthcare context, DEA methodology is frequently use to evaluate the hospital performance. The table also supports the diversity of countries in which hospital performance is measured. Either developing or developed countries are witnessed, ranging from China to Spain, USA to Italy, Colombia to Taiwan, Iran to Greece during the systematic review process on hospital efficiency. According to the size of the hospital, the number of DMUs in these studies ranged from 16 to 669 DMUs.

Table 1. Summary of Systematic Review on Hospital Technical Efficiency Using DEA

Authors	Country	Number of Hospitals	Years	I - O Oriented	Method
Ersoy et al. (1997) [29]	Turkey	573	1994	Input	Standard DEA Model
Junoy (2000) [30]	Spain	94	1990-1997	Input	Standard DEA Model
Athanassopoulos and Gounaris (2001) [31]	Greece	98	1992	Input	Linear Programming Based Model
Giokas (2001) [32]	Greece	91	1992	Input	Standard DEA Model
Chang et al. (2004) [33]	Taiwan	276	1994-1997	Output	Standard DEA Model
Watcharasriroj and Tang (2004) [34]	Thailand	92	2003	Input	Mann-Whitney test; Tobit regression analysis
Linna et al. (2006) [35]	Finland, Norway	98	1999	Input	Standard DEA Model
Aletras et al. (2007) [36]	Greece	51	2000-2003	Input	Standard DEA Model
Vitikainen et al. (2009) [37]	Finland	40	2005	Input	Standard DEA Model
Berta et al. (2010) [38]	Italy	134	1998-2007	Input	Cobb Douglas, Random Effect Model
Caballer-Tarazona et al. (2010) [39]	Spain	22	2005	Input	Standard DEA Model
Chang et al. (2011) [40]	Taiwan	31	1998-2004	Input	Malmquist Index
Chu NG (2011) [41]	China	463	2004-2008	Input	Malmquist Index
Farzianpour et al. (2012) [26]	Iran	16	2010	Input-Output	Standard DEA Model
Hu, Qi and Yang (2012) [42]	China	30	2002-2008	Output	Standard DEA and Tobit Model
Kirigia and Asbu (2013) [43]	Eritre	19	2007	Output	Standard DEA and Tobit Model
De Nicola et al. (2013) [44]	Italy	390	2004-2005	Output	Bootstrap DEA and CART
Mitropoulos et al. (2013) [45]	Greece	32	2001	Input	Integer Programming (IP) Location Allocation Models
Gök and Sezen (2013) [46]	Turkey	348	2008	Input	Multiple Regression Analysis
Kacak et al. (2014) [47]	Turkey	245	2008	Output	Standard DEA Model
Yang and Zeng (2014) [48]	China	70	2006-2010	Output	Three Stage Malmquist Index
Chowdhury et al. (2014) [49]	Canada	113	2002-2006	Output	Boot- Strapp, Malmquist Index (Case Mix), Kernel Density Estimation Tests
Harrison and Meyer (2014) [2950]	USA	165	2007-2011	Input	Standard DEA Model
Leleu et al. (2014) [51]	USA	138	2005	Input-Output	Standard DEA Model
Mitropoulos et al. (2015) [52]	Greece	117	2009	Output	Markov chain Monte Carlo (MCMC), DEA with Gibbs Sampler (GS) Algorithm.
Matranga and Sapienza (2015) [53]	Italy	116	2009	Output	Standard DEA Model
Alonso et al. (2015) [54]	Spain	25	2009	Input-Output	Bootstrap-DEA; Mann-Whitney tests.
Jola-Sanchez et al. (2016) [55]	Colombia	163	2007-2011	Output	Standard DEA Model
Erus and Hatipoglu (2017) [56]	Turkey		2003-2006	Output	Malmquist Index
Campanella et al. (2017) [57]	Italy	50	2010	Input	Standard DEA and Tobit regression analysis
Flokou et al. (2017) [58]	Greece	107	2009-2013	Input	Standard DEA and Malmquist Productivity Index
Gimenez et al. (2018) [59]	Colombia	602	2009-2013	Input-Output	Standard DEA Model
Kucuk et al. (2019) [28]	Turkey	669	2013-2017	Output	Standard DEA Model

3. DEA Methodology

3.1. Data Envelopment Analysis Method

As provided in the previous section, one of the methods frequently used to evaluate the performance of Decision Making Units (DMU) using with several outputs and inputs is DEA. In the literature, CCR model which was putforwarded by Charnes et al. [60] and BCC model by Banker et al. [61] are the common DEA models. DEA based on a non-parametric mathematical programming which can measure the performance of DMUs. It calculates a score which is limited to 0 to 1 for each DMU. DMU indicates efficient with these scores is equivalent to 1. Otherwise, DMU is inefficient [60]. When the production process of a DMU is complex, due to imposes of main objective function of DEA is preferred rather than stochastic frontier, one of other approach without any limitations [62].

$$\max \theta_0 = \sum_{r=1}^{s} u_r y_{r0}$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0$$

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

$$u_r \ge 0$$

$$v_i \ge 0$$

$$j = 1, 2, \ldots, n; r = 1, 2, \ldots, s; i = 1, 2, \ldots m$$

where

u_r : weight of output r by DMU_0,

v_i : weight of input i by DMU_0,

y_{r0} ; output r which is produced by DMU_0,

x_{i0} : input i which is produced by DMU_0,

y_{rj} : output r which is produced by DMUj and

x_{ij} : input i which is produced by DMUj [60].

The θ_0 score obtained at the end of model results are efficiency value for DMU_0 [60,61,63].

3.2. Selection of Input and Output Variables

Several dimensions were used for measuring and assessing of hospital performance. Output and input variables identification process also the most important issue in DEA context. Output and input variables for hospitals in DEA have been determined with preceding empiric and theoretical studies which is given in Table 1 to capture the performance as accurately and comprehensively.

According to Input - Output oriented model status, the studies before 2010 were mostly oriented towards input-oriented DEA models, but in recent years number of output-oriented models was higher, for the concepts of cost inefficiency and especially resource efficiency became more important until the end of 2000s. The cases focusing on quality, such as patient satisfaction, are used in the studies. According to recent studies such as Gimenez et al. [59], hospital efficiency has extended productivity analysis to include minimization of output inefficiency. One of the important issues of measuring efficiency in the hospitals is appropriate inputs and outputs. According to literature, inputs were commonly used by researchers in analysing hospital technical efficiency include the number of doctors, nurses, beds and total expenditure. The number of total patients and inpatients, average daily admission, the number of surgeries, bed occupancy rate and total revenue are commonly the outputs of the hospitals. Hence, six output and four input variables are selected in this study, as described below.

Output variables:
1. Total revenue (TR),
2. Outpatients number (O),
3. Total inpatients (TI),
4. Number of surgeries (S),
5. Number of visits to emergency departments (VE),
6. Number of outpatient visits per physicians (VO)

Input variables:
1. Total expenditures (TE),
2.Number of doctors (D),
3. Number of beds (B),
4. Number of magnetic resonance imaging units (I).

Based on this selection, DEA model is run in DEAP 2.1 software in windows (Win4Deap 2). for 78 training and research hospitals in Turkey. The 25 of them are affiliated and 53 of them are non-affiliated hospitals, using data collected from Turkish MoH Public Hospitals Directorate General from 2013 to 2017.

4. Results

4.1. Descriptive statistics of output and input variables (2013-2017)

Summary descriptive statistics for input and output variables are given in Table 2. It can be observed that, the inputs of number of doctors, number of beds, number of magnetic resonance imaging units (MRI) and scanners have increased by 10-25% during these five years period. This means that physical, technical and labour potentials of the hospitals are becoming better. However, total expenditures of the hospitals are increased more than these inputs, showing 74% increase. On the other hand, the total revenue of the hospitals are increased 50% for the same period. This means that, the hospitals costs have increased more than their revenues.

Table 2. Descriptive statistics of output and input variables (2013-2017)

Year	Variable	Number of beds	Number of doctors	Number of MRI units and CT scanners	Total expenditures	Outpatients Number	Number of visits to emergency departments	Number of outpatient visits per physicians	Total inpatients	Number of surgeries	Total revenue
2013	min	85	7	-	5.018.547	33.416	-	4,66	1.399	-	4.945.208
	max	1.434	462	4	218.755.547	2.915.346	802.662	29,25	90.414	167.259	449.041.735
	mean	546	179	1	96.578.525	1.039.596	251.884	17,97	31.949	42.390	103.337.323
	std dev	293	102	1	57.030.877	635.529	201.106	5,29	18.933	35.566	69.828.065
2014	min	85	14	-	6.148.157	45.005	-	4,88	1.535	-	5.315.884
	max	1.434	451	9	263.951.113	3.221.968	799.633	28,95	95.548	152.880	267.122.525
	mean	544	190	2	111.199.774	1.096.361	260.371	17,98	32.778	41.731	110.548.974
	std dev	288	107	1	65.402.246	657.372	210.929	5,48	19.136	30.652	64.724.079
2015	min	85	8	-	7.997.367	51.662	-	4,65	1.403	-	5.933.537
	max	1.414	467	9	294.365.789	3.293.988	853.430	37,90	93.988	101.202	280.649.953
	mean	539	203	2	123.233.487	1.135.525	269.637	17,89	32.197	33.045	116.994.710
	std dev	288	113	1	71.757.757	670.280	217.667	5,90	18.729	22.794	67.551.112
2016	min	85	10	-	10.707.574	48.902	-	2,89	1.403	-	5.999.539
	max	1.489	507	9	347.335.039	3.754.271	969.021	32,33	94.969	103.911	301.148.561
	mean	559	211	2	149.554.919	1.236.114	284.111	18,41	32.520	32.188	132.772.737
	std dev	312	122	1	86.477.799	783.392	241.017	5,54	19.896	23.561	77.567.536
2017	min	85	13	-	11.231.960	54.725	-	7,17	1.520	-	7.300.235
	max	1.500	515	9	407.281.073	4.046.361	1.254.225	32,64	94.410	103.550	344.114.177
	mean	604	222	2	168.060.097	1.342.539	303.675	18,95	33.193	33.262	155.739.943
	std dev	337	123	1	98.209.226	838.582	255.744	5,25	19.880	23.498	92.880.062
	Change %	***10,57***	***23,51***	***20,09***	***74,01***	***29,14***	***20,56***	***5,45***	***3,90***	***-21,53***	***50,71***

In addition, despite the increase in human resources and physical infrastructure, it is seen that the expected increase in output is not realized with total inpatients variables in operation and hospitalization. This indicates that physicians concentrate on outpatient services rather than labour intensive services based on inpatient and surgery.

In 2017, while minimum number of bed was 85 as well as maximum number of bed was 1500 and the number of doctor was minimum 13, maximum 515. In this case, it is seen that applications in affiliation hospitals are not a standard application and it cannot be transformed into a completely similar structure in terms of scale and capacity.

4.2. Technical Efficiency Results for Affiliated and Non-affiliated Hospitals (2013-2017)

Technical efficiencies of affiliated hospitals given at Table 3. In the first year 8 hospitals were efficient. For the following years 11 hospitals were efficient in 2014, 10 hospitals were efficient in 2015, 10 hospitals were efficient in 2016, 8 hospitals were efficient in 2017. Totally, 3 hospitals were efficient in all these 5 years out of 25 affiliated hospitals, namely Bolu Izzet Baysal Physical Therapy and Rehabilitation Hospital, Ankara Yıldırım Beyazıt University Yenimahalle Hospital and Giresun Women's Maternity and Children' s hospitals. It is also observed that the financial situation of public hospitals has been worsening in parallel with the general increase in expenses since 2016.

Technical efficiencies of non-affiliated hospitals are given in Table 4. In the first year 10 hospitals were efficient. 16 hospitals were efficient in 2014, 16 hospitals were efficient in 2015, 12 hospitals were efficient in 2016, 11 hospitals were efficient in 2017. Totally, 4 hospitals were efficient in all these 5 years out of 53 non-affiliated hospitals, namely Ulucanlar Eye, Bağcılar, Prof. Dr. N. Reşat BELGER Beyoğlu Eye, Kanuni Sultan Süleyman hospitals.

Table 3. Technical efficiencies of affiliated hospitals

HOSPITALS	2013	2014	2015	2016	2017
KIRŞEHIR AHI EVRAN UNIVERSITY	1,0000	1,0000	0,9831	1,0000	0,9196
ISTANBUL MARMARA UNIVERSITY	0,8911	1,0000	1,0000	1,0000	1,0000
ISTANBUL MEDENIYET UNIVERSITY	0,7290	0,8814	0,9022	0,8678	0,8435
ORDU UNIVERSITY	0,7144	0,8626	0,8087	0,7086	0,8222
SAKARYA UNIVERSITY	0,8731	0,9614	0,9372	1,0000	1,0000
RIZE RECEP TAYYIP ERDOĞAN UNIVERSITY	0,8258	0,8974	0,9063	0,9203	0,8627
ANKARA YILDIRIM BEYAZIT UNIVERSITY ATATÜRK	0,9293	1,0000	0,8739	0,9186	0,9319
IZMIR KATIP ÇELEBI UNIVERSITY	0,5410	0,8573	0,8683	0,8079	0,9204
MUĞLA SITKI KOÇMAN UNIVERSITY	0,5930	0,8933	0,9193	0,8691	0,8786
ERZINCAN UNIVERSITY	0,8463	0,9748	0,9369	0,8488	0,9443
ADIYAMAN UNIVERSITY	0,9938	1,0000	1,0000	1,0000	0,9360
KÜTAHYA DUMLUPINAR UNIVERSITY	0,6085	0,9756	0,8294	0,8409	0,9303
ÇORUM HITIT UNIVERSITY	0,7939	0,9660	0,9620	0,8450	0,7848
AMASYA UNIVERSITY	1,0000	1,0000	1,0000	0,8804	0,9123
KARABÜK UNIVERSITY	1,0000	0,9545	0,9870	0,8615	0,8991
BOLU IZZET BAYSAL UNIVERSITY	0,9582	0,7856	1,0000	0,7887	0,8396
BOLU IZZET BAYSAL PHYSICAL THERAPY	1,0000	1,0000	1,0000	1,0000	1,0000
BOLU MENTAL HEALTH AND DISEASES	1,0000	0,9168	0,8548	1,0000	1,0000
ANKARA YILDIRIM BEYAZIT UNIVERSITY YENIMAHALLE	1,0000	1,0000	1,0000	1,0000	1,0000
ANTALYA ALANYA ALAADDIN KEYKUBAT UNIVERSITY	1,0000	1,0000	1,0000	0,8292	0,8923
AKSARAY UNIVERSITY	0,9951	1,0000	1,0000	1,0000	1,0000
GIRESUN UNIVERSITY	0,9219	1,0000	0,9200	0,9904	0,7867
GIRESUN UNIVERSITY MATERNITY AND CHILDREN	1,0000	1,0000	1,0000	1,0000	1,0000
NIĞDE ÖMER HALISDEMIR UNIVERSITY	0,9206	0,9468	1,0000	0,9715	1,0000
UŞAK UNIVERSITY	0,9704	0,9750	0,9634	1,0000	0,9293
Average Efficiency Score of Affiliated Hospitals	**0,8842**	**0,9539**	**0,9461**	**0,9179**	**0,9213**

Table 4. Technical efficiencies of non-affiliated hospitals

HOSPITALS	2013	2014	2015	2016	2017
ZEKAİ TAHİR BURAK MATERNITY AND CHILDREN	1,0000	1,0000	0,9909	0,8955	0,9355
ANKARA	0,8782	0,9479	0,8769	0,8888	0,8398
ANKARA PHYSICAL THERAPY	0,3640	0,8929	0,9522	0,9008	0,8620
ANKARA NUMUNE	0,6530	0,8615	0,8226	0,7706	0,7559
TÜRKİYE HIGH SPECIALIZED HOSPITAL	0,6025	0,8804	0,8568	0,8795	0,8297
ULUCANLAR EYE	1,0000	1,0000	1,0000	1,0000	1,0000
ATATÜRK CHEST	0,4798	0,8652	0,7775	0,8117	0,8025
ANKARA CHILDREN AND ONCOLOGY	0,5930	0,7938	0,8440	0,8189	0,7713
ANKARA DIŞKAPI YILDIRIM BEYAZIT	0,8188	0,9608	0,9470	0,8779	0,8454

HOSPITALS	2013	2014	2015	2016	2017
DR.SAMİ ULUS MATERNITY AND CHILDREN	0,6044	0,8752	0,8523	0,7144	0,6916
ANKARA ETLİK ZÜBEYDE HANIM	0,9613	1,0000	1,0000	1,0000	1,0000
ANKARA KEÇİÖREN	1,0000	0,9926	1,0000	1,0000	1,0000
DR. ABDURRAHMAN YURTASLAN ONCOLOGY	0,5847	0,9248	0,8809	0,9638	0,8953
ANTALYA	0,7786	1,0000	0,9576	0,8914	0,8108
BURSA HIGH SPECIALIZED HOSPITAL	0,9740	0,9115	0,8450	0,8291	0,8831
DİYARBAKIR GAZİ YAŞARGİL	0,6265	0,8221	0,8079	0,8229	0,9077
ELAZIĞ	1,0000	1,0000	0,8136	0,8962	0,9976
ERZURUM REGIONAL	0,7876	0,9289	0,9265	0,8246	0,8466
KARTAL DR.LÜTFİ KIRDAR	0,8267	1,0000	1,0000	1,0000	1,0000
KARTAL KOŞUYOLU HIGH SPECIALIZED HOSPITAL	0,7840	1,0000	1,0000	1,0000	1,0000
SÜREYYAPAŞA CHEST HEART VESSEL	0,4291	0,8256	0,7784	0,8775	0,9152
DR.SİYAMİ ERSEK CHEST HEART VESSEL	0,5005	0,8428	0,8953	0,8765	0,8056
ERENKÖY MENTAL AND NEUROLOGICAL	0,6183	0,8933	0,8347	0,8707	0,9035
FATİH SULTAN MEHMET	0,8297	0,9371	0,9559	0,9439	0,8880
HAYDARPAŞA NUMUNE	0,6862	0,8835	0,7931	0,8489	0,8565
ÜMRANİYE	1,0000	1,0000	1,0000	0,9045	0,8326
ZEYNEP KAMİL MATERNITY AND CHILDREN	0,9163	1,0000	1,0000	0,7869	0,9002
BAĞCILAR	1,0000	1,0000	1,0000	1,0000	1,0000
BAKIRKÖY DR.SADİ KONUK	1,0000	0,9638	0,9698	1,0000	1,0000
PROF.DR.MAZHAR OSMAN MENTAL	0,7234	1,0000	0,9002	0,9837	0,9316
İSTANBUL PHYSICAL THERAPY	0,6432	1,0000	1,0000	1,0000	1,0000
BALTALİMANI METİN SABANCI	0,7754	1,0000	1,0000	1,0000	1,0000
GAZİOSMANPAŞA TAKSİM	0,6949	0,9618	0,9306	0,8514	0,9208
OKMEYDANI	0,8189	0,9629	0,9279	0,8583	0,9403
PROF.DR.N.REŞAT BELGER BEYOĞLU EYE	1,0000	1,0000	1,0000	1,0000	1,0000
ŞİŞLİ HAMİDİYE ETFAL	0,7767	0,9433	0,9594	0,8601	0,8950
KANUNİ SULTAN SÜLEYMAN	1,0000	1,0000	1,0000	1,0000	1,0000
MEHMET AKİF ERSOY CHEST HEART VESSEL	0,9160	0,9688	1,0000	1,0000	0,9839
İSTANBUL	0,7349	0,9085	0,9317	0,9002	0,8943
HASEKİ	0,9035	1,0000	0,9811	0,8522	0,8630
YEDİKULE CHEST	0,5526	0,8438	0,8685	0,8249	0,8230
BOZYAKA	0,6081	0,8621	0,8831	0,8097	0,9473
DR.BEHÇET UZ MATERNITY AND CHILDREN	0,6408	0,8956	0,9353	0,8236	0,8899
DR.SUAT SEREN CHEST	0,5590	0,8616	0,8811	0,8081	0,7948
İZMİR TEPECİK	0,7223	0,8427	0,9363	0,8028	0,7893
KAYSERİ	0,7694	0,9421	0,9559	0,8809	0,9263
KOCAELİ DERİNCE	0,9675	0,9149	0,8901	0,9075	0,8998
KONYA	0,7233	0,8457	0,8349	0,9048	0,9208
SAMSUN	0,5778	0,8821	0,8721	0,9752	0,8372
MEHMET AKİF İNAN	0,9581	0,9938	1,0000	0,8924	0,9436
AHİ EVREN CHEST HEART VESSEL	0,6183	0,9993	1,0000	0,9592	0,9909
KANUNİ	0,7215	0,8387	0,8645	0,7975	0,7643
VAN	1,0000	0,8972	1,0000	0,9573	0,9685
Average Efficiency Score of Non-Affiliated Hospitals	**0,7680**	**0,9315**	**0,9232**	**0,8971**	**0,9000**

It is observed that average technical efficiency of affiliated hospitals increased 4,20% from 2013 to 2017 and for non- affiliated hospitals it increased 17,19% for the same period. These rising trends show that Turkish health system has an increasing performance in time. Also, from 2014 to 2017, average technical efficiency difference was approximately 2% except 2013 for two groups of hospitals.

4.3. Trend Analysis

Figure 1 shows the efficiency scores versus years for affiliated and non-affiliated hospitals. The trend of training and research hospitals appears to be consistent for both affiliated and non-affiliated hospitals from 2013 to 2017. However, hospitals that are non-affiliated show lower performance than other training and research hospitals due to the fact that the structuring of educational staff, physical and infrastructural conditions take a long time, and the income-expense balance resulting from the increase in additional payment is deteriorated.

Efficiency results of affiliated hospitals were higher than those of non-affiliated training and research hospitals. Training and research hospitals which are affiliated have more organized structure in their production of services which is an important advantage. It is seen that the performance of general hospitals is higher than others. This shows us that the affiliation model yields a positive result since these hospitals are predicted to have similar efficiency scores.

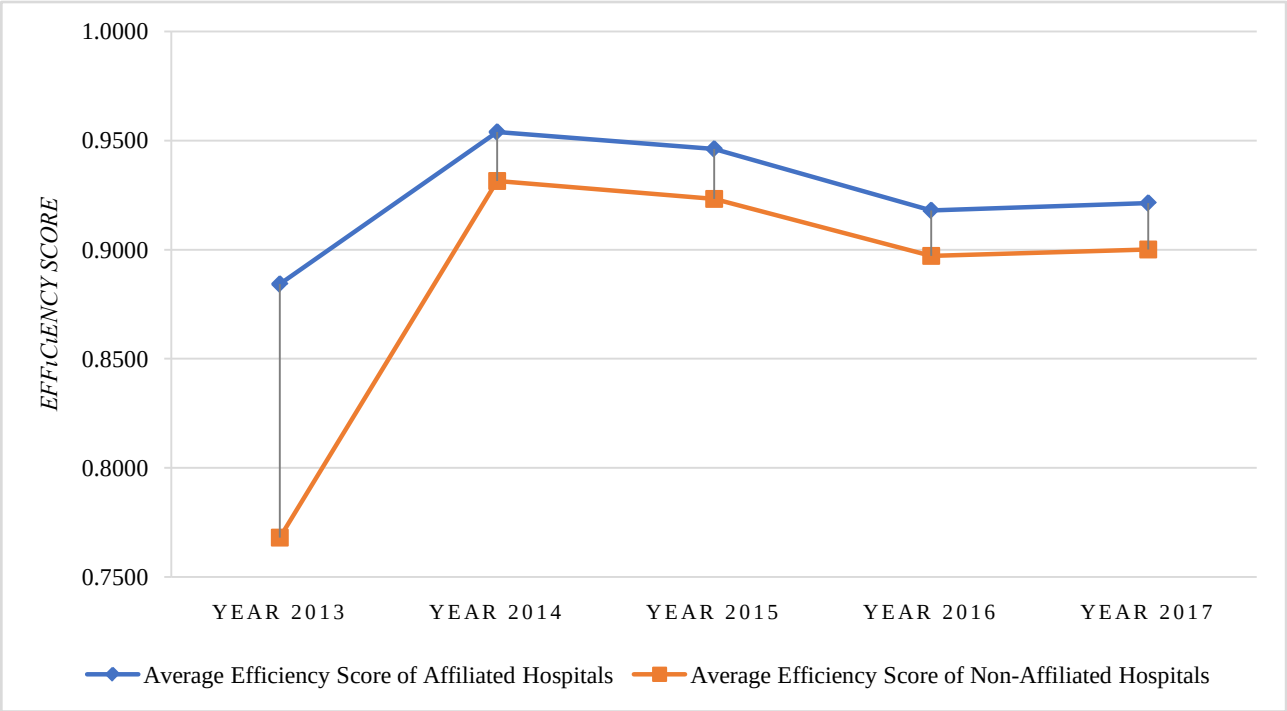

Figure 1. Comparison of the efficiency scores affiliated and non-affiliated training and research hospitals (2013-2017)

4.4. Paired Sample t-test Results

Based on the data, the following hypotheses is tested by using Paired-Samples t test:

h_0 = affiliated and non-affiliated hospitals efficiency scores are equal

h_1= affiliated and non-affiliated hospitals efficiency scores are different

Table 5. Paired-Samples t test results of affiliated and non-affiliated hospitals

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Affiliated_Score	0,9247	5	0,02743	0,01227
Non_Affiliated_Score	0,8840	5	0,06648	0,02973

Paired Samples Correlations

	N	Correlation	Sig.
Affiliated_Score & Non_Affiliated_Score	5	0,930	***0,022***

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Upper	Lower			
Affiliated_Score & Non_Affiliated_Score	0,04072	0,04220	0,01887	-0,01168	0,09312	2,157	4	0,097

Paired-Samples t test results of affiliated and non-affiliated hospitals are shown in Table 5. According to these results 0,022 significance value is smaller than 0,05 confidence interval. Therefore, h0 hypotheses is rejected, meaning that affiliated and non-affiliated hospitals efficiency scores are different from each other.

5. Discussion

In this study, at first Turkish Health System and Affiliations System which was implemented as new system in Turkey was examined in the concept of Health Reform Program. Also, it is mentioned that the condition of the affiliation system and why we need to use this system in Turkey. Then, literature review for measurement of affiliated hospital efficiency studies conducted in various countries is examined via DEA. All training and research hospitals in Turkey which affiliated and non-affiliated have been analysed and special evaluations have been made for these hospitals between 2013 and 2017. Thus, realistic and complete picture is presented for all the hospitals included into analysis.

While the previous system was more regular and organized, the affiliation model is very recent in Turkey. Therefore, it needs more time to understand its effects on the public. Nevertheless, with this system all patients are able to consult the academic staff of the university and owing to this reason, the academician expertise became more available for all types of patient patterns. However, with this new system health service suppliers are under

pressure and the instruction cost of new hospital buildings are significant cost of this system.

When compared with studies in other countries the following are observed. In Hashjin et al. [64] Iran developed a national hospital performance measurement program (HPMP) since 1997. It was similar affiliation system type as Turkey. They compared the performance of affiliated and non-affiliated hospital with 2002-2008 period and they highlighted that the affiliated hospitals were showing better performance than other types of hospitals. Their result is totally in line with this study.

Linde [65] analysed the effect of hospital affiliation in Chicago hospitals. Also, he found affiliated hospitals worked more effective than same type of other non-affiliated hospitals. Lee et al. [66] examined the Catholic hospital affiliation of American hospitals. They found the patients affiliated hospitals had more than other hospitals that means the performance of the affiliated hospitals higher than others. Chowkwanyun [67] showed her opinion that public private partnership was better results with the municipal hospital affiliation system in New York city hospitals. Casalino and Robinson [68] presented the hospital physician affiliation system and another alternative models in the United States hospitals. They highlighted affiliation system will become more economic and with this system it is possible to give more qualified healthcare services. These studies also support Turkey's findings.

Erus and Hatipoglu [56] evaluated the change in efficiency of Turkish public hospitals during 2013-2017. They divide their study into two parts. At first, they considered only the early effects of the initial phase of health transformation program where new physician payments schemes were prominent, whereas the second phase the restructuring of the public hospital system. Secondly, they analysed the size and the specialty of public hospitals as additional factors. This means that they did not say anything about the affiliation system, since they are interested in analysing the health care reform not the affiliation system. Also, they use only public hospital data. But in this study, performance of all of the affiliated and non-affiliated hospitals are analysed together with their own specific data. Therefore, this is the first study which has been evaluating all affiliated and non-affiliated hospitals efficiency measures together in Turkey.

The main limitation of the study is that pictures before and after the period of affiliation was not examined separately. If such an examination is made in future studies, the benefits of affiliation system for university hospitals will be revealed in more detail. In addition, the two-stage Network DEA method is planned to be used for analysing the "education and training" function and "service delivery" stages separately with their own parameters and to present a different perspective on the affiliation system.

6. Conclusions

This study is the first study that have been performing all affiliated and non-affiliated hospital efficiency measures in Turkey with an original contribution to the literature with this direction.

Affiliation model which began in 2009 as a pilot model in Turkey, expands to the opening of new medical schools. With parallel policies their number has reached 25 in 2019. Thus, without any capital investments, the newly established medical faculties and public hospitals carry out health services and training and research activities together. According to a comprehensive analysis performed in this study the efficiency scores of the affiliated hospitals were higher than those of non-affiliated training and research hospitals all of are included in the study. Herewith, status of the affiliated hospitals are more clearly revealed. Gradual application of the model can produce further desired results.

There are continuous changes in the affiliation regulations, the legal infrastructure of the model is not fully established, also there are academic and administrative problems all of which are proof of this system difficulties both for the university and the MoH hospitals. The efficiency analysis conducted within this framework confirms these findings and results. This study has also shown that in general, it is possible to evaluate the effectiveness of the model in terms of efficiency scores.

Recently, there are some news about conjoint of several university hospitals and MoH hospitals in Turkish Government agenda. In addition, this model is expected to continue towards the merger of university medical faculties, which faced especially financial problems, and MoH hospitals. For this reason, policy makers are advised to take precaution regarding the function of model and structural problems. For example, the fact that hospitals remain between the "education and training" function and the "service delivery" function may cause conflict between university and hospital staff. Also, in order to eliminate this problem, the process of signing contracts with lecturers in hospitals and university staff is required to be initiated.

For further studies, it is suggested to compare the affiliation system with longer time series, and to make impact analysis studies that enable before and after period in which model is realized in two separate planes.

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Conflicts of Interest

The author declare that they have no conflict of interest.

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