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The Efficiency of Health Services in the Provinces of the Ottoman State: The Year 1897

Osmanlı Devleti Vilayetlerinde Sağlık Hizmetlerinin Etkinliği: 1897 Yılı



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Abstract

This study examines technical efficiency scores in producing health outcomes of hospital discharges and hospital visits for the twenty-eight Ottoman State provinces. We measure efficiency scores by implementing data envelopment analysis using the first statistical yearbook of the Ottoman State for 1897. Our findings indicate that some provinces achieve relative efficiency, including Dersaadet, Jerusalem, Adana, and Aydın with good health outcomes, Biga and Benghazi with moderate health outcomes, and Yemen with lousy health outcomes. Our results also suggest that inefficient provinces can substantially reduce their inputs without reducing hospital discharges and maintaining the same hospital visits. As a result, this study measures the efficiency of health services in the Ottoman State for 1897.

Öz

Bu çalışma, 28 Osmanlı Devleti vilayeti için hastaneden taburcu olma ve hastane müracaat sayıları sağlık sonuçlarının üretilmesinde teknik etkinlik skorlarını incelemektedir. Etkinlik sonuçlarını, Osmanlı Devleti'nin 1897 tarihli ilk istatistik yıllığını kullanarak veri zarflama analizi uygulayarak ölçmekteyiz. Bulgularımız, iyi sağlık sonuçlarıyla Dersaadet, Kudüs, Adana ve Aydın, orta sağlık sonuçlarıyla Biga ve Bingazi ve kötü sağlık sonuçlarıyla Yemen gibi bazı vilayetlerin göreceli verimlilik elde ettiğini göstermektedir. Sonuçlarımız ayrıca, etkin olmayan vilayetlerin hastane taburcu ve hastane müracaat oranlarını azaltmadan girdilerini önemli ölçüde azaltabileceğini göstermektedir. Sonuç itibarıyla, bu çalışma Osmanlı'da sağlık hizmetlerinin etkinliğini 1897 yılı için ölçmektedir.

Keywords

Health, efficiency · Ottoman economy · health in Ottoman economy · health policy.

Anahtar Kelimeler

Sağlık, etkinlik · Osmanlı ekonomisi · Osmanlı ekonomisinde sağlık · sağlık politikası.



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Introduction

Public health appears to have a deep-rooted history in the Ottoman State. As it is known, the Ottoman State benefited from the knowledge and experience of the Seljuk State in many issues, from the administrative system to tax types. The issue of public health was also among the issues that the Ottoman State benefited from. This transfer, obtained from the Seljuk heritage, shaped and directed the Ottoman health system for many centuries.¹ In this sense, this legacy played an essential role from the establishment of the Ottoman State to the nineteenth century.² On the other hand, Boyar underlined that the Ottomans did not see any problem obtaining medical knowledge from foreign states (for example, from European countries), noting that they benefited significantly from practices that yielded successful results³. Thus, it comes to the fore that the success of the treatment is essential, not the origin or place of the treatment in the Ottoman administration. In this context, it is widely regarded that the policies implemented in the field of health from the establishment of the Ottoman State to its last periods had important contributions to society.

Apart from these above discussions, it is also known that some measures were taken to protect public health from the early periods of the Ottoman State. Although these measures did not develop directly under the health administration, it is possible to say that such measures had an important position in Ottoman society within the scope of preventive health. For example, burying unclaimed corpses like other dead immediately, not throwing garbage on the streets, cleaning the streets, preventing the mixing of wastes into drinking water channels, and controlling situations that may lead to epidemics are only the first ones that come to mind⁴. Therefore, it is fair to say that the Ottoman state implemented some measures to protect public health in addition to general health services.

Mossensohn, who evaluates the history of health services provided in Ottoman society, comes to the following conclusion: mainly before the nineteenth century, the Ottoman administration was not in a position to provide a health service to society⁵. In addition, the Ottoman society was also not at the point of requesting any service from the state administration. However, he continued to argue that, in the nineteenth century (the author mainly referred to the changes introduced by the Tanzimat Edict), a radical change occurred in this situation, and the Ottoman administration implemented policies to prevent the spread of epidemics and make health services accessible to the general public. The developments in the field of health in Damascus during the said period, for instance, were quite remarkable⁶. Mossensohn underlined that in the face of all these developments, the aim of providing health services was not the main purpose but the development of state administration as well as political, social, and economic issues⁷. Before the nineteenth century, health services were provided through foundations or waqfs in the Ottoman administration. These foundations had an autonomous structure in terms of both income and expenditure. However, as discussed in detail below,

¹Sayılı (1980) considers the healthcare system, especially the hospitals in the modern sense, to be a common institution in medieval Islamic society. In this way, he states that these hospitals show the level reached by Islamic civilization. For example, it is known that the first systematic hospital in the Islamic society was built in Damascus in 706-707 by Walid ibn Abdulmalik and the health services offered here were free of charge. Aydın Sayılı, "The Emergence of the Prototype of the Modern Hospital in Medieval Islam." *Bellekten* 44(174) (1980), 280.

²Non-Muslims living in an Ottoman society were free to establish and manage their health institutions, as in other areas. In this sense, it is known that there were hospitals around the places of worship, especially in the 18th and 19th centuries, and that health services were provided there. However, especially among the Orthodox people, a system based on the foundation was common in this period. In other words, a health system, similar to Muslims, emerged with the income of foundations. Alexander and Laiou (2014) argued that this was the result of an effort to show class superiority rather than religious reasons.

³Ebru Boyar, "Medicine In Practice: European Influences On The Ottoman Medical Habitat." *Turkish Historical Review* 9 (2018), 214.

⁴Gülden Sarıyıldız, "Osmanlılar'da Hıfzıssıhha," *Diyanet İslam Ansiklopedisi*, 17, (1998), 319-320.

⁵Miri Shefer Mossensohn, "Health as a Social Agent in Ottoman Patronage and Authority." *New Perspectives on Turkey* 37 (2007), 148.

⁶Abdul-Karim Rafeq, "Traditional and Institutional Medicine in Ottoman Damascus" *Turkish Historical Review* 6 (2015), 76.

⁷Mossensohn, "Health as a Social," 150.



there were immense and fundamental changes in the structure of these services provided by foundations since the first half of the nineteenth century.

Considering the literature on providing healthcare in the Ottoman state, it is possible to say that the literature on health practice in the Ottoman administration is quite limited⁸. Unlike these studies, the issue of health in the Ottoman State was generally discussed on the axis of epidemic diseases. Notable among these studies are those by Lowry, Panzac, Bulmuş, İaneva, Varlık, Ayalon, Robarts, White, and Bolaños⁹. Although all these studies put forward a general evaluation of the health system in the Ottoman State, they ignored the economic and financial effects of the health system. The current literature also did not take into consideration the efficiency of the health system in the Ottoman state. In other words, as far as we know, there are no studies to evaluate the effectiveness of health services provided by the Ottoman state, especially during the nineteenth century. In this sense, this study endeavors to contribute to this field.

In the context of these above explanations, this study aims to examine the effectiveness of health services provided in twenty-eight Ottoman provinces in 1897, the first statistical yearbook of the Ottoman Empire. In the first part of the study, which consists of five parts, the historical framework of health services in the Ottoman Empire is presented. While the second part of the study provides information about the data and method, the third part of the study presents the results. Finally, the last part presents a general evaluation of the study.

Historical Context

The nineteenth century corresponds to a period of intense centralization of Ottoman finance. This centralization step had significant effects on the health sector as well as in other areas. In the Ottoman administration before the nineteenth century, as it is known, health services were provided through waqfs, and these waqfs had a say in the performance of health services. It is possible to say that the fact that hospitals were supported by waqf revenues provides them with assurance in terms of giving services for many years.¹⁰ This also positively affected Ottoman finances, especially from a public expenditure perspective, by reducing expenditure in the budget. It is because the said health expenditures were covered by waqfs revenues rather than the state budget, resulting in no direct expenditure on health from the Ottoman budgets. However, this situation started to change in the first half of the nineteenth century. Thus, in the nineteenth-century Ottoman administration, health services, as in all other areas, became to have the identity of a public service provided by the central administration within the scope of centralization steps.

⁸ Bedi N. Şehsuvaroğlu, *İstanbulda 500 Yıllık Sağlık Hayatımız* (İstanbul: İstanbul Fethi Neşriyatı 1953), 1-10; Osman Şevki Uludağ, *Beşbuçuk Asırlık Türk Tababeti Tarihi* (Ankara: Kültür Bakanlığı Yayınları 1991); Rhoads Murphey, "Ottoman Medicine And Transculturalism from the Sixteenth through the Eighteenth Century," *Bulletin of the History of Medicine*, 66(3) (1992), 376-377; Erdem Aydın, "19. Yüzyıl Osmanlı Sağlık Teşkilatlanması," *Ankara Üniversitesi Osmanlı Tarihi Araştırma ve Uygulama Merkezi Dergisi* 15(15) (2004), 186; Coşkun Yılmaz and Cevdet Yılmaz, *Osmanlılarda Sağlık I, II* (İstanbul: Biofarma 2006); Mossensohn, "Health as a Social," 148; John Alexander and Sophia Laiou, "Health And Philanthropy Among the Ottoman Orthodox Population, Eighteenth to Early Nineteenth Century," *Turkish Historical Review* 5 (2014), 1-2; Rafeq, "Traditional And Institutional," 76-77.

⁹ Heath W. Lowry, "Pushing the Stone Uphill: The Impact of Bubonic Plague on Ottoman Urban Society in the Fifteenth and Sixteenth Centuries," *Osmanlı Araştırmaları* 23 (2003), 93; Daniel Panzac, "Plague," in *Encyclopedia of the Ottoman Empire*, ed. Gábor Ágoston and Bruce Masters (Facts on File, Inc., An imprint of Infobase Publishing, 2009); Birsan Bulmuş, *Plague, Quarantines and Geopolitics in the Ottoman Empire* (Edinburg: Edinburg University Press, 2012); Svetla İaneva, "Hygiene in Nineteenth-Century Ottoman Bulgaria," *Turkish Historical Reviews* 5 (2014), 16; Nükhet Varlık, *Plague and Empire in the Early Modern Mediterranean World the Ottoman Experience, 1347-1600* (Cambridge: Cambridge University Press, 2015); Yaron Ayalon, "Religion and Ottoman Society's Responses to Epidemics in the Seventeenth and Eighteenth Centuries," in *Plague and Contagion in the Islamic Mediterranean*, ed. Nükhet Varlık (Arc Humanities Press, 2017), 179; Andrew Robarts, "Nowhere to Run to, Nowhere to Hide? Society, State, and Epidemic Diseases in the Early Nineteenth-Century Ottoman Balkans," in *Plague and Contagion in the Islamic Mediterranean*, ed. Nükhet Varlık (Arc Humanities Press, 2017), 221; Sam White, "A Model Disaster: From the Great Ottoman Panzootic to the Cattle Plagues of Early Modern Europe," in *Plague and Contagion in the Islamic Mediterranean*, ed. Nükhet Varlık (Arc Humanities Press, 2017), 91; Isacar A. Bolaños, "The Ottomans During the Global Crises of Cholera and Plague: The View From Iraq and the Gulf," *International Journal of Middle East Studies*, 51 (2019), 603.

¹⁰ In fact, this situation is not unique to the Ottoman administration, and it is fair to say that waqfs played a substantial role in providing health services in all Islamic societies in the historical process. For example, the Ahmad bin Tulun Hospital, which was established in Cairo in 872-874, is considered to be the first hospital to survive with waqf revenues. Sayılı, "The Emergence," 283.



Another factor behind this trend in the field of health in the nineteenth-century Ottoman administration was the developments in both treatment and preventive health in Western states. Accordingly, just like in the Ottoman state, it is regarded that there was no health administration organized by the central administration in the Western states before the nineteenth century. Moreover, it is highlighted that developments in the field of health started to occur in these states, especially since the second half of the nineteenth century. Put differently, as Hobson argued, we can hardly speak with accuracy before the nineteenth century on public health¹¹.

Considering these centralization steps from the public-health perspective in the Ottoman State, important steps were taken during the nineteenth century to train physicians and other health personnel, increase the number of hospitals, and establish health organizations. The most striking of these steps was the establishment of the School of Medicine (Mekteb-i Tibbiye), which was established in 1827 to provide modern medical education and to train doctors and surgeons in the military field.¹² However, despite all these efforts to improve the health system, it has been claimed that under the Ottoman administration, there was no success in the organization and the delivery of health services. In other words, as Aydın¹³ puts it, there was not the desired development in both issues. However, the desired size is very ambiguous.

One of the practices introduced by the Ottoman administration in the field of health was the enactment of a regulation in 1861 to register health personnel as well as to increase their quality. This regulation, which consisted of seventeen articles, included important decisions about local and foreign doctors, surgeons, and midwives, from their qualifications to their working methods and punishments.¹⁴ However, as it is clear from the regulation, we can see that the Ottoman administration (perhaps due to the conditions of the period) took steps towards the development of medicine individually rather than the organization of a health system. Thus, it was aimed to expand the practice of individual medicine in every region of the state¹⁵.

In addition to the above regulation, the Ordinance of the General Administration of Medicine (known as İdare-i Umumiye-i Tibbiye Nizamnamesi) was put into effect in 1871.¹⁶ According to Aydın¹⁷, this regulation had a different position in terms of Ottoman health history due to the decisions it put forward. It is because, within the scope of the rules outlined in this regulation, preventive health services were emphasized rather than treatment services. In fact, this policy represents a very modern understanding of the period in question. In addition, this policy reveals that the Ottoman Empire closely followed the developments in other states, mainly in Western countries. In this framework, it became compulsory to have physicians called "state physicians" or "memleket tabibi" in each province (article 1). The regulation, in addition, ruled that the salaries of these physicians would be paid by the relevant municipalities themselves (article 2). The regulation also decided to open a pharmacy in the municipalities (article 3). Finally, it regulated the duties of the state physicians and the administration of municipal pharmacies.

Within the scope of these aims set by the state physicians, in 1913, the Provincial Administration of Health Regulations (so-called Vilayeti İdare-i Sıhhiye Nizamnamesi) was issued to organize the health adminis-

¹¹William Hobson, *The Theory and Practice of Public Health* (Oxford: Oxford University Press, 1965).

¹²This institution is also known as Tıbhane-i Amire. For this reason, its foundation day, 14 March, is still celebrated as a medicine day in Turkey. Naim Sarı, "Mekteb-i Tibbiye," *Diyanet İslam Ansiklopedisi* 29 (2004), 2.

¹³Aydın, "19. Yüzyıl Osmanlı," 185.

¹⁴For more see Tababet-i Belediye İcrasına Dair Nizamname, *Düstur*, Tertip I, 2, 814-816.

¹⁵Aydın, "19. Yüzyıl Osmanlı," 186.

¹⁶İdare-i Umumiye-i Tibbiye Nizamnamesi, *Düstur*, Tertip I, 2, 800-803.

¹⁷Aydın, "19. Yüzyıl Osmanlı," 185-186.



tration more regularly.¹⁸ With this new regulation, health directorates were established in each provincial center to be responsible for health affairs in the province. In this sense, the relevant regulation considered some duties of health directorates, such as prevention of epidemic diseases, recording of population increase or decrease, inspection of workshops and factories in terms of health conditions, protection of workers' health, and control of food and beverages.

These arrangements made through the regulations can give us information about the institutions through which the payments to the health personnel were made. Considering both the relevant regulations and the explanations above, personnel payments had been first met by the municipalities operating in the region. However, considering the 1913 regulation, the payments were now undertaken by the state administration. This claim can be pursued in the nineteenth-century Ottoman budgets. When we take a close look at these budgets,¹⁹ it is obvious that health expenditures were not handled in detail in these budgets.

Data

The data used are from the first statistical yearbook of the Ottoman State.²⁰ This dataset is at the province level, including twenty-eight Ottoman provinces, and available only for 1897. This dataset provides information on the number of hospitals, hospital beds, public health expenditures, populations by state, and healthcare employees, including physicians, nurses, civil servants, caretakers or servants, and others at the province level. In addition, the dataset provides information on hospital discharge records and the number of hospital deaths. Hospital discharge is defined as the total number of patients who left the hospital in a healthy condition after receiving care per 100 people, which is one of the outputs in our analysis. Furthermore, we calculate hospital visits per 100,000 as our second output by adding the number of hospital discharges and the number of hospital deaths, which refer to those who were accepted to the hospital and died. Unfortunately, we had to exclude the province, Cebel-i Lübnan, known as Lebanon, from our analyses due to missing data values.

Table 1. Descriptive Statistics - Ottoman Health Data, 1897.

Ottoman Provinces	Health inputs			Health outputs		
	Hospitals (per million population)	Healthcare Employees (per 100,000 population)	Hospital Beds (per 100,000 population)	Public health expenditures (per 100,000 population)	Hospital Discharges (%)	Hospital Visits (per 100,000)
Dersaadet	3.9	18.1	78.6	193907	86.5	343.8
Syria	2.9	1.9	5.7	8710	82.5	66.2
Tripoli	2.5	1.3	4.0	7725	54.7	19.9
Biga	13.9	1.4	7.6	382	83.3	8.3
Mamuretulaziz	1.8	0.5	2.1	3794	80.0	0.9
Trabzon	1.7	0.8	1.9	4046	78.3	17.0
Benghazi	2.0	0.2	0.0	1025	90.9	11.0
Basra	2.6	1.8	4.2	7320	74.7	47.8
Kastamonu	8.3	5.5	23.8	21020	86.1	140.2
Adana	7.5	5.8	23.6	27740	84.8	286.1

¹⁸Vilayet-i İdare-i Sıhhiye Nizamnamesi, Düstur, Tertip II, 5, 362-366.

¹⁹For these budgets, see. Tevfik Güran. *Osmanlı Mali İstatistikleri Bütçeler 1841-1918* (Ankara: Türkiye İstatistik Kurumu Matbaası, T.C. Başbakanlık Devlet İstatistik Enstitüsü, 1997).

²⁰For more data on Ottoman State for 1897 see the following study: Tevfik Güran. *Osmanlı Devletinin İlk İstatistik Yıllığı* (Ankara: Türkiye İstatistik Kurumu Matbaası, T.C. Başbakanlık Devlet İstatistik Enstitüsü, 1997).



Kosovo	2.1	0.4	0.5	1191	76.5	10.3
Beirut	3.2	2.2	7.5	1925	87.2	12.5
Sivas	2.0	2.7	1.6	7905	84.3	7.1
Manastir	1.9	2.1	6.5	2908	75.3	15.3
Yemen	0.2	0.3	0.2	46	69.6	1.6
Adrianople	5.1	2.7	15.1	17181	81.2	87.7
Thessaloniki	4.8	2.6	18.9	23569	81.9	146.3
Baghdad	1.4	1.9	2.8	12616	81.2	21.4
Ankara	2.9	1.6	6.5	4558	81.8	49.2
Aleppo	2.2	1.5	3.5	9275	88.4	20.5
İzmit	4.4	1.3	4.4	5261	80.1	66.1
Hejaz	0.3	0.6	1.4	2931	61.9	21.7
Diyarbakir	3.5	2.8	9.6	13353	81.7	72.4
Ioannina	3.9	5.4	24.7	32478	84.0	78.7
Jerusalem	3.8	4.2	16.3	35942	96.7	204.3
Bahrisefid	10.3	9.8	39.0	79621	93.4	170.9
Aydın	13.7	17.3	79.2	112406	87.6	741.7
Hudavendigâr	2.7	3.7	13.7	23910	88.4	201.3
Mean	4.1	3.6	14.4	23669	81.5	102.5

Notes: The data are from the first statistical yearbook of the Ottoman State and at the province level, including twenty-eight Ottoman provinces, and are available only for 1897. Public expenditures are in gush.

Table 1 presents four healthcare input variables, including the total number of hospitals per million population, the total number of healthcare employees per 100,000 population, the total number of hospital beds per 100,000 population, public health expenditures per 100,000 population, and two output variables such as the percent hospital discharges and hospital visits per 100,000 for twenty-eight Ottoman provinces. For instance, in 1897 in Jerusalem, about 97 people were admitted to the hospital, out of 100 who were discharged in a healthy condition. However, in Hejaz, about 62 individuals admitted to the hospital left the hospital healthy. Furthermore, the annual hospital visit rates are 742 and 344 per 100,000 per annum for Aydın and Dersaadet, respectively. Also, while the average hospital discharge rate is 82 for all Ottoman provinces, the average hospital visits rate is 103. It is normal for hospital visit rates to vary across different provinces due to several factors. For instance, urban areas typically have higher hospital visit rates because of greater population density, better access to healthcare facilities, and more awareness of medical services. In contrast, rural or remote areas might experience lower hospital visit rates due to limited access to healthcare, fewer facilities, and potential cultural differences in seeking medical care. Additionally, economic disparities between regions can lead to variations, as wealthier provinces may have more resources and infrastructure, increasing healthcare utilization. Lastly, demographic factors such as age distribution, employment sectors (e.g., higher rates of occupational injuries in industrial cities), and the prevalence of chronic conditions can also contribute to these differences.

Method

We analyze each output separately to distinguish differences in technical efficiencies for Ottoman provinces. For doing so, we use the Data Envelopment Analysis (DEA), which is a mathematical programming approach

measuring relative efficiency for a group of decision-making units²¹. In our analysis, each of the twenty-eight Ottoman provinces is considered a separate decision-making unit (DMU). A significant advantage of the DEA method is that it utilizes multiple inputs and outputs and converts these quantities into a single measure of performance, generally referred to as relative efficiency. Another advantage of using the DEA method is that it does not require any assumptions regarding the used variables' statistical features²².

A DEA model can be used as an input-oriented model minimizing the given inputs to reach at least the same output level and as an output-oriented model maximizing output without increasing the input levels²³. We employ the input-oriented DEA model for the two outcome variables of hospital discharges and hospital visits separately. It is clear that outputs are not directly controllable by the DMUs or policymakers, and one should select an orientation based on the controllability of variables, which, in our analysis, would be the input variables²⁴.

The original DEA method proposed the CCR model (Charnes, Cooper, & Rhodes), assuming constant returns to scale (CRS) for the efficiency of DMUs²⁵. Later on, the variable returns to scale (i.e., BCC model- Banker, Charnes, & Cooper) was proposed to evaluate the technical efficiencies of DMUs²⁶. In this study, we employ the BCC model to analyze the efficiency of twenty-eight Ottoman provinces.

We employ the input-oriented DEA model under the variable returns to scale (VRS) assumption, which is shown below:

$$\theta = \max \frac{\sum_{r=1}^s u_r y_{ro} - u_0}{\sum_{i=1}^m v_i x_{io}} \quad (1)$$

subject to $\frac{\sum_{r=1}^s u_r y_{rj} - u_0}{\sum_{i=1}^m v_i x_{ij}} \leq 1, (j = 1, \dots, n; r = 1, \dots, s; i = 1, \dots, m)$

$u_r \geq 0, v_i \geq 0, \text{ and } u_0 \text{ is unconstrained in sign.}$

where θ refers to the technical efficiency scores of n number of DMUs. y_r and x_i are outputs and inputs, respectively. u_r and v_i are the weights assigned for outputs and inputs in the formula, respectively, and all weights are greater than 0. In order to estimate technical efficiency scores for n DMUs, the program will run n times for each outcome, and θ is constrained between 0 and 1. If $\theta = 1$, the DMU is technically efficient and produces on the DEA frontier. If $\theta < 1$, then the DMU is technically inefficient and needs to contract its resources to reach the frontier.

Results

Table 2 presents the technical efficiency scores (θ) for each Ottoman province for the outcome of hospital discharges under the assumption of VRS and executing the input-oriented model. The first column of Table 2 reports the DEA technical efficiency scores from solving the objective function in equation (1).

²¹Tim Coelli, "A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program," *Centre for Efficiency and Productivity Analysis* 96(8) (1996), 1.

²²Donna Retzlaff-Roberts, Cyril F Chang, and Rose M Rubin, "Technical Efficiency In The Use Of Health Care Resources: A Comparison Of OECD Countries," *Health Policy* 69 (2004), 55.

²³Yong-bae Ji and Choonjoo Lee, "Data Envelopment Analysis," *The Stata Journal* 10(2) (2010), 267.

²⁴Pinar Kaya Samut and Reyhan Cafri, "Analysis of the Efficiency Determinants of Health Systems in OECD Countries by DEA and Panel Tobit," *Social Indicators Research* 129(1) (2016), 113; Timothy J. Coelli, D.S. Prasada Rao, Christopher J. O'Donnell, and George E. Battese, *An Introduction To Efficiency And Productivity Analysis* (Springer Science & Business Media, 2005).

²⁵A. Charnes, W. W. Cooper and E. Rhodes, "Measuring the Efficiency of Decision Making Units," *European Journal of Operational Research* 2(6) (1978), 429.

²⁶R. D. Banker, A. Charnes and W. W. Cooper, "Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis," *Management Science* 30(9) (1982), 267.



Table 2. VRS-INPUT Oriented DEA Efficiency Results for Hospital Discharges

Ottoman provinces	DEA Scores	Percent reduction in input variables
	(1)	(2)
Dersaadet	0.417	58.3
Syria	0.445	55.5
Tripoli	0.216	78.4
Biga	1.000	0.0
Mamuretulaziz	0.599	40.1
Trabzon	0.550	45.0
Benghazi	1.000	0.0
Basra	0.243	75.7
Kastamonu	0.192	80.8
Adana	0.198	80.2
Kosovo	0.602	39.8
Beirut	0.527	47.3
Sivas	0.721	27.9
Manastir	0.359	64.1
Yemen	1.000	0.0
Adrianople	0.231	76.9
Thessaloniki	0.258	74.2
Baghdad	0.843	15.7
Ankara	0.424	57.6
Aleppo	0.813	18.7
İzmit	0.247	75.3
Hejaz	0.667	33.3
Diyarbakir	0.349	65.1
Ioannina	0.363	63.7
Jerusalem	1.000	0.0
Bahrisefid	0.270	73.0
Aydın	0.126	87.4
Hudavendigar	0.662	33.8
Mean of inefficient provinces	0.430	57.0

Notes: We use hospitals (per million population), healthcare employees (per 100,000 population), hospital beds (per 100,000 population), and public health expenditures (per 100,000 population) as health inputs and the hospital discharges (%) and the hospital visits (per 100,000) as health outputs in our DEA analysis. We exclude the frontier provinces from the mean calculation.

The frontier provinces assume the value of 1 by definition: Biga, Benghazi, Yemen, and Jerusalem, indicating each of these four provinces is using its inputs efficiently to produce its current levels of hospital discharges. The Dersaadet's efficiency score in column (1), the capital city of the Ottoman Empire, for hospital discharges is 0.417, indicating that inputs can be reduced to 41.7% of their current levels while maintaining the same level of hospital discharges. In other words, the second column of [Table 2](#) shows that this would correspond to about a 58.3% reduction in inputs while keeping the outcome level constant, a rather remarkable outcome.



Table 3. VRS-INPUT Oriented DEA Efficiency Results for Hospital Visits

Ottoman provinces	DEA Scores		Reduction in input variables (%)	
	(1)	(2)	(1)	(2)
Dersaadet	1.000		0.0	
Syria	0.787		21.3	
Tripoli	0.378		62.2	
Biga	1.000		0.0	
Mamuretulaziz	0.519		48.1	
Trabzon	0.550		45.0	
Benghazi	1.000		0.0	
Basra	0.710		29.0	
Kastamonu	0.617		38.3	
Adana	1.000		0.0	
Kosovo	0.735		26.5	
Beirut	0.477		52.3	
Sivas	0.254		74.6	
Manastir	0.435		56.5	
Yemen	1.000		0.0	
Adrianople	0.597		40.3	
Thessaloniki	1.000		0.0	
Baghdad	0.450		55.0	
Ankara	0.914		8.6	
Aleppo	0.349		65.1	
İzmit	1.000		0.0	
Hejaz	1.000		0.0	
Diyarbakir	0.561		43.9	
Ioannina	0.293		70.7	
Jerusalem	0.899		10.1	
Bahrisefid	0.320		68.0	
Aydın	1.000		0.0	
Hudavendigar	1.000		0.0	
Mean of inefficient provinces	0.550		45.3	

Notes: We use hospitals (per million population), healthcare employees (per 100,000 population), hospital beds (per 100,000 population), and public health expenditures (per 100,000 population) as health inputs and the hospital discharges (%) and the hospital visits (per 100,000) as health outputs in our DEA analysis. We exclude the frontier provinces from the mean calculation.

Turning now to the evidence on hospital visit outcomes, [Table 3](#) provides the results obtained from the input-oriented DEA efficiency analysis with the assumption of VRS. Ten of the twenty-eight Ottoman provinces, including Dersaadet, Biga, Benghazi, Adana, Yemen, Thessaloniki, İzmit, Hejaz, Aydın, and Hudavendigar are technically efficient for hospital visits, meaning that these provinces are using their inputs efficiently to produce their current levels of hospital visits.

Three provinces, including Biga, Benghazi, and Yemen, were efficient for each of the two outcomes, such as hospital discharges and hospital visits, in [Table 2](#) and [Table 3](#). Eight of the twenty-eight Ottoman provinces, such as Dersaadet, Adana, Thessaloniki, İzmit, Hejaz, Aydın, Hudavendigar, and Jerusalem, are efficient for

only one output but inefficient for the other, suggesting that for example, Jerusalem is efficient for hospital discharges and inefficient for hospital visits. In other words, whilst Jerusalem is using its resources to produce hospital discharges efficiently, results suggest that there is room for improvement for hospital visits in Jerusalem's operations to become more efficient and potentially catch up with the more efficient provinces such as Biga, Benghazi, and Yemen.

What stands out in the table is that Sivas's technical efficiency score for hospital visits is 0.254 (the lowest technical efficiency score), indicating that inputs can be reduced to 25.4% of their current levels while maintaining the same level of hospital visits. In other words, the second column of [Table 2](#) indicates that policymakers could reduce inputs by 74.6% to keep the same level of hospital visits in Sivas, which is a rather interesting outcome. It is worth noting that seventeen of the twenty-eight Ottoman provinces are inefficient for both outcomes, meaning they are inefficient in producing health outcomes by consuming their inputs, including hospitals, healthcare employees, hospital beds, and public health expenditures.

The single most striking outcome to emerge from the analysis of hospital discharges in [Table 2](#) is the percent reductions in input variables for inefficient provinces. We see that, on average, inefficient provinces could reduce their inputs by about 57% without reducing the hospital discharges (bottom row in column 2 of [Table 2](#)), which is a significant amount. Compared to Aydın, where the largest possible input reduction can be seen at 87.4% while keeping the hospital discharge level constant, Baghdad could reduce its inputs by only 15.7% to reach its current outcome level. Further analysis shows that inefficient provinces could reduce their inputs by 45.31% without reducing hospital visits (bottom row in column 2 of [Table 3](#)). Comparing the two results in [Tables 2](#) and [3](#), it can be seen that there is more room to improve for provinces on average in terms of hospital discharges in using healthcare resources more efficiently.

Together, these results provide important insights into each Ottoman province's situation. These results suggest room for improvement for inefficient provinces to produce health outcomes using their resources efficiently. Overall, the results suggest that seventeen Ottoman provinces have room for improvement in efficiency and input utilization. By optimizing the number of healthcare employees, hospital bed capacity, and public health expenditures while maintaining the same level of hospital discharges and hospital visits, these provinces can work towards becoming more efficient and potentially achieve a higher efficiency score.

Conclusions

Access to the first statistical yearbook of the Ottoman Empire for 1897 has allowed us to evaluate the technical efficiencies of twenty-eight Ottoman provinces. This study is the first to examine individual provinces on technical efficiency in producing health outcomes such as hospital discharges and hospital visits. We analyzed the Ottoman provinces to assess which provinces utilized their health inputs, such as the number of hospitals, number of healthcare employees, and number of beds efficiently given the level of health outcomes. We utilize input-oriented DEA models assuming variable returns to scale to identify efficient Ottoman provinces in producing health outcomes.

What is interesting is that the Yemen province with lousy health outcomes was found to be technically efficient in terms of both hospital discharges and hospital visit outcomes. A possible explanation for this might be that Yemen can be technically efficient in using its healthcare resources, yet there is still room for improvement in its health outcomes.

It is somewhat surprising that while some provinces, such as Dersaadet and Adana, with good health outcomes, are technically efficient for hospital visits, they are inefficient for hospital discharges. This finding was unexpected and suggested that these provinces use their healthcare resources inefficiently for the output of hospital discharges. It can thus be suggested that a province can be technically efficient or ineffi-



cient in using its healthcare resources, given the level of its health outcomes. Furthermore, these findings may be somewhat limited by data availability because we do not have information about the severity of diseases. It could be argued that some provinces had registered patients with severe diseases, and others had patient applications with less severe conditions, which might draw the results. Further studies, which take this concern into account, will need to be undertaken.

Notwithstanding limitations, the present results are significant in at least two main respects. First, this is the first study examining technical efficiency scores on aggregate health outcomes for the twenty-eight Ottoman provinces for 1897. Second, we conclude that resource efficiency does not necessarily depend on the current level of a province's outcome.



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