ESSAYS ON TURKISH PRIVATE HOSPITAL INDUSTRY: DYNAMICS OF MARKET STRUCTURE, HEALTH REFORMS AND REGULATIONS

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DECLARATION OF ORIGINALITY

I, İsrafil Boyacı, certify that

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ABSTRACT

Essays on Turkish Private Hospital Industry:

Dynamics of Market Structure, Health Reforms and Regulations

This thesis consists of three essays on empirical industrial organization. The first chapter focuses on the hospital industry environment in Turkey, provides a comprehensive picture of the industry, and also sets the foundation for the following chapters. The descriptive empirical analysis, which covers a period when the private hospital market nationwide experienced considerable growth, provides an insightful description of the hospital industry in Turkey while comparatively investigating and discussing the change in the competitive and regulatory environment with the health reforms implemented under the Health Transformation Program 2003-2013 (HTP). The second chapter addresses hospital entry and competition by employing a panel dataset on hospitals and local market characteristics. The static model builds on the entry threshold method of Bresnahan and Reiss (1988, 1990, 1991). Besides explaining the proliferation of private hospitals nationwide during the HTP in local districts of Turkey over the sample period 2001-2014, the multi-period estimations help explore the overall role of the health reforms and regulations under the HTP in shaping the hospital market structure. The third and final chapter of the research analyzes the capacity choices of hospitals in the post-reform period after 2010 with the help of a stochastic strategic investment model in an oligopoly game setting. The equilibrium solution of the theoretical model and empirical analysis provides evidence for the discussion of whether the private hospitals in Turkey engage in a medical arms race in the form of strategic capacity accumulation due to the local competitive pressures on them.

ÖZET

Özel Hastane Endüstrisi Üzerine Makaleler:

Piyasa Yapısının Dinamikleri, Sağlık Reformları ve Düzenlemeler

Bu tez ampirik endüstriyel organizasyon konusunda üç makaleden oluşmaktadır. Birinci bölüm, Türkiye'deki hastane endüstrisinin kapsamlı bir resmini çizmekte ve takip eden bölümler için de bir temel oluşturmaktadır. Ülke genelinde özel hastane piyasasının önemli bir büyüme gösterdiği bir dönemi kapsayan betimleyici bir analiz ile, Türkiye'deki hastane endüstrisinin dinamikleri tarif edilirken Sağlıkta Dönüşüm Programı 2003-2013 (SDP) altında gerçekleşen sağlık reformları neticesinde piyasadaki rekabet ve regülasyon koşullarındaki değişimleri karşılaştırmalı olarak inceleyip ele almaktadır. İkinci bölüm, hastaneler ve yerel piyasa özelliklerini içeren panel veri seti kullanarak hastanelerin piyasaya girişini ve rekabeti ele almaktadır. Bresnahan ve Reiss'ın (1988, 1990, 1991) piyasaya giriş eşiği yöntemine dayanan statik model yardımıyla, 2001-2014 dönemine ait veriler kullanılarak, Türkiye'nin ilçelerinde SDP sırasında ülke genelinde gözlemlenen özel hastanelerin çoğalışı açıklanmaktadır. Bunun yanı sıra, çok dönemli tahminler ile SDP kapsamındaki sağlık reformlarının ve düzenlemelerin hastane piyasasını şekillendirmedeki genel rolü ele alınmıştır. Araştırmanın üçüncü ve son bölümü ise, 2010 yılından sonra reformları takip eden dönemde hastanelerin kapasite tercihlerini, oligopol oyun kurgusunda stokastik bir stratejik yatırım modeli yardımıyla analiz etmektedir. Teorik modelin denge çözümü ve bu çözümün ampirik analizi, Türkiye'deki özel hastanelerin yerel piyasa rekabeti baskısının etkisiyle stratejik kapasite birikimi biçiminde bir yarış içinde olup olmadıkları konusundaki tartışma için kanıtlar sunmaktadır.

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Finally, I would like to use this as an opportunity to give a big thanks to my family. In return for their support and patience throughout my lengthy education life, I dedicate this thesis to my parents first and all of my extended family members.

To my dear parents …

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ABBREVIATIONS

ADNKS	Address-based Population Recording System (*Adrese Dayalı Nüfus Kayıt Sistemi*)
CoN	Certificate of Need (*Ön İzin Gerekliliği*)
CT	Computed Tomography
GSS	General Health Insurance (*Genel Sağlık Sigortası*)
HHI	Herfindahl–Hirschman Index
HSA	Healthcare Service Area (*Sağlık Hizmet Bölgesi*)
HTP	Health Transformation Program
MoH	Ministry of Health
MRHS	Centralized Physician Appointment System (*Merkezi Hekim Randevu Sistemi*)
MRI	Magnetic Resonance Imaging
OECD	Organisation for Economic Co-operation and Development
PPP	Public-Private-Partnership
SEGE	Socio-Economic Development Index
SUT	Healthcare Implementation Communique (*Sağlık Uygulamaları Tebliği*)
SSI	Social Security Institution (*Sosyal Güvenlik Kurumu*)
SSK	Social Insurance Institution (*Sosyal Sigortalar Kurumu*)
USG	Ultrasonography medical imaging device
WHO	World Health Organization

CHAPTER 1

HOSPITAL INDUSTRY IN TURKEY

1.1 Introduction

In 2003, Turkey initiated a ten-year Health Transformation Program 2003-2013 (HTP, *Sağlıkta Dönüşüm Programı*). According to the Ministry of Health, in line with the World Health Organization's *Health for All in the 21st Century* policy, the guiding premise of the program was "health care service that is accessible, qualified and sustainable for every one" (Akdağ, 2012). The broad objectives of the policies introduced through the program include achieving universal health coverage, improving access to healthcare services, enhancing efficiency with better service quality, and reducing health inequalities. To attain these goals, the program pursued health reforms on both the demand and the supply sides of the health system at the same time. The Ministry of Health (MoH) advanced the transformation program's goals and implemented the health reforms by incorporating all of the country's health-related resources, including the private sector, into the health system while also implementing significant government regulation and planning. This has resulted in a substantial increase in the overall capacity of the health system in a relatively short period.

The introduction of universal health coverage, which ensures that every citizen has equal access to health services without facing financial hardship, was among the top priorities.[1] Improving health service coverage, ultimately health outcomes, primarily depends on the availability and accessibility of healthcare. Main instruments, reviewed in the next section, that the MoH used to accomplish this mission were the consolidation of health financing, the strengthened role of the private sector and competition in healthcare provision, the implementation of family medicine program at the primary care, new human resource policy, the use of digitalized health information systems, and the reorganization of the MoH.[2]

We should note here that this paper does not aim to make a complete definitive description and assessment of health reforms in Turkey, nor to cover and discuss different policy approaches. It is beyond the paper's purpose to thoroughly describe and discuss all the reforms under HTP. The main elements of the reforms are summarized. Regarding the object of analysis, the focus is on the healthcare markets, especially the general hospital market, not on the population`s health outcomes. The data used to provide aggregate figures throughout the paper are collected and compiled from the Health Statistics Yearbooks (2001-2019).[3] The year 2002 reflects the state of the hospital market environment before the implementation

[1] During the HTP, Turkey emphasized the goals of universal health coverage, renewal of the primary healthcare, people-centered care, integrating health in all policies and inclusive governance, which is consistent with the World Health Report 2008. The World Health Organization (WHO) defines universal health coverage (UHC) as “all individuals and communities receive the health services they need without suffering financial hardship. ... UHC strategies enable everyone to access the services that address the most important causes of disease and death and ensures that the quality of those services is good enough to improve the health of the people who receive them.” (WHO, 2019). However, note that “UHC does not mean completely free coverage for all possible health interventions” (WHO, 2018).

[2] In Section 2, we present a selective overview of the reforms under the Health Transformation Program 2003-2013 (HTP) of Turkey. For the complete description of the HTP reforms, we refer the interested readers to the Ministry of Health (2003, 2009, and 2011), OECD and Worldbank (2008), Akdağ (2012), Tatar et al. (2011) and Atun et al. (2013).

[3] The Health Statistics Yearbooks present data on the health system of Turkey within figures and tables. This creates another challenge for the researchers to collect and compile data from the yearbooks before the empirical analysis of the healthcare markets.

of the HTP reforms, and the post-HTP period until 2018 appears to be sufficient for the consequences of health reforms on the industry to become evident. Although the paper is rooted in the specific experience of Turkey, the conceptual notions and policy implications go beyond national boundaries to provide broad discussions about general issues in healthcare policies that are applicable to any particular national health system.

The paper proceeds as follows. The next section of the chapter provides a circumscribed description of the HTP. It continues with a review of the competition and market structure in the hospital market in Section 3 of the chapter. It is followed by Sections 4 and 5 with the analysis of the transition from a competitive market environment at the early phase of the HTP to a mix of competitive, regulated, and planned market settings in healthcare delivery at the completion of the program. In Section 6, we provide a review of research on the hospital sector from the 2000s onwards. Section 7 concludes the paper.

1.2 The transformation of Turkey's health system: A brief overview of the Health Transformation Program 2003-13 (HTP)

Turkey's health system has been transformed starting in 2003 to achieve universal health coverage together with an increase in the availability of and access to care on the delivery of healthcare. From 2003 onwards, remarkable progress has been made in ensuring better access and financial protection through a series of reforms. This section summarizes the main elements of the reforms. We give a selective review of the market environment in which hospitals operate, focusing on the health reforms and regulations introduced by the HTP that have direct effects on hospitals.

1.2.1 Consolidation of healthcare financing – Establishment of the Social Security Institution (SSI) as the single public purchaser

Prior to reforms, there were five insurance schemes with different benefit packages for different socioeconomic groups, mostly on the basis of employment: (i) *Sosyal Sigortalar Kurumu* (SSK) for formal sector employees, (ii) *Bağ-Kur* for self-employed citizens, (iii) *Emekli Sandığı* for retired civil servants, (iv) Active Civil Servants Insurance Scheme, and (v) *Yeşil Kart* for poor income groups. In 2008, Social Security Institution (SSI – *Sosyal Güvenlik Kurumu, SGK*) was established as a single organization, and all social security programs, including public health insurance programs, were pooled under this institution. During the period from 2003 to 2012, all the public health insurance schemes were gradually unified under the roof of the SSI with the implementation of the General Health Insurance (*Genel Sağlık Sigortası*) scheme, and the consolidation of health financing was completed. Hence, during the HTP, a single compulsory public health insurance scheme replaced the previously fragmented health insurance system.[4]

The General Health Insurance, as the single mandatory public health insurance, is premium-based. It is financed by employer and employee contributions, as well as government contributions that subsidize coverage for low-income people. Government contribution covers people who cannot afford to pay premiums. Beneficiaries are determined through means-testing procedure. When the income of the household is above the means-testing threshold (per capita income above one-third of gross minimum wage), in that case, individuals have to pay their insurance premiums out-of-pocket (see Social Security Institution, n.d.).

[4] For a detailed description of the transition from a multiple insurance schemes to a single-payer system, see Yıldırım and Yıldırım (2011) that mainly focuses on the healthcare financing reform in Turkey. Further, see OECD (2014, Chapter 4) that focuses on the role of payment systems in the development of the healthcare system of Turkey.

Private health insurance in Turkey serves a limited role. In addition to a conventional private health insurance scheme, a voluntary complementary private health insurance program with the name Complementary or Supplementary Health Insurance (*Tamamlayıcı veya Destekleyici Sağlık Sigortası*) was introduced in 2012. It is mainly aimed to be used to cover additional fees paid to private hospitals by patients or to access healthcare services in private hospitals that are not covered by public health insurance. It does not cover copayments to social health insurance and does not give supplemental coverage for pharmaceuticals. Citizens are unable to opt out of public health insurance even if they have private health insurance (see Social Security Institution, n.d.). Private health insurance spending, which constitutes the total private spending on health together with out-of-pocket expenditures, accounts for only 2.7% of all health spending in Turkey in 2019 (OECD, 2022). Despite the increasing trend in private health insurance in recent years, a small proportion of the population of Turkey has private insurance coverage. The number of people with all types of private health insurance is 3,704,596 in 2019, which corresponds to 4.5% of Turkey's population (Insurance Association of Turkey, 2019). Thus, private health insurance in Turkey serves as a supplement or complement to the coverage provided by the compulsory public health insurance program.[5]

1.2.2 Achievement of the universal health insurance coverage

Until the 2010s, a considerable proportion of the population in Turkey was still uninsured, with a rate of 32.8% of the population in 2008 (OECD/The World Bank,

[5] Private health insurance may have varying roles depending on a country's health financing system. It may be compulsory or voluntary, and it may serve as complementary or/and supplementary to public insurance. In some countries (Netherlands, Switzerland), it accounts for nearly half of total health spending, while it has negligible role in some others (Czech Rebuplic, Estonia, Sweeden) (OECD, 2022). Also, see Sagan and Thomson (2016), for an overview of the size, role and regulation of voluntary health insurance markets in countries across Europe.

2009). By the end of 2011, Turkey had achieved universal health insurance coverage.[6] Thus, with the completion of the HTP, Turkey has universal public health insurance coverage in a public-private mixed healthcare delivery system. However, we should remark that people who have not yet registered for the General Health Insurance program, as well as self-employed people who do not pay their insurance premiums, can still be 'uninsured'.

1.2.3 Increased role of the private sector in healthcare delivery

Prior to 2003, services at private hospitals were not covered by the public health insurance schemes unless the service was not available at public facilities, which is a rare condition. Beginning in 2003, health services from private hospitals, which had contracts with SSI, were taken under the public insurance coverage. Coverage for patient access to private hospitals that contracted with the SSI (almost all excluding a few of them) also encouraged investment by the private sector, and so reduced the burden on public hospitals. With this coverage, the private providers began to compete with the public providers and among themselves for patients, and they have been increasingly involved in healthcare delivery. The proliferation of private hospitals during the early years of the HTP, as depicted in the following section, directly increased the supply of hospital healthcare services. That helped narrow the gap between the healthcare supply and the increasing healthcare demand due to historically unmet needs and wider insurance coverage. Hence, with the HTP, the

[6] All OECD member countries had achieved (near-) universal insurance coverage of their populations by the 1990s, with the exception of Mexico, the United States and Turkey (Docteur and Oxley, 2003; Joumard, 2010; OECD, 2016). Almost every OECD country has UHC for a core set of services. For more information about the experiences of OECD member countries including Turkey on the achievement of universal health coverage, see OECD (2016). In Turkey, healthcare coverage includes both primary care and hospital care. According to OECD (2014), in Turkey's universal healthcare system, people has access to common range of health services, which is broad and comparable to those in other publicly financed services in most OECD countries.

role of the private sector in healthcare delivery has increased; however, its role in healthcare financing has remained very limited since the public health insurance system remained the main financing scheme.[7]

1.2.4 Increased competition and patient freedom of choice in healthcare

Public hospitals historically had capacity constraints which resulted in long waiting times to access hospital care. The achievement of universal health insurance coverage, together with the inclusion of private hospitals into the public insurance system during the HTP, has expanded the overall capacity of the health system and resulted in a more pronounced public-private mix in the delivery of healthcare on the supply side. On the demand side, patients are not restricted to a geographical area or a set of hospitals or physicians in their choice among healthcare providers. Patients do not need a referral from primary care centers to receive hospital services.[8] Thus, there seems to be unrestricted freedom of choice in healthcare delivery with a weak

[7] Turkey's private healthcare spending has a declining trend until 2010s. Historically, in Turkey, public health insurance coverage as a percentage of total population was 55.1% in 1990 and 66% in 1997. Out-of-pocket spending of people as a share of total expenditure on health was 31.4% in 1992 and 29.7% in 1995. Total expenditure on healthcare as a percentage of GDP was 3.8% in 1992 and 4.2% in 1997; public share of total expenditure on healthcare was 61% in 1990 and 71.9% in 1998 (Docteur and Oxley, 2003). Health expenditure as a share of GDP has increased to 5.8% in 2007, and then decreased to 4.6% in 2014 and 4.4% in 2018. Out-of-pocket expenditure has declined to 18.5% in 2003, increased to 22.8% in 2005, decreased to 14.1% in 2009, and then increased to 17.8% in 2014 and remained around 17% until 2018. Public share in health expenditure has reached 77% in 2010 and remain stable around 77% in the following years (Health Statistics Yearbooks). Turkey's health expenditures still lags behind that of most OECD countries, therefore cost containment does not appear to be a priority for the health system of Turkey.

[8] For a discussion of the referral system across the levels of healthcare of Turkey with its weak gatekeeping rules and country-level comparisons on the referral systems, see OECD (2014, chapter 3).

gatekeeping mechanism for health services.[9] Hence, with the completion of the reforms under the HTP, private (public) hospitals as well as physicians face greater competition among themselves and from public (private) hospitals.

1.2.5 Improved access to hospital care nationwide

During the HTP and afterward, a rapid rise in demand for hospital care has been observed in Turkey. According to the figures from the MoH's Yearbooks, typical hospital utilization figures have increased dramatically since the 2000s. The hospital visits per capita have risen from 1.9 in 2002 to 4.1 in 2010, 5.1 in 2014, and 6.1 in 2018. The total number of inpatient hospitalizations has increased from 5,508,263 in 2002 to 10,528,173 in 2010, 13,034,273 in 2014, and 13,651,377 in 2018. The total number of days stayed in hospitals has risen from 32,215,516 in 2002 to 42,922,416 in 2010, 51,861,464 in 2014, and 56,642,035 in 2018. The total number of surgical operations has climbed from 1,598,362 in 2002 to 3,830,727 in 2010, 4,798,946 in 2014 and 5,201,738 in 2018 (Table 1).[10]

Moreover, the number of typical medical diagnostic imaging devices and the number of exams by these devices have grown considerably between 2002 and 2018. The total number of MRIs has risen from 58 to 562 in 2008, 757 in 2014, and 915 in 2018. The total number of CTs has increased from 323 in 2002 to 759 in 2008, 1,071

[9] The impact of this 'complete freedom of choice' on paper may differ by geographic regions depending on the availability of hospitals in the close neighborhood. Some people may have a narrower choice set and may face higher financial and time costs to receive services than others simply due to where they live in. Also, there is still financial constraint for patients on the choice of private hospitals in the form of extra billing. In practice, the presence and number of providers and financial and geographical conditions may limit patient choice among hospitals, so the degree of choices available to patients differs across regions. Metropolitan provinces provide their residents with greater hospital options. Moreover, the depth and scope of the health services may vary. In addition, an informed hospital choice of patients requires data on hospital quality and health literacy.

[10] The dataset used to show aggregate figures at country-level throughout the paper are collected and compiled from the Ministry of Health's Health Statistics Yearbooks (2001-2019). Chapters 2 and 3 of the thesis employ panel dataset on the all individual hospitals of Turkey between 2002 and 2014, so the detailed descriptions of the panel data on hospitals are presented in Chapter 2.

in 2014, and 1,211 in 2018. A similar dramatic growth pattern is also observed in the other diagnostic imaging devices (Tables 2-4). Hence, with the completion of the reforms, Turkey's hospitals have been delivering higher amounts of healthcare with increased use of medical technology-intense services such as MRI, CT, and USG.[11]

Table 1. Changes in the Utilization of Hospitals in Turkey Between 2002-2018

Variables	Ministry of Health	Private	University	Total
Number of Hospital Visits				
2002	109,793,128	5,679,170	8,823,361	124,313,659
2006	189,422,137	15,529,416	12,588,872	217,540,425
2010	235,172,934	47,712,540	20,098,754	302,984,218
2014	292,100,331	72,333,383	32,143,930	396,577,644
2018	380.623.055	74.675.065	42.665.139	497.963.259
Per capita hospital visits				
2002	1.7	0.1	0.1	1.9
2006	2.7	0.2	0.2	3.1
2010	3.2	0.6	0.3	4.1
2014	3.8	0.9	0.4	5.1
2018	4.6	0.9	0.5	6.1
Number of inpatients				
2002	4,169,779	556,494	781,990	5,508,263
2006	5,303,347	1,220,176	1,165,277	7,688,800
2010	6,361,116	2,657,573	1,509,484	10,528,173
2014	7,396,239	3,900,407	1,737,627	13,034,273
2018	7,675,972	4,019,422	1,955,983	13,651,377
Number of surgical operations				
2002	1,072,417	218,837	307,108	1,598,362
2006	1,985,405	579,771	508,129	3,073,305
2010	2,039,021	1,215,159	576,547	3,830,727
2014	2,445,424	1,587,973	765,549	4,798,946
2018	2,766,914	1,531,822	903,002	5,201,738
Number of days stayed in hospitals				
2002	23,770,910	1,730,661	6,713,945	32,215,516
2006	27,320,145	2,877,624	9,073,326	39,271,095
2010	28,193,909	5,410,529	9,317,978	42,922,416
2014	32,078,874	9,521,899	10,260,691	51,861,464
2018	34,651,119	11,326,789	10,664,127	56,642,035

Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

[11] We should remark that citizens are not exposed to a strict gatekeeping in receiving healthcare, and providers have incentive to deliver greater amount of healthcare due to the physician payment and hospital reimbursement methods. Therefore, supplier-induced demand is a potential issue that is worth considering further.

Table 2. Changes in the Medical Device Numbers in Inpatient Institutions of Turkey Between 2002-2018

Numbers of imaging equipment in inpatient institutions					
Year	MRI	CT	Ultrasound	Doppler USG	ECHO
2002	58	323	1,005	681	259
2008	562	759	2,117	1,095	689
2009	625	838	2,283	1,251	791
2010	678	904	2,436	1,397	881
2011	709	974	3,775	2,091	1,181
2012	720	1,017	4,282	2,480	1,378
2013	751	1,058	4,756	2,793	1,542
2014	757	1,071	5,286	3,151	1,793
2015	794	1,119	5,518	4,015	1,897
2016	836	1,152	5,470	4,679	2,121
2017	884	1,186	5,635	4,892	2,269
2018	915	1,211	5,846	5,557	2,520

Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

Table 3. Changes in the Medical Device Capacity of Turkey Between 2010-2018

The number of medical devices in inpatient healthcare facilities per 1,000,000 population				
Variables	Ministry of Health	Private	University	Total
Number of MRI				
2010	3.3	5.1	1.0	9.4
2014	3.3	5.2	1.3	9.7
2018	4.1	5.6	1.5	11.2
Number of CT				
2010	5.1	5.8	1.4	12.3
2014	6.0	6.2	1.6	13.8
2018	6.6	6.5	1.7	14.8
Number of Ultrasound				
2010	19.2	11.2	3.5	34.0
2014	35.8	24.0	8.2	68.0
2018	33.1	29.0	9.2	71.3
Number of Doppler Ultrasound				
2010	8.6	8.1	2.2	18.9
2014	21.5	14.5	4.5	40.6
2018	45.5	16.3	6.0	67.8
Number of ECHO				
2010	4.8	5.4	1.8	12.0
2014	11.6	8.6	2.9	23.1
2018	18.6	8.9	3.3	30.7

Notes: The statistics on the number of medical devices across ownership types are available in the Yearbooks for the years after 2010.
Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

Table 4. Changes in the Utilization of the Devices in Turkey Between 2008-2018

Number of exams of imaging devices in inpatient healthcare facilities				
Variables	Ministry of Health	Private	University	Total
MRI exams				
2008	2,280,537	770,628	415,776	3,466,941
2011	4,352,817	2,065,924	803,446	7,222,187
2014	6,151,819	2,772,124	1,335,565	10,259,508
2018	10,180,784	3,135,503	1,967,369	15,283,656
CT exams				
2008	3,834,506	946,065	741,752	5,522,323
2011	5,440,694	1,733,007	1,165,010	8,338,711
2014	8,444,021	2,111,526	1,851,598	12,407,145
2018	13,255,939	2,433,929	2,632,116	18,321,984
Ultrasound exams				
2011	13,527,610	4,491,576	1,297,086	19,316,272
2014	19,459,180	5,746,185	1,946,065	27,151,430
2018	17,998,067	5,629,537	2,409,065	26,036,669
Doppler Ultrasound exams				
2011	3,157,262	1,119,006	482,245	4,758,513
2014	6,836,380	1,906,888	675,193	9,418,461
2018	14,526,373	1,983,226	983,610	17,493,209
ECHO exams				
2011	2,551,543	1,520,421	486,980	4,558,944
2014	4,295,635	1,404,597	690,464	6,390,696
2018	6,535,140	1,678,765	937,498	9,151,403

Notes: The statistics on the examination numbers for MRI and CT across ownership types are available in the Yearbooks for the years after 2008 and for the other devices after 2011.
Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

1.2.6 Digitalized health information systems

Increased patient choice during the HTP is facilitated by a new centralized electronic information and appointment system. In 2010, the MoH introduced the Centralized Physician Appointment System (*Merkezi Hekim Randevu Sistemi, MRHS*). The MRHS portal provides patients with information on the available healthcare providers and physicians as well as some other information like waiting times for the visit at different public providers. The system allows patients to book their hospital visits and family physician appointments by themselves online, by calling, or by mobile apps. This centralized booking interface of public providers empowers people to choose both hospitals and physicians at will. However, there is no local hospital catchment area practice or a mechanism of referral to hospitals with the gatekeeping role of primary care. From this aspect, digitalized platforms for appointments provide unconstrained freedom in the choice of hospitals and physicians across the country. Yet, this does not guarantee shorter waiting times for hospital visits since the healthcare demand is still overwhelming compared to capacity. The MRHS portal covers only public hospitals in the country, while each private hospital has its own appointment procedure.

1.2.7 Family Medicine Program and Full-day Law

Until 2010, physicians were allowed to work in dual practice and could operate their own practices half-time. Then, for physicians working in public hospitals, this was forbidden entirely with the introduction of the Full-day Law (*Tam Gün Kanunu*) in 2010. Physicians are not allowed to work part-time across public and private hospitals since 2011.

Another important development is the Family Medicine Program, which began to be piloted in 2005 and had been expanded nationwide by the end of 2010. It has become the main primary care system. Every citizen is required to register with a primary care physician in a family medicine center, but it is not obliged to get a referral from a primary care physician before receiving hospital services. Primary care services do not require insurance and are available to all for free.

These two new practices, full-day law and family medicine system, have changed the dynamics for the distribution of historically scarce physician resources across the sectors and levels of healthcare.[12] However, the percentage of physicians (including specialist physicians, general practitioners, and medical residents) who work for the private sector has remained almost the same over the years at around 20%. It has slightly changed from 20% in 2008 to 19.5% in 2010, 20.8% in 2014, and 19.2% in 2018, partially due to restraints by the MoH on the private sector's hiring procedures (MoH Yearbooks).

1.2.8 Increased government regulations and planning in healthcare

Greater involvement of both public and private sectors in healthcare came with a stronger stewardship role of the government.[13] In line with its new roles and functions as a result of the health reforms, the MoH was reformed by the law introduced in 2011. The affiliated institutions, agencies, directorates and departments with the Ministry were reorganized, and new ones were created.[14] During and after the HTP, the MoH has undertaken various steps to strengthen its regulatory and planning roles. Two major regulatory practices were on health prices and hospital entry into the market, among others. Two fundamental structural initiatives that helped in regulation have been Health Service Areas and integrated public healthcare campuses (City Hospitals) projects. To better address these regulatory actions, in the next section, we first present how the hospital competition and resulting market

[12] The levels of healthcare are typically organized as (i) primary, (ii) secondary, and (iii) tertiary. The Family Medicine Centers are the main primary care providers. General hospitals are among the secondary level care providers. Tertiary care is provided by higher-level hospitals such as teaching and research hospitals, and university hospitals.

[13] "Stewardship, sometimes more narrowly defined as governance, refers to the wide range of functions carried out by governments as they seek to achieve national health policy objectives. In addition to improving overall levels of population health, objectives are likely to be framed in terms of equity, coverage, access, quality, and patients' rights." Stewardship, Health Systems, World Health Organization, Accessed April 23, 2018.

[14] See Akdağ (2012) for the description of the reorganization of the Ministry, and WHO (2012) for a brief discussion on it.

structure were shaped from the 2000s onwards. Then, we proceed with a discussion of MoH regulations.

To summarize the major developments with the HTP, the government has promoted increasing competition on the provider side of the health system. Nevertheless, today after the HTP, financing healthcare in Turkey is mainly a public responsibility. The SSI of Turkey serves as the single national purchasing agent reimbursing the healthcare providers on behalf of the public via compulsory health insurance of citizens. On the delivery side, with the HTP, Turkey has provided patients with a larger hospital choice set containing the private sector. The hospital market has responded to this policy with a surge in the number of private hospitals within several years, as we explore in the next section.

1.3 Competition and hospital market structure

Market-oriented policies, as mechanisms to achieve health goals, can be used on different components of the health systems, namely on the finance side, provision side, or both.[15] Countries employ various degrees of combinations. Most countries utilize a mix of financing and delivery from the public and private sectors, but the private-sector component is typically smaller.[16] Turkey chose to utilize competition

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[15] It can be argued whether the introduction of 'competition' and 'market discipline' was the most appropriate mechanisms by which to achieve reform objectives. However, this is beyond the scope and purpose of this paper. See European Commission (2015) (or the summary of the panel's full report at Barros et al. (2016)) for a discussion on the use of competition among healthcare providers with examples from different European countries. In the context of health system of Turkey, beyond the research on international health systems that we cited, empirical research on the Turkish hospital market appears to have concentrated on competition and hospital efficiency (see, for example, Sahin, Ozcan and Ozgen, 2011; Erus and Hatipoglu, 2013; Torun, Celik and Younis, 2013; Ozgen Narci et. al., 2015; Yıldız, Heboyan and Khan, 2018).

[16] See Paris et al. (2010) for a review of health systems' institutional characteristics in 29 OECD countries, and Lorenzoni et al. (2019) for the health systems characteristics in 21 Latin American and Caribbean countries. Joumard (2010) identifies groups of countries sharing similar health institutions. Also, a set of international healthcare system profiles for comparison is available at http://international.commonwealthfund.org/countries/.

from the private sector on only the delivery side to achieve the objectives of the HTP while strengthening the single public purchasing mechanism on the financing side.

Hospitals in Turkey compete for patients and physicians.[17] They do not compete for contracts with healthcare purchasers in a market environment with a single public purchaser where there is no competition for providing public health insurance coverage. Competition among hospitals can emerge on the basis of both price and quality due to the two-part character of the Healthcare Implementation Communique (*Sağlık Uygulamaları Tebliği, SUT*) payment scheme for private hospitals, which is detailed in the next section. Medical technology helps in attracting both patients and physicians; therefore, competition in technology as a medical-arms race can take place as well.

The degree of rivalry in a typical market is represented by market structure, which is generally described as the number of firms and their size, but it could also be the set of services provided and their quality, for example. The traditional understanding of competition, which considers the presence of multiple sellers, however, has been strongly questioned in healthcare markets.[18] However, counting the number of hospitals and their sizes in a market is the first step in analyzing competition among hospitals. Therefore, in this section, we present and shortly discuss the main patterns in the hospital market in Turkey from 2002 to 2018.

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[17] In recent years, through 'healthcare tourism' policy of the government, hospitals in Turkey compete also for international patients in the global healthcare markets. Therefore, international patients offer another source of revenue for both public and private hospitals.

[18] See, for example, Gaynor (2006), and Gaynor and Town (2011) for the issues concerning the nature of competition and a review of the literature on competition in healthcare markets. For a broader debate with country experiences about the impact of competition on the provision of hospital services, see OECD (2006) and OECD (2012).

The hospital market in Turkey, consisting of publicly- and privately-owned hospitals, grew rapidly during the implementation of the HTP.[19] The number of hospitals has increased from 1,156 in 2002 to 1,528 in 2014. Particularly, as a consequence of the health policy that initiated coverage for private hospitals in the public health insurance system, there has been a surge in the number of private hospitals. Between 2002 and 2005, there was a modest increase in the number of private hospitals, from 271 to 293. Then, there happened a sharp rise to 489 private hospitals by 2010; but then, with a slower growth rate, the number of private hospitals reached 556 in 2014. On the other hand, during the same period, the number of public MoH hospitals increased at a moderate rate. There were 774 MoH hospitals in 2002, 843 in 2010, and 866 in 2014. In recent years, hospital numbers have risen slightly, from 556 private hospitals in 2014 to 577 private hospitals in 2018; and from 866 public MoH hospitals in 2014 to 899 public MoH hospitals in 2018 (Table 5 and Figure 1).

Figure 2 presents the change in the number of hospitals in Turkey between 2001 and 2018. The growth pattern of private hospitals shows an S-shaped path. Over 2001-2005, hospital entry was rare, but then there appeared to be a substantial number of new hospital entries between 2006 and 2010 during the growth phase. Then, the rate of growth started to slow down. After 2013, at the mature phase of the hospital market, the number of private hospitals remained relatively stable.

[19] The Ministry of Health's Health Statistics Yearbooks separate hospitals into four groups in terms of ownership: (i) Ministry of Health, (ii) University, (iii) Private, and (iv) Ministry of National Defense. In 2016, the hospitals of the Ministry of National Defense (about 34) were transferred to the Ministry of Health. After that, hospitals have been divided into three broad categories in terms of ownership: public MoH, private, and university. Public hospitals are owned by the Ministry of Health. University hospitals are publicly- or privately-owned. Privately-owned hospitals are mainly for-profit hospitals. Public sector provides a large portion of the hospital care in Turkey. In 2014, Turkey has 1,528 hospitals in total; 866 public MoH hospitals, 69 university hospitals, 556 private hospitals, and 37 hospitals affiliated with the Ministry of National Defense, municipalities, and government entities.

The rapid expansion in the number of private hospitals during the early stages of the HTP, which was driven by the involvement of private hospitals into the public health insurance, brought about the introduction of a Certificate of Need (CoN) entry regulation on hospitals in 2008. Also, after 2007, the government began to strictly regulate the public insurance reimbursement of private hospitals. These two regulations on market entry and reimbursement of hospitals, in particular, have changed the growth path of the private hospital markets. Since establishing a new hospital typically take more than two years, the restrictive CoN regulation on the number of new hospital openings took effect within several years after it was enacted. Thus, the increase in the number of private hospitals has slowed, especially after 2010, as seen from the S-shaped growth path in Figure 2.

Table 5. Number of Hospitals in Turkey by Ownership Between 2001-2018

Year	Ministry of Health	Private	University	Other	Total
2001	869	267	43	61	1,240
2002	774	271	50	61	1,156
2003	789	274	50	61	1,174
2004	829	278	52	58	1,217
2005	793	293	53	57	1,196
2006	767	331	56	49	1,203
2007	848	365	56	48	1,317
2008	847	400	57	46	1,350
2009	834	450	59	46	1,389
2010	843	489	62	45	1,439
2011	840	503	65	45	1,453
2012	832	541	65	45	1,483
2013	854	550	69	44	1,517
2014	866	556	69	37	1,528
2015	865	562	70	36	1,533
2016	876	565	69		1,510
2017	879	571	68		1,518
2018	889	577	68		1,534

Notes: The number of hospitals under the category '*Other'* includes the hospitals owned by the Ministry of Defense, municipalities, and other public institutions.
Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

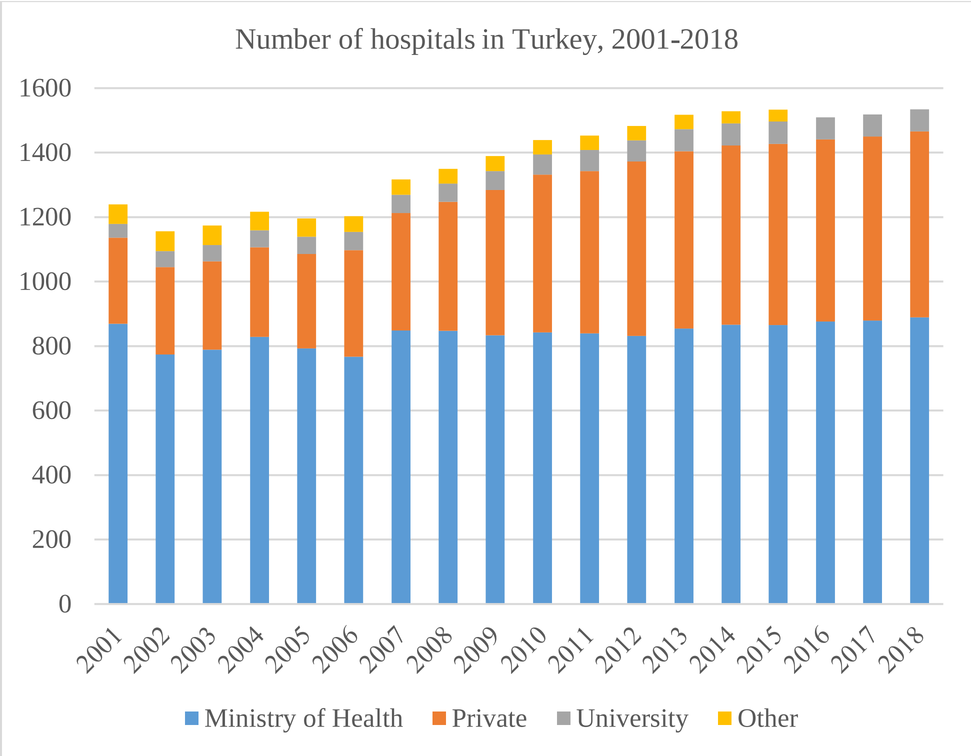


Figure 1. Change in the number of hospitals in all sectors between 2001-2018

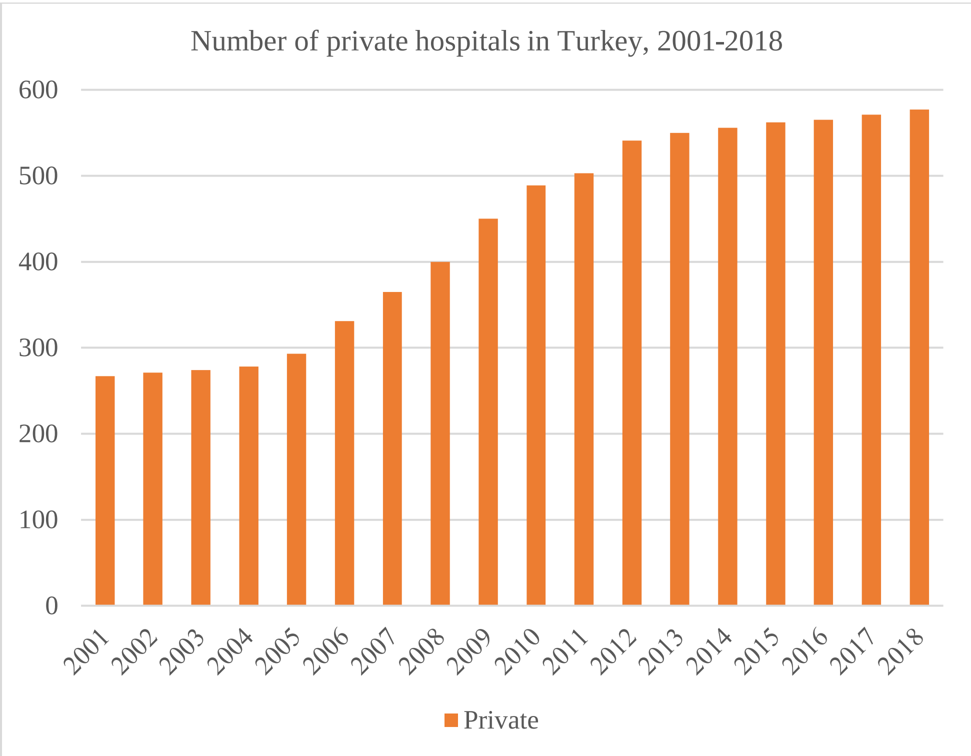


Figure 2. Change in the number of private hospitals between 2001-2018

Table 6. Number of Hospital Beds in Turkey by Ownership Between 2002-2018

Year	Ministry of Health	Private	University	Other	Total
2002	107,394	12,387	26,341	18,349	164,471
2003	107,771	12,917	26,619	18,158	165,465
2004	108,511	12,671	28,025	17,500	166,707
2005	110,109	13,876	29,014	17,973	170,972
2006	110,819	14,639	31,193	17,691	174,342
2007	112,037	17,397	30,978	17,588	178,000
2008	114,428	20,938	29,912	17,905	183,183
2009	115,443	25,178	30,112	17,905	188,638
2010	120,180	28,063	35,001	16,995	200,239
2011	121,297	31,648	34,802	6,757	194,504
2012	122,322	35,767	35,150	6,833	200,072
2013	121,269	37,983	36,056	6,723	202,031
2014	123,690	40,509	36,670	5,967	206,836
2015	122,331	43,645	38,361	5,311	209,648
2016	132,921	47,143	37,707		217,771
2017	135,339	49,200	41,324		225,863
2018	139,651	50,196	42,066		231,913

Notes: The number of hospital beds under the category 'Other' includes the hospital beds that are owned by the Ministry of Defense, municipalities, and other public institutions. Hospital beds are the beds placed in patient rooms or units where patients are given continuous medical care, where patients are hospitalized for more than 24 hours to provide care and treatment. The number of hospital beds includes beds in intensive care, premature and newborn unit (incubator, open baby bed), burnt beds in central and burnt rooms, and qualified beds.
Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

As seen in Table 6, the number of private hospital beds has increased from 12,387 in 2002 to 28,063 in 2010, to 40,509 in 2014, and to 50,196 in 2018. Despite the fact that the rise in the number of private hospitals has slowed down, following the implementation of the tight regulation on the opening of new hospitals after 2008 and the planning-oriented health policies after 2010, the growth of the private hospital market appears to continue more in the form of capacity expansion of existing hospitals. In contrast, there does not appear to be such a sharp increase in the number of public hospital beds over the study period. The number of public MoH hospital beds has risen from 107,394 in 2002 to 120,180 in 2010, to 123,690 in 2014, and to 139,651 in 2018. However, there happened a significant rise in the number of public hospitals' qualified and intensive care unit beds. These patterns together can be interpreted as that, during the HTP years, the public sector has upgraded existing public hospital beds to more equipped forms of hospital beds. However, in accordance with the planning-oriented national health policies and new investments on public hospitals through city hospitals projects, particularly after 2015, both the number of public hospitals and public hospital beds have been increasing at a higher rate.[20]

Another noticeable aspect of the growing private hospital market in a mixed private-public industry environment is its rapid expansion in terms of market share and capacity. The market share of private hospitals in terms of beds among all hospitals was 7.53% in 2002, which has increased to 8.00% in 2006, 14.01% in 2010, 19.58% in 2014, and 21.6% in 2018. Table 7 further contains the countrywide aggregate levels of hospital capacity changes for several more indicators of hospital capacity from 2002 to 2018. There appears to have been a steady increase in hospital beds and medical technology measures of hospital capacity between 2002 and 2018. In addition to bed capacity expansion, private hospitals have a dramatic increase in the number of main diagnostic imaging devices as well. For example, the private sector has higher numbers of CT and MRI devices than the public sector, although the public sector still serves with larger numbers of examinations (Tables 3 and 4). There has also been observed a rise in bed occupancy rates of both public and private hospitals. Private hospitals have higher increases in bed occupancy rates from 32% in 2002 to 51% in 2010 and to 62% in 2018, as the public hospitals continue to have

[20] The number of hospital beds is still lower than most of the other OECD countries. Turkey's hospital beds in all sectors have increased from 24.8 beds per 10,000 population in 2002 to 26.3 in 2008, 26.6 in 2014, 28.3 beds in 2018. However, as of 2018, Turkey has still notably lower hospital beds per capita compared to 46.5 beds per 10.000 population in other OECD countries, on average. Also, the MoH-affiliated hospital beds per 10,000 population has slightly changed from 16.2 in 2002 to 17.0 in 2018, so it appears that the bed capacity expansion in Turkey has been contributed more by private and university hospitals (MoH Yearbooks 2002-2018). It should, however, be noted that Turkey has a younger population compared to OECD averages, and the proportion of people aged 65 and over are relatively low.

higher occupancy rates of 61% in 2002 and 68% in 2018 compared to the private hospitals.[21] On the other hand, hospitals continue to compete in a market environment characterized by physician shortages despite the considerable increases in the total number of physicians over the years.[22]

Table 7. Changes in the Hospital Capacity Figures Between 2002-2018

Variables	Ministry of Health	Private	University	Total
Number of qualified beds				
2002	6,839	5,693	6,402	18,934
2006	14,582	13,338	8,125	36,045
2010	35,747	21,235	11,501	68,483
2014	50,587	29,283	18,651	98,521
2018	83,277	33,014	23,112	139,403
Number of intensive care unit beds				
2002	869	992	353	2,214
2006	4,501	4,011	2,446	10,958
2010	8,239	6,344	3,726	18,309
2014	11,874	11,569	5,129	28,572
2018	16,086	15,973	6,039	38,098
Bed occupancy rate (%)				
2002	60.6	32.0	69.8	59.4
2006	67.5	48.0	79.7	67.9
2010	64.3	50.8	72.9	63.8
2014	71.1	56.1	76.7	68.7
2018	68.0	61.8	69.5	66.9
Number of physicians				
2002	57,406			91,949
2006	61,292			104,475
2010	72,435	24,077	25,445	123,447
2014	77,876	28,245	28,228	135,616
2018	91,559	29,429	32,140	153,128

Notes: Qualified beds are the beds in the rooms with a toilet and bathroom, maximum of two patient beds, television, telephone, refrigerator, dining table, shelving, and a foldable companion chair. These numbers are included in the total number of beds.
Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

[21] While the bed occupancy rates in Turkey have improved over years, it is lower than most of the OECD countries. Higher bed capacity expansion with relatively lower bed occupancy rate might be an indication of overcapacity investment for reasons other than healthcare need. See Chapter 3 of the thesis that examines the hospital capacity decision in Turkey.

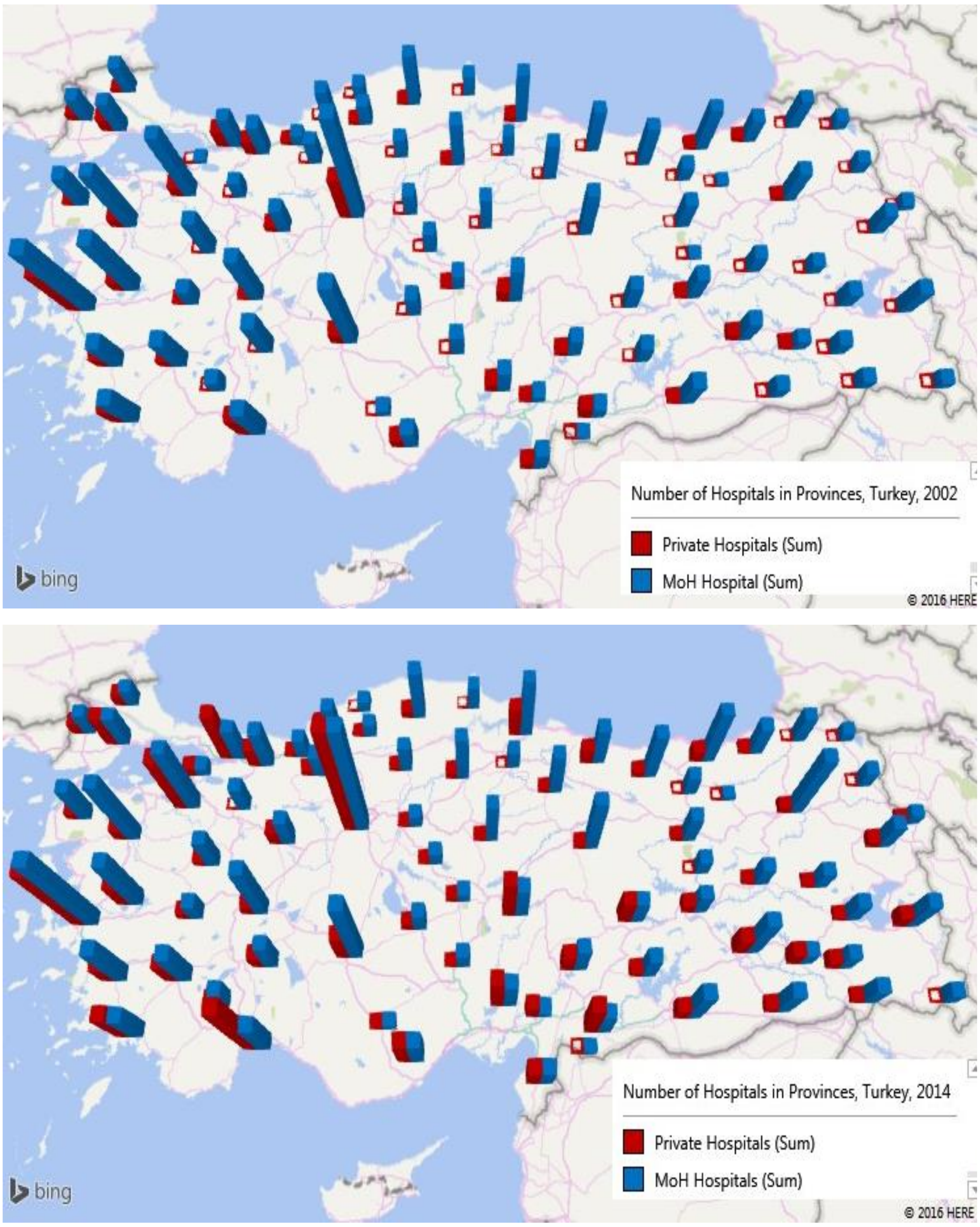
[22] Physician per 100,000 population in Turkey is 187 in 2018, which is low compared to 352 physicians in OECD countries and 379 physicians in EU countries on average. It was 138 physicians in 2002 and 167 physicians in 2010 (MoH Yearbook 2019). Although there is an increasing pattern in the per capita total physician numbers over years, Turkey still seems to have physician shortage in proportion to its population.

In terms of regional variation, prior to the HTP, the private hospitals in Turkey were concentrated mainly in the western part of the country, and more than half of the private hospitals were located in Ankara, İstanbul, and İzmir. In 2002, there were no private hospitals in 40 of Turkey's 81 provinces (at that time, there were a total of 80 provinces). In 2014, 69 of the 81 provinces had at least one private hospital, while 28 of the provinces had five or more private hospitals. Despite the continued concentration of hospitals in major metropolitan cities when the HTP ended, as of 2014, the geographic distribution pattern of hospitals appeared to shift in favor of previously underserved areas.[23] Metropolitan provinces provide larger option sets to their residents in their hospital care choices. Figure 3, which depicts the spatial distribution of hospitals among provinces, demonstrates the regional variation in hospital care provision. Both before and after the HTP, as shown by maps in Figure 3, there appear to be differences in the distribution of hospitals, particularly private hospitals, among provinces. In terms of hospital service availability, it seems that there has been an improvement in the availability of healthcare among provinces, while there are provinces where the choice of hospitals is limited to only one or two.[24] Thus, we can at least say that, following the completion of the HTP in 2014, the vast majority of cities have both private and public hospitals with several options in their regions, as visualized in Figure 3.[25]

[23] We should remark that provinces differ significantly in terms of land area, population, and socio-economic development.

[24] See Boyacı (2017) for a short discussion on that the entry of private hospitals helped in reducing regional disparities in healthcare service delivery. However, there is need for further research about the impact of private hospitals on the access, utilization, cost distribution and quality aspects of healthcare before judging the impact on social welfare of the private healthcare delivery.

[25] See Aksan, Ergin and Ocek (2010) for an investigation of the regional differences through the change in capacity and utilization of health services at public and private hospitals of Turkey between 2001 and 2006. They found that regional inequalities decreased for private sector considerably but not for public sector. However, we should note that the analysis covers starting period of the HTP in which there was not a universal public health insurance system that also covers private hospital care.



Notes: The height of the bars indicates the number of hospitals in provinces. Public MoH hospitals are represented by the blue bars on the right, and private hospitals are shown on the left by the red bars. The unfilled red squares represent the provinces with no private hospitals. Because of its numerous hospitals, which form a spike on the map, the bar of İstanbul has been removed from the map to make the other provinces' bars more visible.
Source: Boyacı (2017)

Figure 3. Distribution of hospitals in Turkey to the provinces in 2002 and 2014

Another trend in the hospital market appears to be the emergence of regional and national hospital chains. In addition to single-market independent hospitals, there are hospitals that are part of a multi-market hospital chain, which operate across the country or in several provinces in close proximity.[26] During the HTP, the overall market environment was quite favorable for the growth of private hospitals. Some hospitals with a corporate management style that had higher abilities to access investment funding have prospered more. In a sense, the contractual relationship of private hospitals with the SSI on the reimbursement of public patients has functioned as a source of revenue guaranteed by the state. This has encouraged them to purchase additional hospitals or to build new hospitals as branches in order to take advantage of the ‘safe’ profit opportunity quickly. Furthermore, hospital chains can benefit from providing healthcare in larger quantities through the practice-makes-perfect effect or/and efficiency gains due to scale economies. Also, their corporate reputation with greater salary and non-salary benefits might have helped them in attracting better-qualified physicians. Therefore, at some provinces, single-market independent hospitals are competing with multi-market national-brand chain hospitals that have greater financial sophistication and managerial depth.[27]

[26] There is no formal identifier for chain hospitals in Turkey, therefore, on paper, the MoH treats each hospital as a separate entity. In the U.S., a multihospital system is defined as “two or more hospitals that are owned, leased, sponsored, or contract managed by a central organization” (American Hospital Association (AHA), 2019). Beyond counting the number of branches, private chain hospitals in Turkey can also be divided into categories according to the extent of the geographical dispersion of their branches such as regional and national or intra- and inter-provinces depending on whether each branch of a hospital chain is located in a single province or not.

[27] After 2010, financial investors have become the main source of funding for hospital investments in the increasingly capital-intensive hospital industry. Several hospital chain groups, which are mostly funded by foreign capital investment companies, have expanded their branches across the country. Thus, profit-seeking orientation in healthcare delivery has become more explicit and stronger. Investor-owned corporate hospital chains have functioned as ‘benchmark’ for the single hospitals on the development of business-style management and operations like corporate management, medical accounting, customer relations, marketing and brand management, and other non-clinical hospital services (such as luxury accommodations, rich amenities and personalized services) that generate new sources of revenues. On the other hand, they might have practiced some opportunistic behaviors such as ‘cream-skimming’ through being selective for ‘good’ patients in admissions, and leaving the remainder to public hospitals. The impacts of the increased nationwide presence of hospital chains (in terms of business-stealing, positive spillovers and other positive or negative externalities they created) merit further research. Here we only provide information from which such consideration can begin.

Thus, as the descriptive patterns documented above demonstrate, while the hospital market in Turkey has grown, the structure of the hospital care market has also changed. First, there is competitive pressure from public hospitals on private hospitals and vice versa. In local markets with single or two private hospitals, the presence of public competitors constrains, to some extent, the misuse of market power.[28] Also, people are not restricted in their provider choice with a hospital set in a particular geographical area. Thus, although hospital services are inherently consumed locally, the presence of unrestricted hospital choice of people with weak gatekeeping mechanisms still makes it more complicated to define the geographical scope of hospital competition. Furthermore, hospitals compete under entry and price regulations that we address in the next section.

1.4 Regulation

The introduction of competitive mechanisms in healthcare delivery was the program's defining feature in the initial phase of the HTP. Later, the market-oriented arrangements have been accompanied by increased regulations of the hospital market. On the financing side, in 2007, a new provider payment mechanism (SUT scheme) was adopted for reimbursement of private hospitals by the Social Security Institution (SSI). The SUT payment method regulates the pricing of hospital care by setting base reimbursement amounts for each itemized hospital service. On the delivery side, in 2008, a Certificate of Need (CoN) regulation on the establishment and capacity expansion of private hospitals was introduced. In this section, we describe these two regulations on the pricing and reimbursement of healthcare and

[28] In hospital markets, competitive market structure does not require the presence of many hospitals, or a single private hospital does not always mean a monopolistic market structure. See Gaynor and Vogt (1999), Gaynor (2006), and European Commission (2015) for a discussion on that the impact of competition on healthcare price and quality is context dependent.

the hospital market entry, which directly impact the evolution of the hospital market's competitive structure during the HTP.

1.4.1 Payments to hospitals – the Social Security Institution's Communique on Healthcare Practices (*Sağlık Uygulamaları Tebliği, SUT*)

The publicly funded healthcare system of Turkey has a uniform pricing structure across the country. Public hospitals are subject to global budgets, which are negotiated between the Ministry of Health and the Social Security Institution. This is accompanied by a fee-for-service scheme for physicians, so-called performance-based payment, which is on top of the base salary for public sector physicians.[29] As to private hospitals, they are allowed to contract with the SSI and then accept publicly insured people. Private hospitals that have contracted with the SSI (all but a few) are subject to the SUT in pricing their services, and the public insurance pays them for providing healthcare to the public patients. The SSI pays the contracted private hospitals a flat fee for each service (that is, payments by procedures or services), which is set by the SUT scheme, on behalf of public patients. The system also allows private hospitals to charge patients additional fees up to a certain limit.

The SUT scheme simply sets single pricing for each service across the country, regardless of the differences in regions or hospitals where the service is delivered.[30] It sets base prices as the common reimbursement rate, but it allows

[29] Global budgets provider payment method is defined in Dredge (2009) as "the allocation of a payment fixed to a healthcare provider to cover the aggregate costs over a specific period to provide a set of services that have been broadly agreed on. … Typically, providers have flexibility to make decisions about how to allocate funds across expenditure categories." Also, see Wolfe and Moran (1993) for the discussion on the use of global budgets to control healthcare costs in the hospital sector in OECD countries.

[30] Since the SUT practice began, there is a continuous uncertainty on how the prices determined and updated, and on the future of the SUT prices. There has been an ongoing debate and bargaining on the SUT prices between private hospitals and the health policy makers.

private hospitals an extent of flexibility in charging patients for additional billing. Private hospitals are permitted to charge people up to 200% of the SUT payment amount in addition to the reimbursement they receive from the SSI.[31] Over the course of the HTP, this ceiling percentage that limits extra charges above SUT pricing was adjusted multiple times. When it was introduced in October 2008, the limit percentage was 30%; it increased to 70% in November 2009, 90% in October 2012, and 200% in October 2013. Patients pay for this extra bill out-of-pocket.[32]

The variations in the amount of additional billing among private hospitals can reflect both the difference between the quality of medical services and non-medical hoteling services provided by hospitals (such as patient rooms, catering, and patient relations). However, hospital payments by the SSI are based on activity rather than outcomes. The unit prices for each itemized healthcare service are set without adjustments for hospital performance or patient severity of illness. This creates a risk of encouraging healthcare providers to focus more on quantity and productivity.[33] Moreover, the SUT reimbursement mechanism has made private hospital care financially more accessible for people (although not completely free of charge). Nevertheless, the quality of the service delivered is in question. Private hospitals may

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[31] Republic of Turkey Official Gazette, "Bakanlar Kurulu Kararı," Date:08.12.2009, Number: 27426. Republic of Turkey Official Gazette, "Bakanlar Kurulu Kararı," Date:17.03.2012, Number: 28236. Republic of Turkey Official Gazette, "Bakanlar Kurulu Kararı," Date:12.10.2013, Number: 28793

[32] After the regulation on private health insurance in 2012, the additional billing charged by the private hospitals began to be able to reimbursed by the voluntary supplementary or complementary private health insurance of patients if they have this kind of private insurance scheme. However, although it has considerably risen in recent years, the number of people who have supplementary or complementary private health insurance is 1,354,318 in 2019 that still corresponds to less than 2% of the Turkey's population (Insurance Association of Turkey, 2019).

[33] Country experiences show that hospital payments can be arranged in a number of ways. Different payment mechanisms have differing influences on hospital behaviors. See Langenbrunner and Wiley (2002) for the description of alternative hospital payment methods and for the discussion on how hospitals are funded across countries.

deliberately choose to or be forced to lower the quality of their services due to the pricing constraint imposed by the SUT payment scheme.[34]

1.4.2 Hospital entry to the market – the Certificate of Need (CoN) requirement

The HTP's health reforms encouraged the private sector to enter the hospital market across the country, and as a result, more private hospitals were opened during the early years of the HTP. A considerable public-private sector mix has emerged in the delivery of healthcare. Then, the rapid growth of private hospitals led to additional regulations on hospital markets. In February 2008, the government introduced a restrictive regulation on hospital entry, a Certificate of Need (*Ön İzin*, CoN) requirement on the establishment and capacity expansion of private hospitals, which slowed the rapid expansion of private hospitals in the following years.[35]

Following the CoN practice, a prior consent from the Ministry of Health's Health Services Planning Department (*Sağlık Hizmetleri Planlama Dairesi Başkanlığı*) is required to open a private hospital; similarly, existing private hospitals must receive approval to extend their capacity. The aim with the CoN practice is to control hospital distribution by matching new hospitals with hospital-needy regions on a demographical and geographical basis, thereby improving regional equality in the face of excessive concentration in big cities and inadequate provision in

[34] As discussed in European Commission (2015), quality competition under regulated prices arises if the healthcare providers have a positive margin; otherwise, if the regulated prices are set too low, competition may destroy quality of care. Thus, increased competition may result in a rise in the excessive use of low-quality healthcare. Also, another concern is on the possibility that private hospitals may illegally charge patients by additional billings beyond the price cap regulated by the SUT in case of poor compliance and weak monitoring and enforcement. See Ozgen et al. (2010) and Yılmaz (2021) for the examination of the presence of informal out-of-pocket healthcare payments in Turkey.

[35] Republic of Turkey Official Gazette, "Özel Hastaneler Yönetmeliğinde Değişiklik Yapılmasına Dair Yönetmelik (Bylaw on the establishment of private hospitals)," Date: 15.02.2008. Number: 26788.

underdeveloped regions of the country. It behaves as a regulatory entry barrier for potential entrants; therefore, following the CoN regulation, new private hospital entry has been limited (Figure 2).[36] However, there seem to be no publications or available data for research on the CoN application process and the approvals granted. Therefore, it is challenging to assess whether the CoN practice works well and judge whether there are some forms of discretion on its application and review processes.[37]

The continual updates on price and entry regulations imposed on private hospitals were another notable characteristic of the industry environment during the HTP. The restrictive regulations on the pricing and establishment of private hospitals also continue to evolve in the later years. Thus, it can be said that Turkey's hospital industry has been subjected to some degree of regulatory uncertainty. On the other side, the public sector involvement in healthcare delivery continues to expand in response to the continuing demand for hospital care. After 2010, the *planning* approach with Health Service Areas practice and City Hospitals projects, which we describe in the next section, has come to the forefront as another parameter of the HTP besides *competition* and *regulation*.

1.5 Planning

After the improvements in the universal public insurance coverage, the MoH focused more on the long-term policies that can maintain the availability and accessibility of healthcare across the country. For this, the MoH has begun to exercise its responsibility through a new set of centralized planning practices, which came into effect, particularly after 2011. With the conclusion of the HTP, the current health

[36] Chapter 2 of the thesis examines hospital entry and competition in Turkey.

[37] CoN programs continue to be implemented in the U.S. since 1970s. See Zoeller, Muller and Janiga (2020) for a brief description of the CoN programs in the U.S.

policy appears to have accomplished considerable improvements in equal access to healthcare through a countrywide planning approach.

First, the MoH began the regional planning on the resource of healthcare delivery in order to guarantee the physical availability and accessibility of healthcare besides the financial accessibility after the achievement of the universal health coverage. Therefore, the country has been divided into Health Service Areas. This has started an era of region-based health service planning. With regional planning, the government aims to improve the coordination and planning of healthcare services at the national and regional levels in order to provide more efficient, integrated, and qualified healthcare (Akdag, 2011). Second, in line with this nationwide planning approach for all of the country's health resources, the MoH has introduced a new type of hospital – City Hospitals. The introduction of city hospitals represents the change in the way in which public hospital services are managed and provided. We briefly present these two policies in the following two subsections.

1.5.1 Region-based planning in healthcare delivery - Health Service Areas

In 2011, the MoH published Inpatient Healthcare Facilities Planning Guidebook (*Yataklı Sağlık Tesisleri Planlama Rehberi*; Akdag, 2011). The guidebook presents long-term foresight on the allocation of healthcare facilities and their bed capacities. According to the projections in the guidebook, considering the needs of the local communities, a range of services for a catchment population is provided in each geographical region, in which the citizens can easily navigate to receive healthcare when they need it.

The MoH determined 30 Health Service Areas (*Sağlık Hizmet Bölgeleri*, HSAs).[38] An HSA is defined as one or more provinces that are relatively self-contained in the provision of hospital care. The criteria considered during this district-based (*ilçe-tabanlı*) assessments for the determination of HSAs are stated as population, geographic features, transportation, and receiving healthcare habits of the district population. The goals of the region-based health service planning include (i) to enable equal distribution of the resources allocated to healthcare, (ii) to ensure the availability of a wide variety of health services and treatment in every area, and (iii) to avoid delays in treatment due to long hospital queuing in particular cities and hospitals (Akdag, 2011).

1.5.2 Integrated Healthcare Campuses - City Hospitals projects

In 2015, the MoH introduced a new type of hospital, known by the name City Hospitals (*Şehir Hastaneleri*). They are built and managed by a form of Public-Private-Partnership model (PPP - *Kamu Özel İşbirliği*): Build-Lease-Transfer (*Yap-Kirala-Devret*).[39] Initially, the projects were introduced to the public as Integrated Healthcare Campuses (Entegre Sağlık Kampüsleri), and then they began to be named City Hospitals. Construction and operational management for each project are contracted out to a private company for at most thirty years. In the contracts, the minimum quantity level of the services to be delivered is predetermined, and the

[38] It is stated at the webpage of the Ministry that the HSAs were determined as a result of three-year comprehensive field studies conducted between 2006 and 2009 through ‘Field Coordinatorship’ model. For the maps of the areas, visit the webpage of the Ministry of Health of the Republic of Turkey, “Sağlık Bölge Haritaları Modülü,” Department of Statistics, Analysis and Reporting, Accessed April 24, 2018.

[39] Republic of Turkey Official Gazette, “Sağlık Bakanlığınca Kamu Özel İş Birliği Modeli İle Tesis Yaptırılması, Yenilenmesi Ve Hizmet Alınması İle Bazı Kanun Ve Kanun Hükmünde Kararnamelerde Değişiklik Yapılması Hakkında Kanun,”, Date: 09.03.2013, Number: 28582.

government guarantees to meet the deficit in case the healthcare delivery is lower than the targeted level specified in the PPP agreements.

In the financing model of City Hospitals projects, a private organization (contractor) designs, builds, funds, and operates the facilities for the lifetime of a long-term contract. The PPP model also allows the contractor for opportunities to incorporate other commercial activities after the construction is completed. The contractor provides maintenance services as well as nonclinical hospital services like catering, cleaning, and hotel services. This investment model used for publicly-owned privately-constructed and operated City Hospitals projects have triggered debates about the benefits and consequences of such a private sector involvement.[40]

In accord with the implementation of the HSA planning-oriented health policy, the countrywide City Hospitals projects have the potential to ensure that all citizens across the country have equal access to quality healthcare and to reduce the regional inequality in the availability of and access to hospital care.[41] The projects can reinforce universal health coverage by improving geographic coverage besides

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[40] Using qualitative research methods, Top and Sungur (2019) identify the views and assessments of stakeholders (including participants from the MoH, the SSI, Ministry of Finance, Ministry of Development, universities, NGOs, medical professional associations) in the implementation of PPP model in City Hospitals projects. They found that public- and private-sector employees and academics are more positive about the use of PPP model in Turkey, while representatives of NGOs and civil servants are more likely to be skeptical. In another qualitative study on City Hospitals at their expansion stage, Atasever (2018) assesses the construction, financing and management of City Hospitals and identify the positive and negative aspects of the PPP model. It concludes that positive aspects of city hospitals outweigh the negative ones, and their weaknesses are improvable.

[41] As of February 2018, the MoH has planned the construction and management of 30 City Hospitals projects with a total of 42,353 beds capacity. For comparison, the total number of hospital beds (all sectors) in Turkey was 231,913 in 2018. They were planned to have different bed capacities ranging from 475 to 4,200 beds. The contractual processes of 19 of these hospital projects have been completed as of 2018. The first city hospital began to provide healthcare in Mersin province in 2017, followed by the openings of city hospitals in Isparta, Yozgat, and Adana in the same year, city hospitals in Eskişehir, Elazığ, Kayseri, and Manisa in 2018, and city hospitals in Ankara and Bursa in 2019. If all the City Hospitals projects can be completed as planned within the following few years, it seems that almost all HSAs will have at least one or two city hospitals (Boyacı, 2021). For more information about each project, visit http://khgm.saglik.gov.tr/DB/37/14688_sehir-hastaneleri-ya and http://www.saglikyatirimlari.gov.tr/. Also, see Boyacı (2021) for further description of the figures on City Hospitals projects.

financial coverage, thanks to the achievement of universal public insurance coverage. However, the question of how these huge organizations are financed, governed, regulated, and monitored is a subject of public discussion.

When a City Hospital opens, all other public hospital resources in that province are also reallocated. These integrated healthcare campuses, with their massive organizations, indeed incorporate several hospitals under one roof and so require their own corporate management model (Atasever, 2018). In terms of ownership, they are public hospitals covered by universal health insurance. Still, one of the most common criticisms of the City Hospitals projects at their expansion stage is that the distance between the hospitals and city centers might increase geographical barriers for people in access to hospital care. Another concern is that the City Hospitals projects may create a high-cost burden on the public in the long run (Top and Sungur, 2019).

In sum, Turkey has strengthened the publicly financed healthcare system and achieved universal public health insurance coverage on the finance side while encouraging the involvement of the private sector through market-oriented policies on the delivery of healthcare. The health policy experimentation continues with the emergence of regulated and planned markets in which the private sector is involved more as the funder of the large public hospital projects in recent years. Overall, today, there appears to be a mix of competitive, regulated, and planned hospital market environment in the public-private mixed healthcare delivery system of Turkey. Before concluding, we finally give a survey of research on the hospital sector of the health system of Turkey in the next section.

1.6 Research on the hospital sector

Efficiency appears to have become the main area of focus on hospital sector research in Turkey. Early attempts to analyze the efficiency of hospitals in Turkey revealed that general hospitals operated inefficiently with excess inputs and insufficient outputs compared to those on the efficiency frontier. Ersoy et al. (1997) used data from 1994 in order to analyze the technical efficiency of general hospitals in Turkey. According to their findings, Turkey's acute care public general hospitals operated inefficiently during those years. Sahin and Ozcan (2000) assessed the technical performance of the public Ministry of Health's hospitals in 80 provinces of Turkey. They concluded that most of the hospitals owned by the MoH operated inefficiently according to the hospital data from 1996.

At the implementation stage of the HTP reforms, Sahin, Ozcan, and Ozgen (2011) evaluated the technical efficiency of a sample of the MoH general hospitals from 2005 to 2008. They observed that hospitals of all sizes tend to adopt more technology and be more efficient as they become larger. They also discovered regional differences in hospital productivity. Using data on rural general hospitals in 2006, Bilsel and Davutyan (2014) found that hospitals with less than 50 beds exhibit relatively high levels of scale inefficiency.

Cetin, Aksu, and Ozer (2012) investigated the impact of technology investments on cost and quality performance and whether hospital size and location play a role in this relationship. Using cross-section survey data for 2006 from public and private hospital managers, they concluded that the level of investment in information and clinical technologies has a significant effect on hospitals' costs and quality performance, and hospital size has a significant and positive effect on this relationship. Clinical technology was found to be cost-reducing and quality-improving in large hospitals. They also found that perceived cost and quality performances are higher for hospitals in more developed regions.

For comparison of the pre- and post-HTP period, Sulku (2012) investigated the impact of the HTP reforms on the efficiency and productivity of public hospitals in 81 provinces of Turkey in the years 2001 and 2006. The majority of the provinces, except for a few socioeconomically underdeveloped ones, had total factor productivity growth in the MoH hospitals. They observed that technical and scale efficiencies of hospitals had improved after the reforms, but hospital performance indicators did not. Erus and Hatipoglu (2013) discussed the shortcomings of the empirical method utilized in Sulku (2012) and similar early studies at the implementation stage of the HTP for assessing the impact of the health reforms on the efficiency of public hospitals. It was remarked on avoiding conclusions that are not supported by the evidence due to the simultaneous implementation of the various health reforms under HTP and the lack of appropriate datasets.

Torun, Celik, and Younis (2013) examined the evolution of hospital competition (as measured by Herfindahl-Hirschman Index, HHI, for inpatient and outpatient services at the province level) in Turkey from 1990 to 2006 and estimated the consequences of increased competition on the efficiency and quality of individual hospitals. The level of competition among hospitals appeared to vary depending on the geographical region, the ownership form, and the hospital type. During the study period, they observed that private hospitals in the Marmara, the Aegean, and the Mediterranean regions mostly had a competitive market environment while hospitals in the Black Sea, Eastern Anatolia, and Southeast Anatolia regions usually were almost monopolistic market characteristics. They concluded that increased hospital competition in Turkey had a positive impact on hospital efficiency throughout the study years but not on hospital quality.

Özgen Narci et al. (2015) examined the effect of increased competition on technical efficiency for the hospital industry in Turkey. They calculated the intensity of competition by objective (using the HHI) and subjective (using a survey with hospital managers) measures. Using general hospital data that includes different ownership forms in 2010, they found that the level of competition among general hospitals has no statistically significant relationship with the technical efficiency of hospitals. Their results suggest that increasing competition among general hospitals does not result in higher hospital efficiency.

Atılgan (2016) estimated hospital-specific and environmental factors on efficiency using cross-sectional data on the MoH's general hospitals and teaching hospitals in 2013. It was found that the average efficiency score rises as the size of the hospitals grows, teaching hospitals have higher efficiency scores, and efficiency scores decrease in the more populated and socioeconomically developed western regions. The positive effect of hospital size on efficiency was interpreted as a consequence of patients' preference for larger hospitals or economies of scale.

In another study, Yildiz, Heboyan, and Khan (2018) used data on public and private hospitals of Turkey in 2012 to estimate the technical efficiency of hospitals. They found efficiency variations across different hospital ownership forms but no statistically significant differences in hospital inefficiency by geographic locations or development levels of regions. They uncovered that the MoH general hospitals were the most efficient, followed by teaching hospitals; the efficiency scores of private hospitals varied widely between highly efficient and inefficient, and the least efficient ones were small private hospitals.

Mollahaliloglu et al. (2018) examined the changes in total factor productivity of hospitals with the technical efficiency and technological change components during the pre-reform and reform periods by using data on MoH general hospitals between 2001 and 2009. They found that hospital inputs have slightly changed while there was a considerable rise in hospital outputs. They concluded that hospitals in Turkey had achieved a remarkable improvement in productivity. They attributed the productivity gains during the study period to the change of payment methods for physicians and hospitals towards a performance-oriented system after HTP reforms.

In a more recent study, Küçük, Özsoy, and Balkan (2020) evaluated the efficiency of public hospitals, including research and training hospitals but not university hospitals, between 2013 and 2017. They found that the most efficient hospitals were large-sized hospitals, overcrowded regions (Marmara and Southeastern Anatolia) had more efficient hospitals, and teaching and research hospitals had higher efficiency than general and specialty hospitals. Their results support the existence of economies of scale and the presence of geographic variation in the hospital industry of Turkey.

As reviewed above, efficiency has become the main area of hospital research, but there also appears a body of literature on patients' hospital choices in Turkey. Using a survey data in 1999 with patients from several hospitals of different ownership types, Akinci et al. (2004) concluded that distance to hospitals, physical appearance, existing technology, and access to public health insurance schemes were important factors determining hospital preferences of people in Turkey.

Paköz and Yüzer (2014) analyzed the determinants of hospital preference in another survey study, whose data was collected in Istanbul, by taking into account the supply-side geographical component in access to healthcare and individual sociodemographic factors. They found that individuals were willing to travel up to 30 minutes to reach a hospital, the average distance traveled to the most commonly visited hospital was about 5 kilometers, and it was more common to travel outside the district of residence to receive healthcare from university hospitals, and teaching and research hospitals.

In another survey study that uses a questionnaire conducted in Samsun province of Turkey, Dündar (2017) descriptively examined the determinants of patient preferences among different kinds of healthcare institutions. They concluded that hospital choice was determined by the location and geographical accessibility of healthcare institutions along with the population characteristics. Can and Işın (2018), with a survey of patients from only a few hospitals, found that waiting time and human relations of health professionals had the most significant impact on the hospital preference of private patients.

Adaman et al. (2009) examined patient characteristics that influence the choice between public and private healthcare providers in Istanbul. Their econometric findings, based on data from a small-scale survey conducted in Istanbul in 2006, show the importance of social ties in patients' choice of public healthcare providers, among others. Their findings suggest that access to public facilities in those years may be easier for people with a higher social network. Yıldırım, Hughes, and Yıldırım (2011) discussed another interpretation of patient choice policy in Turkey. They concluded that patients’ freedom of hospital choice in Turkey reflects patient rights and social solidarity discourse that is in line with EU health policies beyond the role of the market-oriented healthcare delivery.

Another strand of literature is on patient satisfaction and hospital service quality. Tengilimoglu, Kisa, and Dziegielewski (1999) measured the degree of patient satisfaction using data from a patient survey conducted at several hospitals in Ankara. They concluded that service waiting time was regarded by patients as the critical factor influencing overall patient satisfaction, and patients believed that health professionals of private hospitals are more skilled, attentive, helpful, and have more pleasant attitudes.

Taner and Antony (2006) examined the variations in service quality between public and private hospitals in İstanbul. Using a small sample of patients who evaluated expected and perceived hospital service quality with a quality measuring scale, they found that patients in private hospitals gave higher expected scores for service quality than those in public hospitals, and patients were more satisfied with private hospitals due to nonclinical hoteling services.

Bakan, Buyukbese, and Ersahan (2014) investigated the impact of the various dimensions of hospital service quality on patient satisfaction. Using a patient survey data on healthcare quality from one public and one private hospital in Kahramanmaraş province of Turkey, their estimation results revealed that the quality of the hospital's social responsibility (medical integrity, reasonable hospital cost, free or low-cost medical services for those in need, etc.), administrative procedures (process of service delivery, waiting time, etc.) and overall experience of medical care (technical competence of the medical practitioner, etc.) were key determinants of patients' perceived satisfaction from service quality.

To sum up, from the 2000s onwards, the hospital sector in Turkey has been experiencing substantial changes in market structure, the nature of competition, incentives, and outcomes. Although there was a growing hospital market in the transformed health system of Turkey with the HTP reforms, there does not appear to be an increasing interest in the hospital sector among industrial organization researchers. There appears to be no research on the hospital sector that is based on the industrial organization literature.[42] The Structure-Conduct-Performance of the private hospital market has not been explored yet. The industry dynamics, the nature of market competition among hospitals, hospital behaviors on pricing and quality choices, and the effect of government regulations, among others, waits to be researched.

1.7 Conclusion

Turkey has achieved universal health coverage by consolidating its publicly funded health insurance system in the finance of healthcare, while the private sector's involvement and competitive policies in healthcare delivery have been encouraged. With the completion of the HTP reforms, the overall capacity of Turkey's transformed health system has improved remarkably. The private hospitals market has expanded rapidly at the early stages of the HTP, but it has continued to grow more in the form of capacity expansion in recent years. In Turkey's mixed private-public market environment in the delivery of healthcare, public hospitals continue to have a larger share of the hospital market. However, during the HTP, private hospitals' market share increased significantly.

In the early years of the HTP, the government encouraged the higher involvement of the private sector and greater competition in healthcare delivery. Then, the market-oriented policies that improved the health system's healthcare provision capacity led to strict regulations on pricing and new private hospital entry in the later years of the HTP. Following these regulations, the expansion of the

[42] See Gaynor and Town (2011) and Gaynor, Ho and Town (2015) for a description of key issues in the industrial organization of healthcare markets and for the frameworks on thinking about the topics in healthcare markets.

private hospitals market has been curbed. Then, with the emergence of new countrywide planning practices after 2010, the government has given the private sector a different role as a funder of investments in new public healthcare infrastructure. Hence, a highly regulated and planned hospital market environment with a public-private mix in healthcare provision has emerged. Overall, today, there appears to be a mix of competition, government regulation, and planning practices in the Turkish hospital industry.

In this paper, we provided an insightful description of the hospital industry in Turkey and illuminated the evolution of the hospital market environment after the 2000s. We concluded the paper with a review of the research on the hospital sector of the healthcare system of Turkey. Throughout the paper, we have noted and remarked on many interesting topics that we could not address and discuss adequately, but each of them is worth considering properly on its own merits within appropriate research frameworks. There are promising areas for further research where there is currently no evidence provided with the use of the methods in empirical industrial organization. Among the other research opportunities, by employing a panel dataset on hospitals and local market characteristics, we address hospital entry and competition in the next chapter and hospital capacity choice in the third and last chapter of the thesis research. From this aspect, this chapter serves as the background paper on Turkey's hospital industry environment for the following two chapters. Further, the paper provides the foundation for further research that can employ Industrial Organization methods to investigate healthcare markets in Turkey.

CHAPTER 2

HOSPITAL ENTRY AND COMPETITION IN TURKEY

2.1 Introduction

The hospital care industry in Turkey has experienced major changes since the 2000s, particularly as a result of the health reforms and regulations under the Health Transformation Program 2003-13 (HTP). The rise in the demand for healthcare as a consequence of the progress toward universal health coverage, together with the increased involvement of the privately-owned hospitals in the delivery of healthcare, has dramatically changed the competitive environment of the private hospital market. Along with the advance in the overall capacity of the health system during the HTP, the reforms resulted in the proliferation of private hospitals nationwide throughout the late 2000s, followed by the introduction of new regulations on pricing and entry of private hospitals. Yet, within the framework of the new empirical industrial organization methods, there appears no empirical investigation of the hospital market in Turkey and the impact of the most recent health reforms and regulations that have dramatically transformed the industry environment.[43]

This article empirically analyzes the market structure and competition in the hospital markets in Turkey. Building on the models of empirical industrial organization on firm entry and market structure, the paper investigates the nature of hospital competition and its change during the reform period in the hospital markets of Turkey. In a multi-period static equilibrium framework, we estimate ordered

[43] It appears that the recent empirical studies on the hospitals market in Turkey has been focused on the competition and hospital efficiency; see Sahin, Ozcan and Ozgen (2011), Erus and Hatipoglu (2013), Torun, Celik and Younis (2013), Ozgen Narcı et. al. (2015), Yıldız, Heboyan and Khan (2018). We refer the interested readers to the Chapter 1 of the thesis for a review of the research on hospital sector of Turkey's health system.

probit models of hospital entry in the local markets of Turkey. Our analyses focus on the determinants of market structure with the use of yearly data on local markets and hospital entry into these markets. We cannot observe directly the market profitability of hospitals in the absence of price and cost data, but still we can employ structural approaches proposed by the firm entry and market structure literature, which model firm entry as a function of observable market characteristics.

We follow the methodology of the Bresnahan and Reiss (1987, 1990, 1991; BR hereafter) and attempt to include hospitals of different sizes in the analysis. In this static cross-section approach, the primary focus is on the relationship between the number of homogeneous firms and the corresponding minimum market size in a given year, which is defined as *entry thresholds* needed to accommodate one, two, three firms, and so on in geographically local markets. Then, the estimates of consecutive *per firm entry threshold ratios* enable us to infer changes in the degree of competition as the number of firms rises in a market.

Our empirical analyses rely on the yearly countrywide data about all the public and private hospitals at general hospital status over the period 2001-2014. Our dataset combines data on hospitals and market characteristics of local districts of Turkey. The dataset comes from a variety of sources. Particularly, hospital data is from the Ministry of Health of Turkey. The unit of analysis is a geographically local market. At the outset, we took all the 927 districts, second-level geopolitical divisions, of Turkey in 2010 as local markets, but then we subjected them to market selection rules that eliminated 'unqualified' districts for our empirical framework, as described in detail below in the section about data. The scope of the product market is general hospital care. We excluded the specialty hospitals from the analysis and the university hospitals likewise since, by definition, they are not supposed to compete for general hospital care services. The paper assumes that general hospital services are consumed locally while patients travel further for specialized/more complex hospital care after diagnosis if they need it.

Hospital care is differentiated horizontally according to geographic location and vertically by quality and size. In healthcare markets with reimbursement policies where prices are regulated, the estimates of demand models for hospital care show that distance and service quality are key determinants of hospital choice of patients (Tay, 2003). Our dataset does not allow us to account for quality differences between hospitals. Instead, we utilize hospital size in terms of hospital bed capacity to capture differences among hospitals. Therefore, for the purpose of this paper, we consider the spatial dimension of the private hospital market while attempting to incorporate firm heterogeneity into the analysis.

A critical issue that arises in attempts to empirically study the market structure and competition has been the delineation of a *relevant market*.[44] Different approaches have been used to define geographic market areas in the literature. There are studies that identify local healthcare market areas by (i) adhering to geopolitical boundaries such as towns, counties, districts, and metropolitan statistical areas (e.g., Bresnahan & Reiss, 1991; Abraham, Gaynor, & Vogt, 2007), (ii) using a fixed (or variable) radius around each particular hospital (e.g., Gresenz, Rogowski, & Escarce, 2004; Cooper, Gibbons, Jones, & McGuire, 2011), (iii) utilizing patient inflows and outflows data to derive geographic market boundaries (e.g., Morrisey, Sloan, & Volvana, 1989; Tay, 2003; Kessler and McClellan, 2000; Bowblis and North, 2011; Kleiner, Lyons and White, 2012). The lack of data precludes us from applying the fixed (variable)-radius or patient-flow approaches. Hence, a priori, we assume that

[44] See the seminal article on the geographic market delineation of Elzinga and Hogarty (1973).

the markets coincide with geographic boundaries. Accordingly, we defined all the districts of Turkey as geographically local markets. Then, we engaged in intense market selection procedures and robustness investigations that resulted in a sample of districts of Turkey in which the possibility of market overlap is minimal. The market selection restrictions made the sample somewhat smaller, but they enabled the minimization of possible errors in relevant market definition and interrelations across markets. The remaining sample used in the estimations consists of 205 districts as local markets across 72 provinces of Turkey.[45]

We consider two time periods in our analysis. We suppose that the industry was at the long-run market equilibrium before the Ministry of Health (MoH) commenced various health reforms under the Health Transformation Program (HTP) in 2003; the reforms distorted the equilibrium and led to a switch from one long-run equilibrium to another. Therefore, the paper focuses on the years immediately before and after the HTP program. The entire sample years, 2001-14, are divided into two periods: before 2003 and after 2003 as pre-reforms and post-reforms periods. Also, due to greater regulations on price and entry into the market after 2008, we consider the post-reforms period into two sub-periods: 2003-2008 and 2008-2014, as relatively free entry and restrictive, highly regulated entry periods, respectively. For the reasons discussed in Section 2, we employ the dataset for the years 2002 and 2010 in order to analyze the pre-reforms and post-reforms periods.[46]

[45] Section 4 thoroughly provides the relevant market definition and market selection rules. The provinces, which do not appear in the sample, are İstanbul, Ankara, İzmir, Muğla, Antalya, Ardahan, Artvin, Gümüşhane, Tunceli.

[46] In Section 2, we provide a brief description of the market environment of the hospital industry in Turkey including recent health reforms and regulatory climate. For further information on the hospital industry in Turkey, see Chapter 1 of the thesis, which includes an overview of the reforms under the Health Transformation Program 2003-2013, as well as the description of the competitive and regulatory conditions in the hospital industry of Turkey during the study period.

In the empirical analysis, we first use the hospital data in 2010 for the baseline estimations. In these BR-style analyses, we find that the market size required to support a second hospital is slightly less than the average size of monopoly markets. After two firms, the average market size required for additional hospitals remains almost the same, which suggests that margins do not fall when local markets have more competitors. Next, we perform the entry threshold estimations for the year 2002. The results for the sample year 2002 indicate that the effects of most explanatory variables are similar to those in 2010. Again, we find that the second hospital entrant does not require a greater market size in comparison to the first hospital in 2002. However, the comparison of these multi-period entry threshold estimates demonstrates that local market sizes required to support hospital entry remarkably lessened in 2010.

The choice of two time periods, the years 2002 and 2010, for the analyses of the pre-reforms and post-reforms periods allows us to comparatively examine the change in the competitive environment in local hospital markets with the surge in hospital entry after the inception of the HTP in 2003. These analyses using the entry threshold method produced results for the pre-reform and post-reform entry thresholds that are comparable in order to figure out the overall impact of reforms and regulations under the HTP. Thus, the multi-period threshold estimates help to discriminate the impacts of the population shifts over the years and the effect of the implementation of health reforms on the number of hospitals in local markets. Furthermore, they enable us to explore further the consequences of greater regulations in the more restrictive planning period after 2010 with counterfactual policy simulations using the estimation results for the free-market period.

Particularly, the paper provides answers to the following questions: (i) What determines the number of private hospitals in a market over the years in a multi-period framework? (ii) What market sizes does it take to support different numbers of firms? (iii) What number of hospitals are required to ensure competitive conduct in a local market? How quickly do markets converge to competitive conduct by hospital entry? Addressing these questions provides insights to both the researchers and policymakers about the competitive condition and evolution of market structure in the hospital industry.[47] Eventually, the paper aims to provide evidence-based information on the practice of assessing the market structure and the nature of competition in antitrust analysis.

With this empirical research, it becomes possible to tell whether the market size of a given local district is below or above the size predicted by the estimated entry threshold level. This answers the questions like whether an additional hospital is economically sustainable in a given district or in what market conditions in a district no more entrants are economically sustainable. Thus, the results of the analysis reveal whether reduction (increase), due to acquisitions and mergers, for example, in the number of private hospitals to a given level reduces (enhances) competition in a local market.

The paper proceeds as follows. The next section of the chapter describes the hospital market environment, recent health system reforms, and regulatory climate. A subsequent section presents a model of hospital entry and equilibrium market structure along with the econometric framework. It is followed by Section 4 on the dataset, including the description of hospitals, relevant market definition, market

[47] Another question that we intended to address at the beginning was: To what extent an additional same-size or different-size hospital affects competition? However, it appeared that our sample dataset is not suitable for the exploration of competition among different sized-hospitals.

selection rules, and the variables used in the estimations. Then, Section 5 presents the estimation results. Next, we further perform some prediction exercises and policy simulations in Section 6. A final section of the chapter concludes with a discussion.

2.2 The hospital market environment: A brief overview of the recent health system reforms and hospital regulations

The hospital market environment had rapidly changed during the Health Transformation Program 2003-13 (HTP). The program has opened the doors of private hospitals to patients with public insurance. As such, private hospitals have begun to be funded publicly and to operate in somewhat ‘competition’ with public providers. Progress towards the universal health coverage and price regulation on hospital care introduced in 2008 have reduced the patients` sensitivity to the bill and eliminated, to some extent, price differences among hospitals. Patients began to have virtually a complete freedom of direct choice on both public and private providers, given relatively low out-of-pocket payments for private hospital services. With the completion of the program, hospitals in Turkey have been operating in a pluralistic mixed market.

Here, we provide a selective overview of the market environment in which hospitals operate. For brevity, only particular health reforms and regulations of the HTP that have direct influences on the profitability and ease of market entry of hospitals are described.[48]

Beginning in 2003, health services provided by private hospitals were progressively taken under public insurance coverage. In 2006, the Social Security

[48] In Chapter 1 of the thesis, we provide a description of the hospital industry environment and give a review of health reforms and regulations. For the full description of the HTP reforms, we refer the reader to the Ministry of Health (2003, 2009, 2011), OECD and Worldbank (2008), Tatar et al. (2011), and Atun et al. (2013) to name a few.

Institution (SSI - *Sosyal Güvenlik Kurumu, SGK*) and the Social Insurance and General Health Insurance (*Sosyal Sigortalar ve Genel Sağlık Sigortası*) laws were enacted. Under the SSI, the consolidation of formerly fragmented health insurance schemes has been completed under a unified General Health Insurance (GHI - *Genel Sağlık Sigortası, GSS*) scheme as of 2011. Especially with the inclusion of the Green Card (*Yeşil Kart*) insurance scheme, which gave access to healthcare for uninsured poor citizens without payment, to the General Health Insurance in 2011, the GHI coverage has improved towards the Universal Health Coverage nationwide. Thus, before the completion of the HTP, people began receiving both public and private hospital services through their public insurance.

In 2007, the Social Security Institution (SSI) introduced a new payment method, the SUT (Communique on Healthcare Practices - *Sağlık Uygulamaları Tebliği*), which regulates the private healthcare prices for hospitals that have contracts with SSI. The SUT payment scheme sets base prices as the common reimbursement rate, in which payment to the contracted private hospitals is made prospectively by the single national public purchaser SSI based on a predetermined fixed unit price for each itemized service. From this aspect, the program has led to greater homogeneity of local hospital markets across the country. Although all the private hospitals, except a few which have no contract with SSI, are subject to the common reimbursement rates with the SUT practice, they are allowed certain flexibility in extra billing. This payment mechanism has provided publicly-insured citizens with easier access to 'affordably-priced' private hospital care.

The reforms, along with better public insurance coverage, promoted the private sector to enter the hospital care markets countrywide and triggered more private hospital entry. Then, the rapid proliferation of private hospitals in the following years led to further regulation. In 2008, the government introduced a restrictive regulation on market entry of hospitals that curbed the rapid expansion of private hospitals - a Certificate of Needs (CoN) requirement concerning the establishment and capacity expansion of private hospitals. The aim of the government with the CoN practice is communicated as to control the distribution of hospitals for a better match with the healthcare needs on a demographical and geographical basis. Following the regulation, private hospital entry has been prominently slowed down.

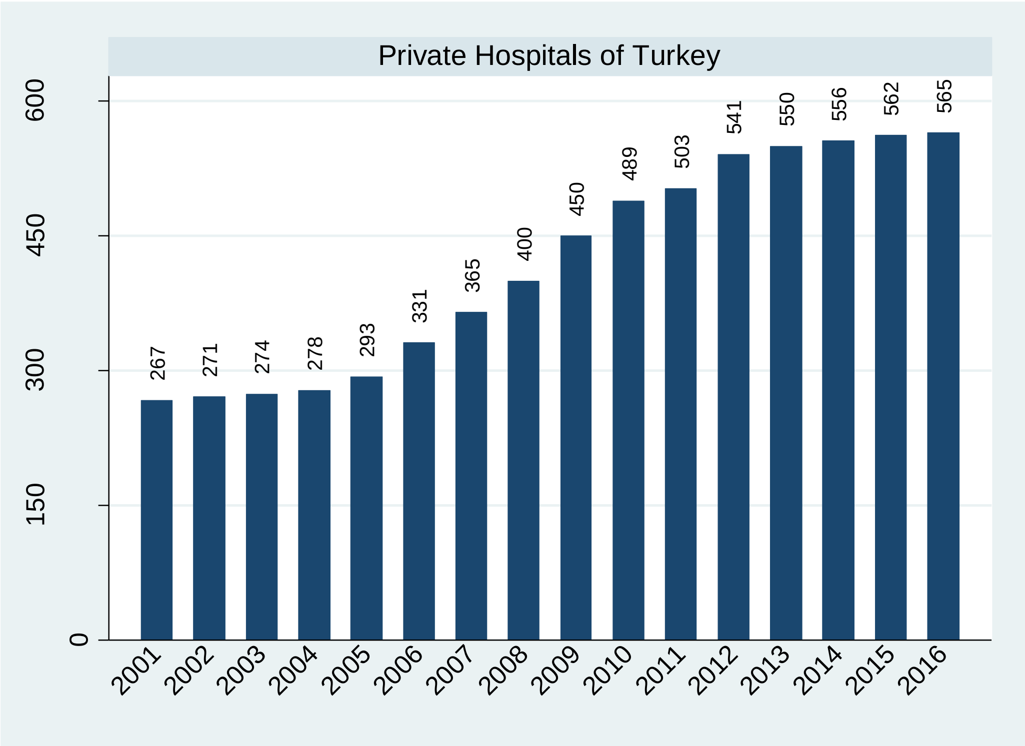

Figure 4. Number of all private hospitals from 2001 to 2016

Figure 4 shows the number of private hospitals over the period 2001-2016. It helps to identify the hospital industry`s recent life cycle. Overall, the time pattern of hospital entry reveals an *S-shaped growth path* of the industry. At the early stage, between

2001-05, demand for private hospital care was limited, so firm entry seemed rare. Over 2005-09, there were a large number of entrants into the hospital market. During this growth phase, an expansion in the overall capacity of the industry happened; and exit was unusual. The surge in hospital entry began diminishing after the restrictive CoN regulation in 2008. The period 2009-12 seems to be the industry's shakeout phase in which hospital entry was relatively low, and entry rates began to decline as the industry approached its maturity. After 2012, at its mature phase, entry rates tapered off. With the finalization of the HTP in 2013, the structure of the hospital care markets remained almost stable in the subsequent years.

Among others, the year 2010 was a critical year during the implementation of the HTP. A new nationwide planning approach regarding all the country's healthcare resources has been robustly put into practice. In 2010, the dual practice of physicians in public hospitals was completely forbidden with the introduction of the *full-day law*. The Family Medicine Program at the primary care level was expanded nationwide by the end of 2010. The MoH located 30 Health Service Areas in 2010 and started a *region-based healthcare service planning* era in the public sector (see Appendix A). Thus, arguably, there has happened a transition from a competitive market setting at the early phase of the HTP (particularly between the years 2003 and 2008) to a mix of competitive, regulated, and planned market environments after 2010. On the other side, there has been a more robust patient demand for hospital care thanks to the achievement of universal health insurance coverage as of 2011.

The underlying assumption of the static entry model of the paper is that the industry is at long-run equilibrium in estimation years. Considering the transformation of the industry environment we summarized above, it is reasonable to assume that the industry was at long-run market equilibrium in 2002 before the HTP commenced. Also, given the proliferation of private hospitals during the early stages of the program until 2010 and the introduction of CoN entry regulation in 2008, it is justifiable to suppose that the industry reached another long-run equilibrium in 2010.

The completion of a new hospital entry process typically takes two or three years after the MoH grants a pre-approval (*Ön İzin*) for establishing a new hospital. Therefore, the hospital projects that had started just before the introduction of the new restrictive entry regulation in 2008 can be supposed to become apparent in the market competition as of 2010, more or less. From this aspect, the year 2010 is a more suitable sample year than 2008 for the empirical analysis. Thus, we choose the years 2010 and 2002 to estimate our static entry model. The remaining years in our dataset, covering the period between 2001-2014, serve to conduct some supplemental analyses, including robustness and sensitivity checks and counter-factual analysis for policy implications.

2.3 Model and econometrics

The model relies on Bresnahan and Reiss's (1987, 1990, 1991; hereafter BR) static cross-section oligopoly framework of entry. BR's entry threshold method allows estimation of the minimum demand necessary for a specific number of firms to enter a market. The *entry threshold* is defined as the minimum market size required to sustain the entry of a particular number of firms in the market. Then, the market size estimated in terms of local population makes it possible to predict the number of participants in a local market.

BR framework is useful in analyzing the market structure and the nature of competition through observations on firm entry and some demand and supply indicators in the absence of price and cost data. This setting is particularly instrumental for (i) the industries in which one can identify all sellers of a narrowly defined product or service; and (ii) the industries in which one can define local geographic markets. Firms are assumed to be symmetric, and their post-entry profits depend on the number of identical firms competing in the market and some other market characteristics.

As BR points out, the model leaves several important issues unexplored. It does not allow for differentiated products and inter-firm differences. Firms are identical, products are homogeneous, and all entrants in a market face identical fixed costs. When markets overlap, it becomes less clear how the entry threshold needs to be computed. For this reason, the relevant product and market delineation necessitate extraordinary diligence. Finally, the static cross-section framework does not consider the timing of entry and exit decisions.

Our analysis considers the whole range of general hospital care as a composite good. By their definition, general hospitals admit all types of medical cases, so they provide a wide range of health services. Thus, the hospital market product in our analysis is assumed to be a homogenous good. Also, the paper assumes that patients are less likely to travel outside of their residential area in order to receive general hospital services at the secondary care level. Hence, working with diligence in the selection of sample districts as geographical markets, sample hospital care markets covered in the analysis are considered adequately local.[49] Thus, the unit of analysis is a geographically local market.

[49] Unfortunately, we have difficulty in finding data or publications (reports, white paper etc.) about the service provision patterns of hospitals and the local nature of general hospital care.

2.3.1 The Model: BR (1991) framework of static cross-section entry threshold

Here, we reiterate BR's (1991) static cross-sectional model framework. BR proposes the concept of demand entry threshold in order to predict how the number of firms, N, in a market varies with the market size, S.

The model assumes that a market has N entrants if firms that entered make positive profits and any additional firm would make negative profits: $\Pi_N \geq 0$ and $\Pi_{N+1} < 0$. Thus, the *entry threshold* is defined as the minimal market size S_N that can accommodate N identical firms. It is derived from the following zero-profit equilibrium level of demand conditions: at S_N, $\Pi_N(S_N) = 0$; at S_{N+1}, $\Pi_{N+1}(S_{N+1}) = 0$ and so on for every $N > 0$. Then, the equilibrium reduced-form profit function is

$$\Pi_N(\mathrm{S}_N) = V_N(.)S_N(.) - F_N(.) = 0$$

for every $N = 1,2,3, \ldots$. Next, solving for the entry threshold gives

$$S_N = \frac{F_N(W)}{V_N(.)}$$

which is the ratio of fixed costs $F(.)$ to variable profits $V_N(.)$. Then, *per firm entry thresholds* are defined as the minimal market size needed for each one of the N identical firms as:

$$s_N = \frac{S_N}{N} = \frac{F_N(W)}{N\, V_N(.)}$$

Hence, as the variable profits (and margins) decrease, s_N increases; holding the fixed costs constant. Likewise, s_N rises with increases in fixed costs. Lastly, *the per firm entry threshold ratio* is defined as

$$\frac{s_{N+1}}{s_N} = \frac{V^N}{V^{N+1}}\frac{F^{N+1}}{F^N}\frac{N}{N+1}$$

The sequence of these ratios gives a measure for the fall in markups (variable profits) as the number of firms increases, holding fixed costs constant.[50] Under the assumption that fixed costs do not change with entry, if the ratio is higher than one, this is interpreted as a fall in variable profits with a new firm entry and implies that later entrants need more per firm demand to breakeven compared to earlier entrants. The model supposes that an additional market participant always leads to a decrease in profits. Moreover, as the sequence of the ratios of successive per firm entry thresholds converges to one, the model infers that the market becomes more competitive. Thus, the ratios provide inference on how the competitive conduct changes when the number of firms increases with entry, but we should remark that the ratio does not give the level of competition.

We can summarize the intuition behind the entry threshold method as follows: if the per firm market size required to support a given number of firms increases as the number of firms increases, the entry of new firms must intensify the competition. That is because the profit margin shrinks as competition becomes more intense, and successive entrants need larger populations to make enough revenue and to cover fixed costs.[51]

[50] The equation of entry threshold ratio consists of the change in fixed costs and the change in the toughness of competition due to entry. It is assumed that fixed costs do not change with entry in order to identify the change in the toughness of competition. Abraham, Gaynor and Vogt (2007) augment the BR approach by using quantity data besides market structure data in order to be able to identify changes in the toughness of competition and changes in fixed costs. However, quantity data, such as hospital admissions is not publicly available for Turkey. Thus, our model adheres to the BR`s original model.

[51] It might be helpful here to reiterate the hypothetical example in Bresnahan and Reiss (1991) to have better understanding of how to interpret entry thresholds. Let`s suppose it takes 2,000 customers to support a monopolist, and the market becomes perfectly competitive when each firm has 4,000 customers. It is expected to observe per firm entry thresholds between 2,000 and 4,000. For example, if the third entrant expects to compete in a perfectly competitive market, then we should observe 3x4,000=12,000 customers in this market.

2.3.2 Econometric specification

The long-run total profit function in a market with N firms is parameterized as

$$\Pi_N(S^N) = V_N(\vec{Z}, \overrightarrow{W}, \alpha, \beta)\, S(\vec{Y}, \lambda) - F_N(\overrightarrow{W}, \gamma) + \varepsilon$$

where $\vec{Y}$ represents market size variables, particularly local population; $\vec{Z}$ and $\overrightarrow{W}$ represent exogenous demand and cost shifters; $\lambda, \alpha, \beta, \gamma$ are profit parameters to be estimated; ε captures the unobserved profits and market-level shocks.

Market size, $S(.)$, is assumed to be a linear function of population variables,

$$S(\vec{Y}, \lambda) = \lambda_0 + \lambda_1 Y_1 + \cdots + \lambda_k Y_k$$

Firms' per capita variable profits are assumed to be a linear function of some cost and demand shifters, $W\ and\ Z$; and include an additional α_N component to capture the decrease in variable profits with the number of firms in the market:

$$V_N(\vec{Z}, \overrightarrow{W}, \alpha, \beta) = \alpha_1 + X(\vec{Z}, \overrightarrow{W})\beta - \sum_{n=2}^{N} \alpha_N$$

where the variable profits are supposed to fall as the number of firms rises, $\alpha_N \geq 0$.

Likewise, fixed costs are assumed to be a linear function of some cost variables W; and include an additional γ_N component:

$$F_N(\overrightarrow{W}, \gamma) = \gamma_1 + \gamma_L \overrightarrow{W}_L + \sum_{n=2}^{N} \gamma_N$$

where the fixed costs are supposed to increase as the number of firms increases, $\gamma_N \geq 0$. The model imposes that later entrants have smaller variable profits and higher fixed costs.

The model focuses on a single market outcome, the number of firms, rather than analyzing the decision of individual firms. This allows using an ordered probit model, in which the dependent variable is the number of firms in each market, in order to estimate the parameters of the profit function that are used in the calculations of entry thresholds.

Although each component of the profit function, $S(.), V(.)$, and $F(.)$, has linear forms itself; after replacing them into the log-likelihood function, it becomes a nonlinear function of the parameters. Hence, an ordered probit estimation is conducted, and the parameters are estimated via maximum likelihood as follows.[52]

The total profit function in a market with N firms is decomposed as

$$\Pi_N = \overline{\Pi}_N + \varepsilon$$

where $\overline{\Pi}_N$ is the latent variable; ε is the error term that cannot be observed, and it is assumed that $\varepsilon \sim i.i.d\ N(0, \sigma)$. The model assumes that all firms within a market have the same unobserved profits, and it does not differ across market structures, so successive entrants' profits differ only through the deterministic component. This setup makes it possible to derive a likelihood function for the number of firms a market can sustain. It allows for a probit estimation of the discrete ordered dependent variable, N, as follows.

The equilibrium inequality condition is: a market has N entrants if $\Pi_N \geq 0$ and $\Pi_{N+1} < 0$, that is, N firms that entered make positive profits, but if one more firm enters, it will make negative profits. Then, the probabilities of each state of the market, which model potential entrants' unobserved profits and form of the likelihood function, are calculated as:

$$Pr(N = 0) = \Pr(\Pi_1 < 0) = \Pr(\overline{\Pi}_1 + \varepsilon < 0) = 1 - \Pr(\varepsilon \leq \overline{\Pi}_1) = 1 - \Phi(\overline{\Pi}_1)$$

$$Pr(N = 1) = \Pr(\Pi_1 \geq 0\ and\ \Pi_2 < 0) = \Pr(\overline{\Pi}_1 + \varepsilon \geq 0\ and\ \overline{\Pi}_2 + \varepsilon < 0)$$

$$= \Pr(\varepsilon \leq \overline{\Pi}_1\ and\ \varepsilon \geq \overline{\Pi}_2\ ) = \Phi(\overline{\Pi}_1) - \Phi(\overline{\Pi}_2)$$

[52] STATA codes for the BR framework analysis is available thanks to Balmer (2013).

$$Pr(N=2) = \Pr(\Pi_2 \geq 0 \; and \; \Pi_3 < 0) = \Pr(\overline{\Pi}_2 + \varepsilon \geq 0 \; and \; \overline{\Pi}_3 + \varepsilon < 0)$$

$$= \Pr(\varepsilon \leq \overline{\Pi}_2 \; and \; \varepsilon \geq \overline{\Pi}_3) = \Phi(\overline{\Pi}_2) - \Phi(\overline{\Pi}_3)$$

and so on. Thus, the probability of observing n firms is

$$Pr(N=n) = Pr(\Pi_n \geq 0 \; and \; \Pi_{n+1} < 0) = \Phi(\overline{\Pi}_n) - \Phi(\overline{\Pi}_{n+1})$$

Finally, the product of probabilities for each observed state of the market, which gives the likelihood of observed market configuration, is maximized to obtain the estimates of parameters.

To sum up, the equations of market size, variable profits, and fixed costs are implicitly estimated with the ordered probit model via the maximum likelihood estimation procedure. The three equations estimated simultaneously are

$$S(\vec{Y}, \lambda) = \lambda_0 Y_0 + \lambda_1 Y_1 + \cdots + \lambda_k Y_k$$

$$V_N(\vec{Z}, \overrightarrow{W}, \alpha, \beta) = \alpha_1 + X(\vec{Z}, \overrightarrow{W})\beta - \sum_{n=2}^{N} \alpha_N$$

$$F_N(\overrightarrow{W}, \gamma) = \gamma_1 + \gamma_L \overrightarrow{W}_L + \sum_{n=2}^{N} \gamma_N$$

2.4 Data

The original data set includes the list of all hospitals in operation in Turkey for at least one year during the 2001-2014 period. Since the unit of analysis is the local market, we combined data on all the hospitals in Turkey with information on local market characteristics. The data on hospitals comes from the Ministry of Health (MoH), and we gathered market-level data from various sources.

2.4.1 Hospital industry

In 2010, there were a total of 1,439 hospital care institutions in Turkey. Of these, 842 are public hospitals owned by the Ministry of Health; 62 are publicly- and privately-owned university hospitals; 489 are privately-owned hospitals; and the remaining 45 hospitals are owned by the Ministry of National Defense, municipalities, and other public institutions.[53] Further disaggregation indicates that 149 public hospitals provide specialty health services at the secondary level of care or tertiary care as teaching institutions, as are 57 private hospitals. After excluding these specialized healthcare hospitals and tertiary-level hospitals, our empirical analysis begins with employing the data on the remaining publicly-owned 694 and privately-owned 432 general hospitals.

The sizes of hospitals vary. Yet, private hospitals are usually small. About 54% of the private hospitals have less than 50 beds, and around 85% of them have less than 100 beds. Table 8 provides a breakdown of the hospital bed numbers. It helps to see the degree of variation in hospital sizes. The mean and median number of hospital beds is 58 and 46, respectively.[54]

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[53] Hospitals belonging to the Ministry of National Defense (about 34 hospitals) have been transferred to the Ministry of Health in 2016. Thus, after 2015, the Health Statistics Yearbooks of the MoH categorize hospitals regarding ownership as (i) Ministry of Health, (ii) University and (iii) Private. The paper simply refers privately-owned hospitals to as private hospitals and publicly-owned MoH hospitals as public hospitals.

[54] Hospitals are not officially categorized in terms of their sizes; however, for various purposes, some cutoff bed numbers, namely 30, 50, 75 and 100 beds, are mentioned in the Private Hospitals Regulations (accessed 09.09.2019). Another measure of firm size could be the total floor area of hospital buildings to distinguish hospitals, but this information is not available in our data set. Hospitals also differ in terms of their physician numbers, but the number of physicians in a hospital is usually proportional to the number of beds, so we do not further present the variations in the physician numbers among hospitals.

Table 8. Public and Private General Hospitals and Their Bed Capacities in 2010

Hospitals in 2010	Private		Public	
Number of beds	Frequency	Percent	Frequency	Percent
Less than 25	57	13.19	229	33.00
25-50	176	40.74	127	18.30
50-75	92	21.30	96	13.83
75-100	41	9.49	31	4.47
100-125	33	7.64	36	5.19
125-150	15	3.47	23	3.31
150-200	8	1.85	28	4.03
200-300	8	1.85	57	8.21
Over 300	2	0.46	67	9.65
Total	432	100.00	694	100.00

Source: Author`s tabulations using the MoH data for the year 2010.

2.4.2 Relevant market definition

Delineation of the relevant product and geographic markets is a prerequisite for the identification of the providers and potential customers in each local market.[55] The model supposes that the scope of the product market is general hospital care, and patients prefer to receive general hospital care from the healthcare providers closest to their homes. Thus, it is assumed in the model that geographic markets for hospital care are isolated from one another.[56]

Unfortunately, we have no evidence (from case studies, policy reports, white papers, etc.) on the average distance traveled by patients for hospital care. Also, due to the lack of data on the actual pattern of patient flows, we could not address the

[55] For a detailed discussion on the relevant geographic market definition in hospital care for analyses conducted in different countries, see OECD (2006, 2012).

[56] The Competition Authority of Turkey (*Rekabet Kurumu*) has delineated the relevant market as provinces, except İstanbul, for specific antitrust investigations of mergers and acquisitions in the industry. However, the cases evaluated by the Competition Authority are very rare in hospital sector compared to other industries. An examination of the actual flow of patients, that is, patients travel patterns into and out of the proposed geographic market for hospital services, could be helpful in examining the relevance of this assumption if we had access to patient-level data.

question of whether hospitals in different areas indeed constitute a real alternative source of supply for patients. Thus, we presume that people seldom travel outside their districts (or, more broadly, from their provinces) in search of general hospital care. Similar studies in the literature apply some presupposed market selection rules assuring that markets are geographically isolated enough so that competition from firms in nearby areas is minimal. However, there is no one-size-fits-all approach for delineating relevant markets.

Turkey has a unitary administration structure. The country is subdivided into 81 provinces (*il*) as the first-level administrative units; each province is divided into districts (*ilçe*) at the secondary level. The districts are further subdivided into urban neighborhoods (*mahalle*), semi-urban towns (*belde-kasaba*), or rural villages (*köy*). Highly-populated provinces with more than 750,000 population have metropolitan municipalities, and their districts are in the metropolitan district status.[57]

The country is not very densely populated compared to, for example, England or Germany. In 2014, the population density was 101 people per km2 on average; however, it ranges from 45 to 270 among provinces. There are provinces that have exceptionally high population densities, namely İstanbul (2,767), Kocaeli (477), İzmir (342), Gaziantep (277), Bursa (267), Yalova (267), Hatay (261), Ankara (210); the most densely populated districts are in İstanbul, İzmir, Kocaeli, Bursa, Ankara, and Antalya, respectively.[58]

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[57] In 1984, Ankara, İstanbul and İzmir were the first three metropolitan provinces. As of 2012, the number of provinces with metropolitan municipalities has reached to 30 in total. The list includes Adana, Bursa, Gaziantep, Konya (1987) and Kayseri (1988); Antalya, Diyarbakır, Eskişehir, Erzurum, Mersin, Kocaeli, Samsun (1993); Sakarya (2000); Aydın, Balıkesir, Denizli, Hatay, Kahramanmaraş, Malatya, Manisa, Mardin, Muğla, Ordu, Şanlıurfa, Tekirdağ, Trabzon, Van (2012); see http://www.tbb.gov.tr/en/local-authorities/municipalities-in-turkey/.

[58] We collected Surface Areas data from the website of the General Command of Mapping, Ministry of National Defense: https://www.hgk.msb.gov.tr/images/urun/il_ilce_alanlari.pdf . Then, we calculated the population density of each province (district) by dividing surface area with province (district) population.

The district centers typically represent areas of administrative and economic activity. According to population census data, as of 2010, there were a total of 957 districts in 81 provinces of Turkey; the number was 923 in the 2000 and 2007 censuses and increased to 970 districts in the 2014 census. In 2010, the districts had 77,036 population on average, ranging from 1,731 to 817,262, with a standard deviation of 123,885. Figure 5 shows the variation in the population of the districts of Turkey. The majority of the districts have a population below 50,000 people. The rest, about 35% of all districts, show large variations in population size, with the most populous one having an 850,000 population.

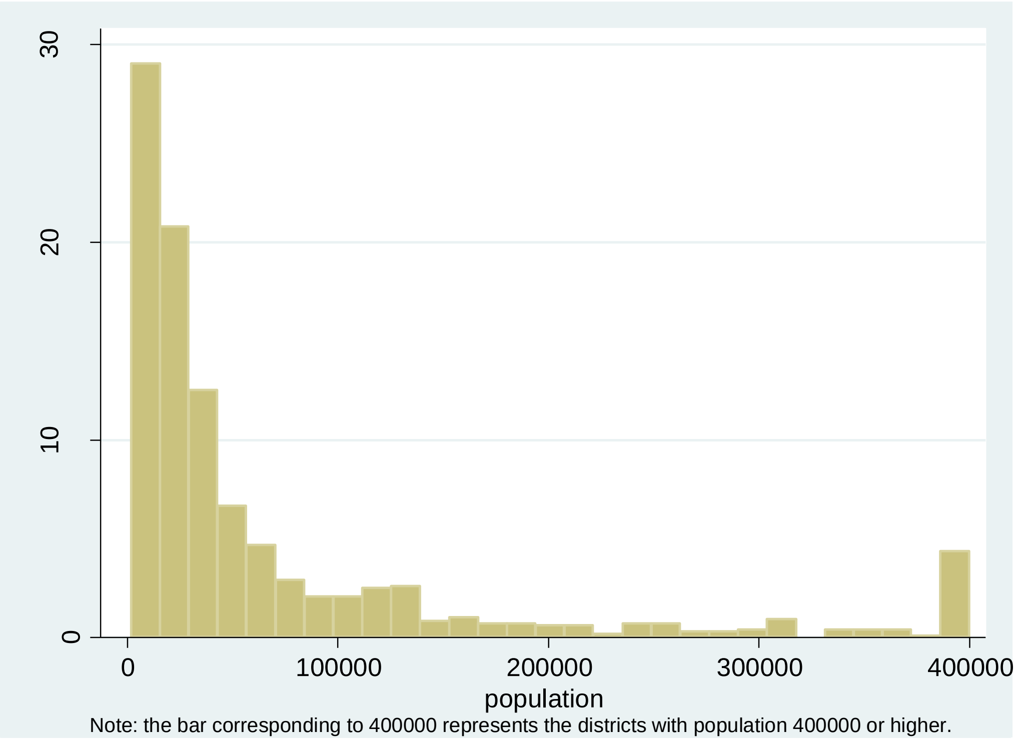

Figure 5. Variation in the population of the districts of Turkey in 2010

We had to omit certain provinces from the study. First, the three largest metropolitan provinces - İstanbul, Ankara, and İzmir - are particularly outliers. İstanbul is not only the most densely populated metropolitan city in Turkey but also historically and economically at the central position. Ankara is the capital province of the country. İzmir, a commercial port city throughout history, is the third-most populous metropolitan city after İstanbul and Ankara. The districts of these three provinces are mostly contiguous to each other; they likely form integrated local markets. This renders the delineation of market boundaries in these provinces insurmountable.[59] In addition, Antalya and Muğla, on the Mediterranean and Aegean coasts of Turkey, are among the most popular international tourism destinations, so their economic activities and populations vary dramatically from season to season and year to year.

2.4.3 Market selection

At the outset, we assume all the districts listed on the Address-based Population Recording System (*Adrese Dayalı Nüfus Kayıt Sistemi*, ADNKS) in 2010 as potential geographical markets.[60] Then, considering various dimensions described above, we applied some market selection rules, as spelled out below, to define local hospital care markets. Next, amongst the 'qualified' districts, we checked the actual highway distance between the neighboring districts to check for market overlaps, which led to further eliminations.

Firstly, we omitted the districts in Ankara, İstanbul, İzmir, Antalya, and Muğla from the empirical analysis for the reasons described above. Since similar difficulties are likely to arise, we excluded districts with populations greater than

[59] İstanbul has 144 private general hospitals and a population of 13,255,685 people in 2010. Despite large number of hospitals, we had to omit Istanbul in this empirical analysis. Exploration of the nature of hospital competition in İstanbul would require a specific analytical framework, since, arguably, hospitals in Istanbul attract considerable shares of their volumes from other provinces. Anecdotal evidence suggests that patients with complex or serious cases are commonly referred to the hospitals in 'big' cities. Given that the market dynamics and the interactions among hospitals in these 'too big' markets are likely to be different, the paper leaves the study of these markets for future research.

[60] The geopolitical divisions are based on 2010 definitions, and they are held constant throughout the sample periods.

600,000 in 2010.[61] These are markets, mostly, with a large number of hospitals that can typically be considered to be attracting patients from other markets. This elimination helps to ensure homogeneity across markets, so our focus can remain on the competitive interactions among hospitals in relatively isolated markets.

An additional issue is that some districts have very low populations and have no general hospital. After several experimentations, we decided to eliminate districts with a population of less than 50,000 since this population size appears to be insufficient to sustain a hospital. Finally, in case a province has multiple central districts which are in close proximity to each other, or if a district has at some point in time been partitioned to separate close districts, we took the geographical union of such contiguous districts as single markets.[62]

All these eliminations leave a sample of 205 districts as local markets across 72 provinces of Turkey with 157 private general hospitals for the empirical analysis. Table 9 presents the number of hospitals and population statistics for these markets during the study period. Local districts with a single private hospital represent 17% of all districts in the sample for the year 2010 compared to 15% for the year 2002, and districts with at least two private hospitals have risen from 5% of the sample districts in 2002 to 20% in 2010. About 25%, 40 of 164, of the sample districts with no private hospitals in 2002 had at least one private hospital in 2010. Also, 33% (68

[61] The districts, which have a population over 600,000 in 2010, are all Central districts of Adana (1,614,072 - 6), Antalya (983,827 - 10), Bursa (1,695,136 - 7), Diyarbakır (895,362 - 6), Eskişehir (643,640 - 5), Gaziantep (1,370,598 - 9), Kayseri (843,903 - 11), Konya (1,085,594 - 10), Mersin (891,495 - 5), Şanlıurfa (732,722 - 2). Their populations and the corresponding number of private hospitals are in parenthesis, respectively.

[62] The provinces with more than one central district are Adana, Antalya, Bursa, Diyarbakır, Erzurum, Eskişehir, Gaziantep, Kayseri, Konya, Mersin, Sakarya, Samsun. Kocaeli has several newer districts that are too close to the districts they were part of. Çayırova, Darıca, Dilovası belonged to Gebze district; Başiskele, Kartepe belonged to Kocaeli Central district; likewise, Aksu district of Antalya belonged to Central district previously. Then, they have become separate districts.

of 205) of the districts in the sample show at least one hospital entry between the years 2002 and 2010. Despite the noticeable rise in the number of private hospitals between 2002 and 2010, 128 districts out of 205 do not have a private hospital in the sample data for the year 2010. Also, the case of districts with more than three private hospitals is relatively rare. Yet, the sample has variation in market size to estimate the population required to support one, two, three, and four or more firms in 2010. For the year 2002, however, the data allows estimating entry thresholds only for one and two or more firms.

Table 9. Market Counts and Population in 2002 and 2010

Number of Hospitals in Local Market (N)	Number of Districts	Population Mean	Std Dev	Min	Max
Year: 2010					
0	128	87,488	43,145	50,041	331,113
1	35	146,319	64,797	61,173	354,913
2	24	203,557	76,776	103,922	364,547
3	9	262,524	145,860	117,890	477,580
4 or more	9	459,693	108,866	229,744	585,934
Year: 2002					
0	164	100,250	50,052	28,087	356,494
1	30	187,592	87,637	65,765	389,619
2	7	354,754	133,915	149,151	465,370
3	2	373,020	39,173	345,320	400,719
4 or more	1	340,825	-	340,825	340,825
Total markets	205				

Source: Author`s tabulations using the MoH data for the years 2002 and 2010.

The districts are geographically distinct and independent in terms of the identities of the hospitals that form each market. There are multi-market chain hospitals operating nationwide or in several markets; however, over 80 percent of the sample hospitals, corresponding to 125 of 157, are independent single-market hospitals. Also, there appear to be no clear asymmetric patterns in terms of bed numbers between multimarket chain hospitals and single-market hospitals; for instance, 20 of 32 multi-market chain hospitals have less than 50 hospital beds. Thus, the chain hospitals in the sample do not appear to differentiate themselves from others in terms of hospital bed capacity.

Table 10 presents the distribution of hospitals in the sample with respect to their bed capacities. There seems to be variation in bed capacities, which reveals some degree of asymmetry in market structure. To provide further breakdowns of the market configuration in the sample by hospital types, Table 11 displays the observed number of markets with each configuration. For that, we first categorized each hospital with respect to bed capacity as SMALL or BIG and with respect to its being part of a hospital chain as SINGLE or CHAIN. The table reveals that the markets are rather homogeneous, and the differentiated configurations in terms of both hospital size and being owned by a chain are not common. For instance, as the middle panel indicates, in the 23 markets with two hospitals, only three of them consist of one small and one big hospital, and only six of them consist of one independent and one chain hospital. Thus, we do not attempt to model the market configurations by type as an attempt to incorporate firm heterogeneity in the spirit of Mazzeo (2002).[63]

[63] Bresnahan and Reiss (1991) model is useful for evaluating the competitiveness of homogeneous markets with identical firms. Mazzeo's (2002) framework allows for heterogeneity across firms and makes it possible to distinguish the effect of same-type and different-type competitors a firm face on profitability in addition to the market conditions, and the number of competing firms. It extends the BR`s entry threshold method in a way to empirically analyze the structure of differentiated product markets by estimating an equilibrium model that predicts both the number of firms operating in a market and their product types. The dependent variable in Mazzeo-style models is an ordered pair indicating the number of market participants of each type.

Table 10. Sample Private General Hospitals and Their Bed Capacities in 2010

Number of beds	Number of private hospitals		
Year: 2010	Frequency	Percent	Mean Beds
Less than 25	23	14.65	20
25-50	78	49.68	38
50-75	31	19.75	59
75-100	12	7.64	86
100-125	10	6.37	111
125-150	3	1.91	133
Over 150	0	0.00	-
Total	157	100.00	50

Source: Author`s tabulations using the MoH data for the year 2010.

Table 11. Market Configurations by Hospital Types in 2010

Year: 2010		Number of SMALLER hospitals 75- beds					
		0	1	2	3	4+	Total
Number of BIGGER hospitals 75+ beds	0	127	32	20	3	3	185
	1	5	3	6	3	1	18
	2	0	0	0	1	0	1
	3	0	0	0	1	0	1
	4+	0	0	0	0	0	0
	Total	132	35	26	8	4	205

		Number of SMALLER hospitals 100- beds					
		0	1	2	3	4+	Total
Number of BIGGER hospitals 100+ beds	0	127	36	20	7	5	195
	1	1	3	2	1	1	8
	2	0	0	0	1	0	1
	3	0	0	0	1	0	1
	4+	0	0	0	0	0	0
	Total	128	39	22	10	6	205

		Number of SINGLE independent hospitals					
		0	1	2	3	4+	Total
Number of CHAIN hospitals	0	127	32	16	6	3	184
	1	5	6	2	0	2	15
	2	1	1	0	1	1	4
	3	0	0	1	0	0	1
	4+	0	0	0	1	0	1
	Total	133	39	19	8	6	205

Source: Author`s tabulations using the MoH data for the year 2010.

2.4.4 Market size variables

The population is the key determinant of the relevant market size, S, in the model. In the estimations, we use the population of districts, DPOP, as the primary determinant of the local market size. Despite the prima facia evidence of a robust positive relationship between a district`s population and the number of hospitals operating there, population alone is an imperfect indicator for the whole market size. For instance, hospitals in neighboring districts may constitute an alternative healthcare supply source for patients, and hospitals in a district may compete for patients from nearby districts. Also, since entry is a long-run decision, the anticipation of potential entrants in the future may affect the entry behaviors. Therefore, we included some other predictors of the market size in the analysis.

First, we included the surrounding population variable, NEARPOP, to measure the demand that may come from the residents of nearby districts. The Health Service Areas (HSAs) classification of the MoH was useful in deriving a measure of the nearby population surrounding a district.[64] The MoH identifies relatively major districts in an area as pivotal district areas consisting of one or more adjacent and relatively integrated districts. Thus, we computed the nearby population variable for each district as the population of the *pivotal district* where the particular district is located minus the district's population.[65] However, the neighborhood effect on competition among districts may be positive or negative depending on a district's regional centrality. Therefore, to capture this, we added an interaction variable for NEARPOP with the dummy variable for being a pivotal district, PDISTRICT.

[64] See Appendix A for the description of HSA classification of the Ministry of Health of Turkey.

[65] It would be more desirable to conduct a formal check to arrive at a precise relevant geographic market size definition like the Shipment test (Elzinga-Hogarty test), the Hypothetical Monopolist test (Small but Significant Non-transitory Increase in Prices SSNIP test). However, the former requires patient-level information and the latter relies on the price data, which are not available.

Besides, we included the ten-year change of district population variable between 2000 and 2010, which indicates the expectations about future market growth, GRW00. Its decompositions as negative and positive population growth variables, NGRW and PGRW, are used in the estimations to be able to capture potential asymmetry in expectations about market growth.

Hence, the market size equation is modelled in the following linear form:[66]

$$\hat{S}(\vec{Y},\lambda) = DPOP + \lambda_1 NEARPOP + \lambda_2 NEARPOPxPDIST + \lambda_3 NGRW + \lambda_4 PGRW$$

2.4.5 Demand and cost shifters

The districts vary both within themselves and among provinces in demography and socioeconomic development; in turn, hospital variable profits V(.) likely vary across markets. Thus, the model includes a set of variables, Z and W, to explain cross-section variations in local market demand and cost conditions of the districts. These are the urbanization rate, the fractions of elderly and children, a socio-economic development index, and the number of public MoH hospitals.

The variable MOHHOSP is the number of public hospitals. There are considerable differences in accessibility, pricing, and service content among public and private providers. Therefore, they cannot be considered to belong exactly in the same relevant product market. But still, the presence of public hospitals generates somewhat competitive constraints in the private hospital market. Thus, we included the number of public hospitals as a demand shifter.

A Socio-Economic Development Index ranking (*Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması*, SEGE) was published by Ministry of Development

[66] Following the literature, the coefficient of district population is set to one; therefore, S(Y) is scaled to the number of people living in the district. This normalization translates units of market demand into the units of district population.

(formerly State Planning Organization). It is available at the district level and can be used as an overall indicator of the income and wealth level of the districts. The index ranks the districts, provinces, and regions based on a wide range of economic, social, and cultural variables. It was published at the province level in 1996, 2003, and 2011, but only in 2004 at the district level. Hence, we used the SEGE-2004 variable at the district level in the estimations.[67]

In addition, we added two more variables regarding the presence of relatively smaller and larger firms in the market that might be weak or strong competitors. SMLCOMP and BIGCOMP represent the percentage of total hospital beds in a market owned by hospitals with less than 50 beds and more than 75 beds, respectively.[68] The presence of big (or small) hospitals may stimulate or deter entry. For example, the incumbent large hospitals could use strategic capacity investments to deter entry; or the presence of large hospitals could signal to potential entrants for supernormal profit opportunities and future market growth.[69]

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[67] See Appendix B for the description of SEGE-index of the Ministry of Development of Turkey.

[68] There does not appear to be an a priori classification for hospitals in terms of their bed sizes. Thus, for practical reasons in the estimations, after experimenting with alternative cutoff bed numbers, we choose to identify hospitals with less than 50 beds and more than 75 beds as relatively SMALL and BIG, respectively.

[69] We also experimented with several more variables.

(i) *LaggedHHI*, as a measure of market concentration, is calculated by the three-years lagged number of hospital beds. It had negative coefficient estimates which can be interpreted as an indication of strategic barriers to entry into more concentrated markets.

(ii) *PASTENRTY_* indicates the number of new hospitals that entered over the years 2006-09 or 2008-09. Past entry appeared to be positively related to the number of hospitals at the current period. Firm *learning or spillover effects* can happen by virtue of observing the profitability of the most recent entrants.

(iii) *INCUMBENT_* represents the number of existing hospitals in the recent past, as of 2006 and 2008, which may capture some *demand-creation effect* or other between-market differences. It showed positive coefficient.

However, the persistence in the structure with rare entry-exit rates within several years at local markets makes the things more complicated to control for all these variables together with the other market demographics included. Thus, in accordance with the purpose of the paper, we leave these market structure variables out of the analysis.

Fixed costs incurred by a hospital include medical labor and equipment, building, and some overhead expenses. To proxy such cost differences, first, we collected data on the value per m^2 of agricultural land, LANDV, from the Revenue Administration of Turkey. However, it differs among the neighborhoods inside the same district area, so LANDV data did not seem to be a good indicator of fixed cost variations between local markets. As an alternative more specific to the healthcare market, we gathered data on the cost index of the Turkish Medical Association, TBBCOST. This index is officially accepted as a measure of the difference in factor prices, like labor and rent, among provinces of Turkey. Hence, we continue the analysis using the TTBCOST variable as a fixed cost shifter.

Table 12 summarizes the definition of the variables used in the analysis and their sources. Table 13 presents sample descriptive statistics for the dataset used in the estimations.

2.5 Estimation results

Our first set of estimation results primarily explains the number of private hospitals that operate in a local market. This baseline analysis enables us to explore determinants of the number of hospitals in the local markets. Then, the coefficients from these estimations are used to calculate entry thresholds, per firm entry thresholds, and their ratios, which produce evidence on how additional market concentration affects firms` profitability, and the nature of competition along with market sizes required to support a given number of firms.

Tables 14-15 present the cross-section estimates for the years 2010 and 2002 for various specifications. Almost all the coefficients have the expected sign. Market size is explained by district population, market growth, and nearby population. The coefficient of the district population, λ_0, is set equal to one to normalize the unit of market demand to the unit of the district population.

Table 12. Variable Definitions and Their Sources

Variable Name		Definition
Dependent Variable		
PHOSP	N	Number of private general hospitals in local districts - Ministry of Health (MoH)
Market size	S	
DPOP	Y1	Population of districts, Address-based Population Recording System (ADNKS hereafter) - Turkish Statistical Institute (TUIK hereafter)
NEARPOP	Y2	Total population of nearby districts in the same pivotal district, ADNKS
NGRW00	Y3	Negative change in district population between 2000 and 2010; zero otherwise
PGRW00	Y4	Positive change in district population between 2000 and 2010; zero otherwise
PDISTRICT	D1	Dummy for whether a district is a pivotal district or not based on the MoH`s Health Service Area identification
Demand shifters	Z	
SEGE04	Z1	Socio-Economic Development Ranking Survey of Districts, SEGE-2004 index - Ministry of Development
FURBAN	Z2	Rate of district urban population - TUIK
FCHILD	Z3	Fraction of district children, the population aged 0-14 years - TUIK
FELDER	Z4	Fraction of district population over 65 years - TUIK
MOHHOSP	Z5	Number of public general hospitals in a district - Ministry of Health
NBMOHHOSP	Z6	Number of public general hospitals in nearby districts
SML_COMP	Z7	Fraction of total hospital beds in a district held by hospitals with less than 30 or 50 beds, as a concentration measure of relatively `small` competitors
BIG_COMP	Z8	Fraction of total hospital beds in a district held by hospitals with 50 or 75 and more beds, as a concentration measure of relatively `big` competitors
Fixed cost shifters	W	
WAGE index (TTBCOST)	W1	Hospital cost index regarding factor prices, including labor and rent, which is used to guide minimum price levels in each province - Turkish Medical Association

Table 13. Sample Market Descriptive Statistics

	2010			2002		
Variable Name	Mean	Std Dev	Range	Mean	Std Dev	Range
Market structure						
PHOSP	0.77	1.32	[0, 9]	0.26	0.62	[0, 4]
Market size (in 100,000s)						
DPOP	1.35	1.05	[0.50, 5.86]	1.26	0.86	[0.28, 4.65]
NEARPOP	1.89	3.27	[0, 19.89]	1.73	2.55	[0, 15.61]
NGRW00	-0.06	0.11	[-0.59, 0]	-0.06	0.11	[-0.59, 0]
PGRW00	0.15	0.26	[0, 1.64]	0.15	0.26	[0, 1.64]
PDISTRICT	0.74	0.44	[0, 1]	0.74	0.44	[0, 1]
Demand shifters						
SEGE04 (index)	0.52	1.13	[-1.63, 5.08]	0.52	1.13	[-1.63, 5.08]
FURBAN	0.61	0.21	[0.09, 0.99]	0.54	0.19	[0.09, 0.93]
FCHILD	0.27	0.09	[0.14, 0.5]	0.32	0.09	[0.19, 0.55]
FELDER	0.07	0.03	[0.02, 0.15]	0.06	0.02	[0.02, 0.12]
MOHHOSP	1.08	0.33	[0, 2]	0.95	0.23	[0, 1]
NBMOHHOSP	2.29	1.84	[0, 7]	1.56	1.37	[0, 5]
SML50COMP	0.54	0.43	[0, 1]	0.71	0.44	[0, 1]
BIG75COMP	0.19	0.33	[0, 1]	0.03	0.16	[0, 1]
Fixed cost shifters						
WAGE (TTBCOST)	3.08	0.20	[2.4, 3.3]	1.42	0.10	[1.2, 1.5]
Sample Size: 205						

Nearby population affects market size positively if the market is a pivotal district; negatively otherwise. Thus, it suggests that residents of smaller districts travel to more central *pivotal districts* to receive healthcare. It can also be interpreted that those hospitals in more central districts compete for patients from surrounding smaller districts. Population growth affects long-run market size positively. Decreases in population over the years significantly reduce the predicted market size. These results are robust to alternative specifications and sample years.

The market size of a given district can be predicted using the following equation, whose coefficients are obtained from specification (2) of Table 14. This predicted market size equation, among others, suggests that about two people from neighboring districts of a pivotal district correspond to one resident of the pivotal district itself.

$$\hat{S}(\vec{Y}, \lambda) = 1DPOP - 0.10NEARPOP + 0.58NEARPOPxPDIST + 2.78NGRW + 1.43PGRW$$

As for market characteristics other than population, socio-economic development index, urbanization rate, elderly and child population in a local district have all positive effects on the variable profits, while the presence of public hospitals has a negative effect. The residents of more urbanized and developed districts and those with higher proportions of elder and children populations are more likely to visit private hospitals. In the estimations for the sample year 2002, coefficients of WAGE and FCHILD are contrary to expectations; they turn out to be negative. The sign change in the coefficient of WAGE may be a consequence of the reforms on the physicians' working conditions and payment methods to them. And the inclusion of private hospitals into the public insurance system together with the improvement in universal health coverage between the two periods may be the reason that FCHILD has a positive effect on private hospital demand in 2010 but not in 2002.[70] The other demand shifters follow almost the same patterns as the baseline estimations for 2010.

In addition, the two variables regarding the presence of relatively smaller and larger competitors in the market, SMLCOMP and BIGCOMP, have both significantly positive coefficients according to the specifications (4) to (6). However, the coefficient estimates of these two market concentration variables are not significantly different, which raises concerns since the effects might come just from the total number of past hospital entries regardless of the firm sizes. Thus, only based on this observation, it is difficult to argue that the presence of big or small hospitals stimulates the entry of more new hospitals. Due to these concerns, our further analysis is based on the specification (2).

Tables 16-17 report the entry threshold estimates corresponding to the specifications in Tables 14-15. Entry thresholds, entry thresholds per firm, and entry threshold ratios in Tables 16-17 are predicted using the formulas presented below:

$$S_N = \frac{\hat{F}}{\hat{V}} = \frac{\hat{\gamma}_1 + \hat{\gamma}_L \bar{\vec{W}} + \sum_{n=2}^{N} \hat{\gamma}_n}{\hat{\alpha}_1 + \bar{\vec{Z}}\hat{\beta} + \sum_{n=2}^{N} \hat{\alpha}_n}, \qquad s_N = \frac{S_N}{N}, \qquad s_{N+1,N} = \frac{s_{N+1}}{s_N}$$

where $\vec{Z}$ and $\vec{W}$ are evaluated at their sample means, and the estimated parameters come from Table 14-15.[71]

[70] In the structural econometric models of entry literature, the estimates of some coefficients may appear with unexpected signs (for example, see Vogt, 2007).

[71] Since we use an ordered probit model, marginal effects are to be calculated for each level of equilibrium number of hospitals as usual. Following BR and keeping the focus on the entry threshold market size estimates, we refrain from calculating the marginal effects.

Table 14. Ordered Probit Estimation of Number of Hospitals in 2010

Variable Name and Coefficient		(1)	(2)	(3)	(4)	(5)	(6)
Market size	S						
DPOP	λ_0	1 (offset)	1 (offset)	1 (offset)	1 (offset)	1 (offset)	1 (offset)
NEARPOP	λ_1	-0.11*	-0.10	-0.10	-0.10	-0.08	-0.07
		(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)
NEARPOP	λ_2	0.44**	0.58***	0.57***	0.57***	0.60***	0.59***
x[PDISTRICT=1]		(0.21)	(0.22)	(0.22)	(0.22)	(0.21)	(0.22)
NGRW00	λ_3	2.72**	2.78**	2.86**	2.40*	2.73**	2.06*
		(1.16)	(1.18)	(1.20)	(1.25)	(1.14)	(1.24)
PGRW00	λ_4	1.29	1.43	1.34	1.55	1.06	1.14
		(0.99)	(1.04)	(1.04)	(1.10)	(0.98)	(0.98)
Demand shifters	Z						
SEGE04	β_1	0.07		0.03			
(Development index)		(0.05)		(0.07)			
FURBAN	β_2		1.20***	1.13***	1.19***	1.27***	1.22***
			(0.38)	(0.40)	(0.39)	(0.39)	(0.38)
FCHILD	β_3		1.26	1.61**	1.67	0.89	0.77
			(1.21)	(0.69)	(1.21)	(1.29)	(0.58)
FELDER	β_4		4.33	4.57*	5.15	4.08	3.86
			(4.23)	(2.54)	(4.17)	(4.36)	(2.52)
MOHHOSP	β_5	-0.23**	-0.37***	-0.38***	-0.35***	-0.42***	-0.40***
		(0.12)	(0.13)	(0.13)	(0.13)	(0.13)	(0.14)
NBMOHHOSP	β_6	0.004	-0.01	-0.01	-0.00	-0.02	-0.00
		(0.27)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
SML50COMP	β_7				0.34***		0.47***
					(0.12)		(0.14)
BIG75COMP	β_8					0.27*	0.48***
						(0.15)	(0.17)
Fixed cost shifters	W						
WAGE	γ_L	-0.74	-1.01*	-1.01*	-0.75	-0.92*	-0.75
		(0.52)	(0.56)	(0.56)	(0.58)	(0.56)	(0.58)
V_1	α_1	1.30***	0.08	(omitted)	(omitted)	0.22	(omitted)
		(0.29)	(0.61)			(0.66)	
$V_1 - V_2$	α_2	0.09	(omitted)	(omitted)	0.05	0.02	0.05
		(0.19)			(0.21)	(0.19)	(0.21)
$V_2 - V_3$	α_3	0.29	0.19	0.22	0.15	0.23	0.15
		(0.19)	(0.17)	(0.18)	(0.19)	(0.18)	(0.19)
$V_3 - V_4$	α_4	0.01	0.01	0.02	(omitted)	(omitted)	(omitted)
		(0.15)	(0.17)	(0.18)			
F_1	γ_1	4.07***	5.02***	5.00***	4.19**	4.79***	4.19**
		(1.66)	(1.79)	(1.78)	(1.83)	(1.79)	(1.83)
$F_2 - F_1$	γ_2	0.97***	1.16***	1.16***	1.23***	1.14***	1.23***
		(0.36)	(0.17)	(0.17)		(0.38)	(0.43)
$F_3 - F_2$	γ_3	0.42	0.70	0.64	0.89	0.65	0.89
		(0.49)	(0.53)	(0.53)	(0.56)	(0.52)	(0.56)
$F_4 - F_3$	γ_4	0.89	1.12	1.08	1.25***	1.22***	1.25***
		(0.67)	(0.84)	(0.84)	(0.41)	(0.40)	(0.41)
Log Likelihood:		-139.77	-132.97	-132.84	-128,07	-131.25	-123.21
Sample Size: 205							

Notes: Standard errors are in parentheses.

Table 15. Ordered Probit Estimation of Number of Hospitals in 2002

Variable Name and Coefficient		(1)	(2)	(3)	(4)	(5)	(6)
Market size	S						
DPOP	λ_0	1 (offset)	1 (offset)	1 (offset)	1 (offset)	1 (offset)	1 (offset)
NEARPOP	λ_1	-0.08*	-0.04	-0.06	-0.08	-0.03	-0.08
		(0.17)	(0.13)	(0.15)	(0.17)	(0.13)	(0.18)
NEARPOP	λ_2	0.23	0.53*	0.37	0.43	0.47*	0.34***
x[PDISTRICT=1]		(0.31)	(0.28)	(0.28)	(0.28)	(0.27)	(0.27)
NGRW00	λ_3	1.28**	1.34	0.92	1.21	1.64	1.53
		(2.27)	(1.58)	(1.77)	(1.61)	(1.60)	(1.62)
PGRW00	λ_4	0.96	1.67*	1.32	2.10**	1.79*	2.67**
		(0.96)	(0.92)	(0.90)	(1.04)	(0.95)	(1.14)
Demand shifters	Z						
SEGE04	β_1	0.34**		0.23			
(Development index)		(0.15)		(0.19)			
FURBAN	β_2		0.01	-0.35	-0.14	0.13	-0.07
			(0.33)	(0.50)	(0.36)	(0.39)	(0.43)
FCHILD	β_3		-2.88**	-0.19	-1.96	-1.97	0.38
			(1.44)	(2.45)	(1.41)	(1.48)	(1.43)
FELDER	β_4		3.53	9.80	4.87	7.41	11.95*
			(5.60)	(7.80)	(5.94)	(5.85)	(6.32)
MOHHOSP	β_5	-0.21	-0.08	0.02	-0.17	-0.20	-0.44
		(0.51)	(0.36)	(0.41)	(0.36)	(0.38)	(0.38)
NBMOHHOSP	β_6	0.03	-0.05	-0.02	-0.01	-0.08*	-0.05
		(0.06)	(0.04)	(0.06)	(0.04)	(0.05)	(0.05)
SML30COMP	β_7				0.38***		0.63***
					(0.15)		(0.18)
BIG50COMP	β_8					0.47**	0.90***
						(0.19)	(0.27)
Fixed cost shifters	W						
WAGE	γ_L	1.14	0.79	0.93	0.51	0.73	0.22
		(1.45)	(1.55)	(1.58)	(1.58)	(1.60)	(1.70)
V_1	α_1	0.09	1.81**	0.47	1.47*	1.43*	0.55
		(0.64)	(0.87)	(1.34)	0.86	(0.84)	(0.78)
$V_1 - V_2$	α_2	0.11	0.05	0.16	0.03	(omitted)	(omitted)
		(0.29)	(0.23)	(0.27)	(0.24)		
F_1	γ_1	0.43	1.79	1.36	2.05	1.93	2.57
		(2.07)	(2.24)	(2.28)	(2.28)	(2.26)	(2.42)
$F_2 - F_1$	γ_2	1.81**	1.92**	1.74*	2.24**	2.23***	2.76***
		(0.88)	(0.89)	(0.90)	0.92	(0.40)	(0.50)
Log Likelihood:		-61.34	-58.39	-57.10	-53.57	-54.31	-43.25
Sample Size: 204							

Notes: Standard errors are in parentheses.

The estimates in the first panel of Table 16 show breakeven market size in terms of population implied by the specifications in Table 14. The estimated market size refers to the population of potential customers, including the residents of nearby districts and market growth expectations. They should be interpreted with caution. For example, according to the specification (2), the central district of Sivas has a market size of 469,701 while its resident population is 354,913.[72] Based on this calculation, the model predicts that the entry of almost three hospitals is economically sustainable in the Central district of Sivas.[73]

In the middle panel of Table 16, the per firm entry threshold for the first firm appears to be higher than the thresholds for later entrants. The third panel of Table 16 presents the estimated ratios of successive per firm entry thresholds. The ratios do not follow a monotonic pattern. The threshold ratios for two or more firms do not indicate evidence for lower margins with an additional private hospital. That is, the competitive conduct remains almost unchanged as the number of hospitals rises except for the first entry. The pattern does not differ across model specifications. Thus, it is difficult to argue that the hospital competition intensifies with the entry of a second and later entrant based on these estimates.[74]

Similarly, the entry threshold estimates for the year 2002 in Table 17 suggest that per firm entry thresholds for the later entrants are not higher than the first

[72] Market size prediction for the central district of Sivas province:
$S_{sivas}(Y)$ =1*DPOP-
0.10*NEARPOP+0.58*NEARPOP*PDISTRICT+2.78*NGRW00+1.43*PGRW00
=1*354,913 - 0.10*74,145 + 0.58*75,145*1 + 2.78*0 + 1.43*54,978 = 469,701.

[73] In Sivas Merkez, there was only one private hospital in 2010. However, in line with our prediction, the number of private hospitals has risen from one in 2010 to three in 2018 while the population has slightly increased from 354,913 in 2010 to 377,561 in 2018.

[74] The economic model suggests that the threshold ratio starts from somewhere close to two and eventually converges to one. Departures of successive entry threshold ratios from the value of one measure whether competitive conduct changes as the number of firms increases. When the ratio of successive per firm entry thresholds converges to one, the market becomes competitive.

entrant. The year 2002 consists only of three categories for N, so one should be particularly careful when comparing the threshold estimates for 2002 with the estimates from 2010. In the estimation for the year 2002, S2 represents the category of two or more hospitals in the market. Therefore, the per firm entry threshold for only two firms would likely be even less than that reported in Table 17.

Table 16. Entry Threshold Estimates for 2010

Year: 2010		(1)	(2)	(3)	(4)	(5)	(6)
Entry Thresholds (market size in terms of district population, including nearby population and market growth variables)	S1	163,567	180,892	178,738	194,464	180,304	201,110
	S2	274,599	290,287	288,497	320,614	291,352	348,788
	S3	443,867	435,680	438,944	470,559	448,578	538,061
	S4	573,370	569,746	578,757	606,331	595,282	706,424
Per Firm Entry Thresholds S_N/N	S1/1	163,567	180,892	178,738	194,464	180,304	201,201
	S2/2	137,299	145,144	144,248	160,307	145,676	174,394
	S3/3	147,956	145,227	146,315	156,853	149,526	179,354
	S4/4	143,342	142,437	144,689	151,583	148,846	176,606
Per Firm Entry Threshold Ratios s_{N+1}/s_N	s_2/s_1	0.83	0.80	0.81	0.82	0.81	0.87
	s_3/s_2	1.08	1.00	1.01	0.98	1.03	1.03
	s_4/s_3	0.97	0.98	0.99	0.97	1.00	0.99

Notes: Estimates are based on the coefficient estimates in Table 14.

Table 17. Entry Threshold Estimates for 2002

Year: 2002		(1)	(2)	(3)	(4)	(5)	(6)
Entry Thresholds	S1	407,878	308,215	304,626	309.979	300,738	308,176
	S2	980,339	539,310	613,593	576.920	526,166	602,273
Per Firm Entry Thresholds S_N/N	S1/1	407,878	308,215	304,626	309.979	300,738	308,176
	S2/2	490,169	269,955	306,797	288,460	263,083	301,136
Per Firm Entry Threshold Ratios s_{N+1}/s_N	s_2/s_1	1.20	0.88	1.00	0.93	0.88	0.98

Notes: Estimates are based on the coefficient estimates in Table 15.

Compared with the estimates from the sample year 2002, the market size required to support the first entry shrunk in 2010. Therefore, it can be argued that the profitability (margins) has increased, the fixed costs have decreased, or both have occurred between these two sample years. An interpretation may be through the achievement of universal insurance coverage with the completion of health reforms under the HTP. During the pre-reform period, in 2002, the insurance coverage was not universal; that is, not every citizen had public insurance coverage. Also, in 2002, citizens couldn't receive private healthcare from hospitals through their public insurance. The resident population of a district in 2002 is translated in market demand for a private hospital at a rate lower than the one in 2010 because, with the implementation of universal health insurance coverage, all citizens have begun to have access to private healthcare services through their public insurance at relatively low cost. Such changes in the institutional environment might explain the noticeable decrease in the estimated required market sizes for the entry of the first private hospital in 2010.

To summarize, private hospitals have entry threshold ratios around one at all market configurations. The threshold ratios do not follow a monotonic pattern implying that entry by the second and later hospitals has no effects on margins. This pattern on the estimated ratios of successive per firm entry thresholds does not seem to differ across model specifications, alternative market definitions, and different sample years.[75]

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[75] We experimented with different geographic relevant market definitions. However, use of alternative market definitions and similar robustness checks do not produce evidence that our findings are sensitive to such changes. For brevity, these supplementary analyses are not reported.

2.6 Further analysis for policy implications

In this section, using the estimated parameters, we conduct some hit-and-miss analysis and counter-factual policy analysis to explore further the consequences of restrictive regulations.

Table 18 compares the number of private hospitals in the central districts of the provinces in the sample actually observed in 2014 with the model's predictions based on the coefficient estimates for 2010. The table cells present the number of districts for possible pairs of market configurations. There appear some undershoots and overshoots as well as ‘accurate’ predictions.

Table 18. Actual and Predicted Market Configurations in 2014

Year: 2014 Actual \ Predicted	N = 0	N = 1	N = 2	N = 3	N ≥ 4	Total
N = 0	14	3	0	0	0	17
N = 1	4	8	6	1	0	19
N = 2	0	8	5	2	1	16
N = 3	0	2	1	1	0	4
N ≥ 4	0	0	1	1	8	10
Total (number of districts)	18	21	13	5	9	66

Notes: Includes only the Central districts of the provinces in the sample. Predictions are based on the coefficient estimates and entry threshold estimates at the specification (2) of Tables 14 and 16.

Tables 19-20 contain the predicted market sizes for the year 2014 of all central districts in the sample provinces that are calculated using the estimated coefficients and the entry thresholds for the year 2010 in the specification (2) of Tables 14 and 16. It presents the predicted carrying capacities (that is, the predicted number of private hospitals that a local market environment can economically sustain) of the sixty-six central districts of the provinces in the sample. According to Tables 19-20, although the predictions appear to be ‘correct’ for most districts, some districts have a higher number of private hospitals than the number of hospitals predicted by the estimated entry threshold levels, while others have fewer. The deviations of the predicted number of hospitals from the actually observed ones may indicate the lack of predictive power of the model; on the other hand, they may also reveal the level of distortions due to the restrictive government regulations.

This analysis provides a counter-factual policy exercise that reveals the difference between the market structures observed in 2014 and what we might expect to see if there were less restrictive entry regulations. The results of this exercise provide some guidance to address whether reduction or increase, as a result of acquisition and mergers of existing hospitals or new hospital entry, in the number of private hospitals to a particular level reduces or enhances competition at a local hospital care market. However, since the predictions are calculated using the sample mean values of the variables, this exercise should not be interpreted as definitive.

2.7 Concluding discussion

This paper empirically analyzes the structure of the hospital care market in Turkey by estimating static equilibrium models for various specifications. The analyses enable us to predict the number of private hospitals operating in Turkey’s local geographic markets and explore the determinants of hospital market structure and the nature of competition.

Table 19. Predicted Carrying Capacities of the Central Districts in 2014, A to I

Districts					Estimated cutoffs					Entry
District Name	District Population in 2014	Actual # of private hospitals in 2010	Actual # of private hospitals in 2014	Prediction of market sizes in 2014 using estimated coefficient of 2010	No potential entrant S < 1 80,892	One potential entrant 180,892 < S < 290,287	Two potential entrants 290,287 < S < 435,680	Three potential entrants 435,680 < S < 569,746	Four or more entrants S > 569,746	Entry / Exit / Stable between 2010 and 2014
Adıyaman M.	283,556	0	2	318,369			x			entry
Afyonkarahisar M.	274,639	2	2	415,866			x			-
Ağrı M.	146,007	1	1	247,259		x				-
Aksaray M.	278,171	2	1	343,188			x			exit
Amasya M.	135,950	0	0	193,446		x				-
Ardahan M.	40,960	0	0	55,459	x					-
Artvin M.	34,050	0	0	53,497	x					-
Aydın M.	270,835	1	1	431,711			x			-
Balıkesir M.	342,799	2	2	576,244					x	-
Bartın M.	145,230	0	0	183,165		x				-
Batman M.	408,248	6	5	568,434				x		exit
Bayburt M.	63,848	0	0	37,796	x					-
Bilecik M.	72,611	0	0	135,928	x					-
Bingöl M.	147,087	1	1	212,683		x				-
Bitlis M.	66,732	0	0	115,598	x					-
Bolu M.	177,855	2	2	237,226		x				-
Burdur M.	99,333	0	0	143,297	x					-
Çanakkale M.	155,657	1	1	292,719			x			-
Çankırı M.	86,381	1	1	113,321	x					-
Çorum M.	275,610	2	2	360,920			x			-
Denizli M.	592,084	5	5	851,190					x	-
Düzce M.	214,991	1	1	336,829			x			-
Edirne M.	165,979	2	2	200,113		x				-
Elazığ M.	412,220	3	3	504,800				x		-
Erzincan M.	149,879	1	1	111,287	x					-
Erzurum M.	348,078	0	1	243,051		x				entry
Giresun M.	126,172	2	2	201,433		x				-
Gümüşhane M.	52,628	0	0	46,390	x					-
Hakkari M.	79,335	0	0	90,058	x					-
Iğdır M.	132,110	0	1	190,803		x				entry
Isparta M.	228,730	3	3	356,312			x			-

Notes: Predictions are based on the coefficients and threshold estimates at the specification (2) of Tables 14 and 16.

Table 20. Predicted Carrying Capacities of the Central Districts in 2014, K-Z

Districts					Estimated cutoffs					Entry
District Name	District Population in 2014	Actual # of private hospitals in 2010	Actual # of private hospitals in 2014	Prediction of market sizes in 2014 using estimated coefficient of 2010	No potential entrant S < 1 80,892	One potential entrant 180,892 < S < 290,287	Two potential entrants 290,287 < S < 435,680	Three potential entrants 435,680 < S < 569,746	Four or more entrants S > 569,746	Entry / Exit / Stable between 2010 and 2014
Kahramanmaraş M.	589,413	4	5	779,850					x	entry
Karabük M.	127,658	1	1	180,996		x				-
Karaman M.	181,383	2	2	213,070		x				-
Kars M.	111,278	0	0	183,469		x				-
Kastamonu M.	137,391	3	2	216,134		x				exit
Kilis M.	103,531	0	0	128,502	x					-
Kırıkkale M.	197,037	0	1	167,287	x					entry
Kırklareli M.	92,514	0	0	125,097	x					-
Kırşehir M.	134,367	1	1	171,632	x					-
Kocaeli M.	523,217	3	4	919,274					x	entry
Kütahya M.	253,175	2	2	344,801			x			-
Malatya M.	299,863	9	9	596,743					x	-
Manisa M.	370,879	2	2	617,745					x	-
Muş M.	186,097	1	1	231,330		x				-
Nevşehir M.	127,891	3	2	222,224		x				exit
Niğde M.	205,753	1	1	298,791			x			-
Ordu M.	195,817	2	3	274,117		x				entry
Osmaniye M.	249,136	4	4	339,843			x			-
Rize M.	141,250	1	1	199,708		x				-
Sakarya M.	494,977	5	5	890,834					x	-
Samsun M.	570,676	5	7	983,421					x	entry
Şanlıurfa M.	837,180	2	4	1,528,471					x	entry
Siirt M.	152,539	3	3	274,769		x				-
Sinop M.	59,571	0	0	104,636	x					-
Şırnak M.	91,573	0	0	130,897	x					-
Sivas M.	351,431	1	1	464,891				x		-
Tekirdağ M.	182,522	2	2	213,098		x				-
Tokat M.	185,626	1	1	237,503		x				-
Trabzon M.	314,246	2	2	476,366				x		-
Tunceli M.	38,015	0	0	61,843	x					-
Uşak M.	231,563	2	2	340,654			x			-
Van M.	424,802	5	4	722,118					x	exit
Yalova M.	127,670	2	2	218,559		x				-
Yozgat M.	96,831	1	0	72,490	x					exit
Zonguldak M.	210,103	0	1	323,750			x			entry

Notes: Predictions are based on the coefficients and threshold estimates at the specification (2) of Tables 14 and 16.

In explaining hospital entry in the local districts of Turkey over the sample period, 2001-2014, the empirical analysis focuses on threshold market sizes estimated by population and other market characteristics. It also pays attention to the presence of different-sized hospitals in local markets. An additional factor that influences the number of private hospitals is the regulatory environment. However, since the hospital regulations have been practiced nationwide, it could not be possible for us to distinguish the effects of the hospital regulatory climate across local markets in the estimations. For this reason, in a multi-period static framework, we attempted to explore the overall role of the health reforms and regulations under the HTP in shaping the hospital market structure with the help of comparisons of the estimation results for two different sample years, 2002 and 2010.

Our estimates robustly reveal that per hospital demand thresholds to achieve long-run profitability do not display an increasing path. Thus, there appears to be no evidence that more private hospital entries after the first entry lead to a rise in competitive conduct.

Whereas the threshold ratios for 2002 and 2010 appear not to follow different patterns, the divergence between the estimated market size thresholds for the pre-reforms and post-reforms periods clearly suggests that the predicted carrying capacities of the local markets have increased during the HTP. This growing demand in the industry can be plausibly interpreted as a consequence of the reforms that encourage the private provision of healthcare in an improved public insurance coverage climate.

The nonmonotonic nature of the estimated entry thresholds is particularly striking. From this aspect, the paper provides an example of market settings in which “one is enough” to ensure competitive conduct. Related studies in the literature initiated by Bresnahan and Reiss (1991) generally find that the estimate for the threshold ratio to be high for the first entry (close to two, which means the second entrant needs almost double per firm demand to enter compared to the first entrant); and the successive ratios decline with the entry of the second and third firms; eventually, the sequence of the threshold ratios converges to one where the market is assumed to reach to competitive conduct.

For example, Bresnahan and Reiss (1991) study the entry of five retail and professional industries (e.g., doctors, dentists, druggists, plumbers, and tire dealers) in isolated U.S. towns. They find that competitive conduct usually falls monotonically as the number of firms rises; most of the increase in competition comes with the entry of the second and third firms; and, once the market has between three and five firms, the next entrant has little effect on competitive conduct. Similarly, Abraham, Gaynor, and Vogt (2007) find the entry threshold ratios of $\{s_{n+1}/s_n\}_{n=1}^{n=3} = \{1.97, 1.44,\ 1.06\}$ for the hospital industry in the U.S. cities, and they conclude that entry of a second or third hospital has considerable estimated effects on competition. In another study, Balmer (2013) concludes that two firms in newspaper sellers' markets of Swiss communes seem sufficient to ensure competition with the estimated ratios of $\{s_{n+1}/s_n\}_{n=1}^{n=4} = \{1.91, 1.09, 1.03, 1.07\}$.

On the other hand, there are few studies that investigate healthcare markets with similarly regulated market environments with which our result on the non-monotonic nature of the entry threshold ratios seems to be in line. Dranove, Gron, and Mazzeo (2003) examine the Health Maintenance Organization (HMO) markets in the U.S. They initially proceed as if the HMOs are homogeneous markets and employ the BR model, and they find a non-monotonic relationship between the predicted entry threshold ratios and the number of firms as $\{s_{n+1}/s_n\}_{n=1}^{n=5} =$

$\{0.93, 1.58, 1.50, 1.30, 1.20\}$, which implies that the market size required to support a second firm is roughly the same as the average market size of monopoly markets. Then, to explore whether product differentiation can explain this pattern, they apply Mazzeo's (2002) model that endogenizes product type choice as well as entry decision. They distinguish the HMOs as 'local' operating in only one market and 'national' doing business nationwide. They examine to what extent additional same-type and different-type HMOs affect competition. This time, the entry threshold ratios calculated separately for the local and national HMOs are $\{s_{n+1}/s_n\}_{n=1}^{n=3} = \{3.38, 2.25, 2.08\}$ and $\{1.83, 1.42, 1.32\}$, respectively. The entry threshold ratios monotonically fall consistent with the pattern in the homogenous product industries, suggesting that competitors' effect on profitability comes almost exclusively from the same-type HMOs.

Similar to this paper, Schaumans and Verboven (2008) provide an example of market settings in which additional entry does not lead to a more intensified competition. Using a Mazzeo-style econometric model of entry, they investigate two interdependent professions (namely, pharmacies and physicians) in Belgium, which are both subject to heavy regulations. Under a regime of high regulated markups and restricted entry, they find that (i) entry into one profession has a positive effect on the profitability of entry into another profession, suggesting that entry of different-type firms are strategic complements; (ii) entry does not lead to intensified competition among the same-same type competitors; thus, for both professions, the market size to support a certain number of firms increases roughly proportionally with the number of firms. The comparison of our findings with the ones in the literature calls for more research on industries in which the public and private sector coexists in a highly regulated market environment.

From the welfare point of view, our analysis provides some policy implications. The paper proposes a way of answering the question of how many firms a local market can carry. It reveals the discrepancy, if there is, between the actual number of firms in a market and the predicted carrying capacity of the market. Thus, the paper enables us to ascertain markets in such a ‘disequilibrium’ in health service provision. Concerning the availability of hospital services for the achievement of universal access to healthcare and other similar health-for-all goals, the government may see it necessary to raise the number of public hospitals in certain districts. However, there may be districts in which the private sector already has sufficient economic motives to enter and compete in the market if private healthcare continues to be financed by public insurance. Therefore, in a situation where a local market already has competitive conduct, government interventions by establishing public hospitals may not be needed. On the other hand, in the districts where no private hospital entry seems economically feasible, such a government intervention may be needed to ensure healthcare delivery for all citizens of the country. Therefore, from the welfare aspect, our analysis appears to be instrumental in identifying markets in which private sector entry is profitable and the markets to which more public resources need to be devoted for delivering healthcare on an equal basis across the nation. Furthermore, our model seems helpful for the antitrust merger analysis in assessing the impact of specific hospital mergers.

Our analysis is incomplete in that the model does not account for the nature of competition in the denser contiguous markets in metropolitan provinces of Turkey. The exclusion of the markets in the main metropolitan provinces from the sample used in the estimations limits the generalizability of the paper's results. The type and nature of competition among hospitals in ‘bigger’ provinces that have continuous boundaries across their districts (such as Ankara, Gaziantep, İstanbul, İzmir, Kayseri, and Konya) is arguably different from that in 'smaller' less dense provinces (like Amasya, Bolu, Giresun, Kahramanmaraş, Manisa, and Tokat).

A concern about modeling is that service characteristics of hospitals might differ between relatively small and large hospitals or between independent single-market hospitals and hospitals owned by a national multi-market chain hospital group. Different types of firms may react differently to similar determinants of firm entry. Also, the presence of bigger (or smaller) hospitals may stimulate or deter entry into the market. For example, it could signal potential entrants for supernormal profit opportunities or future market growth. If such asymmetries among hospitals in local markets exist, the estimations based on the simple count of the hospitals might produce misleading results.

In terms of firm size, there appear to be some variations in hospital sizes measured by the number of beds in the sample. Two-thirds, 102 of 157, of the private hospitals have fewer than 50 hospital beds, whereas 13 of the private hospitals have more than 100 beds. Also, only 6 of 35 single hospital districts have a hospital with more than 75 beds as a monopolist. In the duopoly markets, 11 (out of 24) districts have only small hospitals (with less than 50 beds), only 3 of them have one hospital with more than or equal to 75 beds, and no duopoly markets have two large hospitals. Even though there seem to be such variations in hospital sizes within local markets, the limited number of observations makes it difficult to detect a general pattern of firm asymmetry in hospital size. Hence, from this aspect, we could not explore the asymmetric market structure with nonstrategic and strategic interactions like capacity investments to deter entry in this chapter. The size choice of hospitals necessitates their own research framework to be properly addressed (see Chapter 3 of the thesis for the analysis of strategic capacity formation in a different setting).

Among others, the paper's model does not consider the quality dimension of healthcare. The quality of the hospitals is taken as homogeneous across hospitals. Although Mazzeo (2002) provides a model to analyze equilibrium market structure in a differentiated product oligopoly where entrants can also choose their firm types (i.e., product quality), both the absence of a measure of hospital service quality and the very limited number of observations in our dataset on each market configuration make the Mazzeo-style models impractical for our analysis when we attempted to consider the hospital size as a quality indicator.

The paper has necessarily made some restrictive assumptions. There are still a number of topics on the hospital markets in Turkey waiting to be addressed, which are beyond the scope of this paper. In addition to hospital entry decisions, the size choice of hospitals needs to be explored properly. Moreover, single-market independent firms may face some competition from multi-market chain hospitals. For instance, a national-brand hospital may have competitive advantages over inexperienced single-market independent entrants due to information asymmetries such as foreseeing the market conditions for entry better. Furthermore, the timing of entry might have a strategic role in market competition if there is an early- or later-mover advantage in entering a local market. However, these research topics are more relevant for hospital markets in the big metropolitan cities, which are outside the sample of this paper, with half-dozen hospitals, compared to local districts with few hospitals. Despite their importance, these topics wait to be researched; yet, a critical reason for this omission might be the difficulty in obtaining and developing suitable datasets. We hope this paper stimulates additional future research on these topics.

CHAPTER 3

HOSPITAL CAPACITY CHOICE IN TURKEY

3.1 Introduction

In industries with high market concentrations, incumbent firms may have strategic motives to discourage new firm entry and expansion of rivals or to induce exit through various strategic actions, including excess capacity investments. Capacity and similar forms of investments can be used strategically to deter entry or exploit the advantage of preempting a growing market to some degree (Spence, 1977; Spence, 1979). Costly excess capacity investments may also serve as a strategic commitment that makes the post-entry predatory output increase of incumbent firms a credible threat to prospective entrants (Dixit, 1979; Dixit, 1980). According to the business strategy taxonomy of Fudenberg and Tirole (1984), firms may overinvest to become a 'top dog' (being big or strong to look tough or aggressive) in case their reaction curves are downward sloping in rivals` output, or 'fat cat' (being big or strong to look soft or inoffensive that commits to play less aggressively post-entry) if their reaction curves are upward sloping. It is well understood in the literature that, in the interest of entry deterrence or for some other strategic reasons, the established firms may set their capacity at a higher level than the extent of a local market's carrying capacity.

With the inception of the Health Transformation Program (HTP) from 2003 to 2013 in Turkey, the government chose to utilize market mechanisms more on the delivery side of the health system, and that has resulted in greater involvement of private healthcare providers while strengthening the single public purchasing mechanism, the Social Security Institution (SSI), on the financing side. On the public health insurance front, individuals were allowed to receive health services from private hospitals with limited copayments. Under these circumstances, private hospitals have been increasingly involved in healthcare delivery. A surge happened in the number of private hospitals nationwide through the 2000s. However, in the later years of the HTP, the surge in the number of private hospitals was followed by new regulations on hospital entry and healthcare prices.[76]

In 2008, a Certificate of Need (CoN) regulation concerning the establishment and capacity expansion of private hospitals was introduced. On the financing side, a new healthcare provider payment method (SUT scheme) was introduced in 2007 for the reimbursement of private healthcare providers by the publicly financed national social security institution within the scope of public health insurance. The SUT payment method regulates the private healthcare prices by setting base unit prices for each itemized hospital service. After such restrictive regulations, the rapid rise in the number of private hospitals has slowed down starting from the year 2010. In the later years of the program, under such a heavily regulated industry environment, entry of new hospitals was less common, whereas the growth of the private hospitals market seems to have happened not in the form of new hospital entry but in the form of capacity expansion of existing hospitals. In this paper, we aim to explore the strategic aspect of the capacity choices of hospitals in the heavily regulated Turkish hospital market during the 2010-2014 period.

More specifically, we aim to investigate the strategic incentives of hospitals through capacity investments. First, we build an analytical framework that provides

[76] Here, we briefly present particular health reforms and regulations, introduced by the implementation of the HTP, that directly influence the hospital market environment. For more, we refer the interested readers to the Ministry of Health (2003, 2009, 2011), OECD and Worldbank (2008), Tatar et al. (2011), and Atun et al. (2013) to name a few.

some theoretical predictions and insights into the question of how private hospitals have adapted to new restrictive regulations after 2010. Then, we evaluate the analytical results of the model with data on the local hospital markets in Turkey.

Our stylized theoretical model builds on the literature that studies the entry-deterrence motives of firms via strategic investments. Gilbert and Vives (1986) provide an equilibrium framework that examines the incentives for entry prevention in an established oligopoly. Within a firm entry game setting where investments to deter entry are known with certainty, they discuss the incentives for the excessive investment for entry prevention purpose. According to their model, while there is no underinvestment due to the free-rider problem in entry-preventing activities, there are excessive investments in entry deterrence.[77] Ellison and Ellison (2011) provide a stylized strategic entry-deterrence model and, by relying on this theoretical model, develop a new approach to empirically test for strategic entry deterrence behavior of incumbents – the monotonicity test.[78] They applied the monotonicity test for strategic entry deterrence to the investment behavior of incumbent pharmaceutical firms before their patents expire. Dafny (2005) uses the monotonicity test approach developed by Ellison and Ellison (2000) to study the strategic behavior of hospitals in the U.S. It examines whether hospitals invest in volume in order to deter entry and finds suggestive evidence that hospitals can manipulate surgical volume for strategic reasons. Bokhari and Yan (2019) employ the test with the data from the U.K.

[77] In the early theoretical works, it is well investigated whether the public good aspect of entry prevention in a noncooperative oligopolistic market environment results in the free rider problem. Waldman (1987) reconsidered the model of Gilbert and Vives (1984) by adding uncertainty to the model in order to investigate whether the free rider problem is likely to be important when uncertainty is present. Waldman (1987) shows that even adding uncertainty to the Gilbert and Vives (1984) model does not lead to the free rider problem to be an important factor and the incumbent firms have a tendency to overinvest.

[78] The monotonicity test is firstly developed in an earlier unpublished version in Ellison and Ellison (2000) as referred in Dafny (2005).

pharmaceutical industry to investigate whether firms engage in product proliferation to deter firm entry. Their findings are in favor of entry deterrence via strategic investments. Fang and Yang (2020) apply Ellison and Ellison's (2011) entry deterrence model to a retail chain store setting to investigate the role of preemptive motives in store proliferation behavior among fast-food chains in Canada.

To investigate the strategic entry-deterrence motives of incumbent hospitals, we closely follow the theoretical approach of Ellison and Ellison (2011). However, our empirical analysis does not rely on the monotonicity test because our sample dataset on local markets mainly consists of intermediate-sized markets; yet, the rationale behind the monotonicity test relies on the heterogeneity in market size.[79]

Following Ellison and Ellison (2011), we modify the textbook model by assuming that entry costs are random and unknown to the incumbent firms when they make their capacity investment decisions.[80] But unlike Ellison and Ellison`s (2011) stochastic model that reviews the idea of strategic entry deterrence within a closed-form duopoly setting, we solve an oligopolistic game with N-incumbent hospitals facing a single potential entrant under linear demand and cost forms. Therefore, our stochastic model further provides an equilibrium framework for evaluating the impacts of changes in the number of incumbent firms and the changes in entry conditions (i.e., fixed entry costs) on incentives for entry prevention through strategic capacity investment choices. Thus, this theoretical analysis provides some

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[79] The testable prediction of Ellison and Ellison's (2011) closed-form duopoly model is that capacity investments are expected to be highest in intermediate-sized markets with moderate potential for a new hospital entry as compared to very small or very large markets where entry is more unlikely or likely. Thus, incumbents are predicted to have highest entry-deterrence incentives in intermediate-sized markets, which implies a nonmonotonic pattern between market size and investment variables.

[80] See Appendix C for the characterization of a deterministic Gilbert and Vives (1986)-style entry-deterrence textbook model. Gilbert and Vives (1986) examine the entry deterrence behavior of n-incumbent firms plus single potential entrant with certain costs.

empirically testable insights into the relationship between the capacity investment choices of hospitals and local market characteristics. We first set up and solve a model with strategic entry-deterrence incentives, then switch to another setting without entry-deterrence motives. The comparison of equilibria from these two settings enables us to uncover and discuss the effect of entry prevention incentives of incumbent hospitals through their capacity investment choices.

We then evaluate the theoretical model's prediction with data from local hospital markets in Turkey for the years 2010 and 2014. The data analysis reveals that an increase in local competition is associated with significant growth in the hospital capacity of districts. The estimation results suggest that private hospitals respond to tougher local competition by making higher capacity investments.

The rest of the paper is organized as follows. Section 2 of the chapter introduces the analytical strategic entry-deterrence game model under uncertainty in an oligopolistic market setting. Section 3 characterizes the equilibrium solutions of the model. Section 4 examines the comparative statics of capacity investments. Section 5 contains the empirical analysis that tests the theoretical model's prediction on the relationship between capacity investments of hospitals and local market structure. Section 6 concludes with a discussion.

3.2 The model

Consider an oligopolistic health services market where the products of hospitals are supposed to be homogeneous general hospital care. Suppose that N established hospitals, denoted by $i = 1,2, \ldots, N$, operate in the market, and they face the threat of entry by a single potential entrant. In the first stage, incumbent hospitals simultaneously and independently choose their capacity investment levels. In the second stage, a potential entrant decides whether to enter and chooses its capacity level in case of entry. In the third stage, incumbents continue to operate in the N-oligopoly market; or if entry occurs, they compete in the market that includes the new entrant hospital as well. In the last stage, while it is prohibitively costly to expand capacity, hospitals can supply health services up to existing capacity at no additional cost.

The inverse demand for health services has the linear form $p = P(K) = a - K$ where K_i is the capacity of hospital i for $i = 1, \dots, N$; and $K = K_1 + K_2 + \cdots + K_N$ is the total industry capacity. The cost function of incumbent hospitals and the potential entrant hospital are respectively given by $C_i(K_i) = cK_i$ for $i = 1, \dots, N$; and $C_e(K_e) = E + cK_e$ if entry occurs, and zero otherwise. The parameter $c > 0$ denotes the marginal cost of capacity expansion with the assumption that the market is sufficiently large, $a > c$; and the parameter $E > 0$ denotes the sunk fixed cost of entry incurred by the entrant hospital in case of entry.[81]

We consider a three-stage game. The timing of the game, summarized in Figure 6, is as follows. In the first stage, incumbent hospitals choose their capacity investment level K_i at the cost of $C(K_i)$. At this stage, incumbent hospitals do not know with certainty whether new hospital entry will occur. We suppose that incumbent hospitals' belief about the potential entrant hospital's entry cost E is stochastic with the cdf given by $F(E)$. This uncertainty on the entry cost makes the model more suitable for the industry environment that we focus on. During the study period, one of the most prominent features of the hospital industry environment was

[81] The sunk costs of entry include the overall burden, which results from the market frictions such as regulations and bureaucratic procedures that are required to be followed before establishing a new hospital. For example, after the restrictive Certificate of Needs regulation on hospital entry introduced in 2008, a prior consent from the Health Service Planning of the Ministry is required to start establishing a new private hospital.

the continually changing price and entry regulations applied to private hospitals. Although these regulations were introduced in the earlier years of the Health Transformation Program (2003-13), they continued to evolve in the later years. Therefore, the hospital industry in Turkey has been exposed to a high level of "regulatory uncertainty" during the study period.[82]

Specifically, we assume that the fixed entry cost E is a random variable that is uniformly distributed over $[0, \varepsilon]$, $E \sim U[0, \varepsilon]$ so the parameter ε captures the level of uncertainty.[83] Suppose that when $E = E^b$, the entrant hospital is indifferent between entering and not entering. Then, the incumbent hospitals believe that the potential entrant enters with a probability $F(E \leq E^b) = \frac{E^b}{\varepsilon}$ and it does not enter with probability $1 - F(E \leq E^b) = \frac{\varepsilon - E^b}{\varepsilon}$.

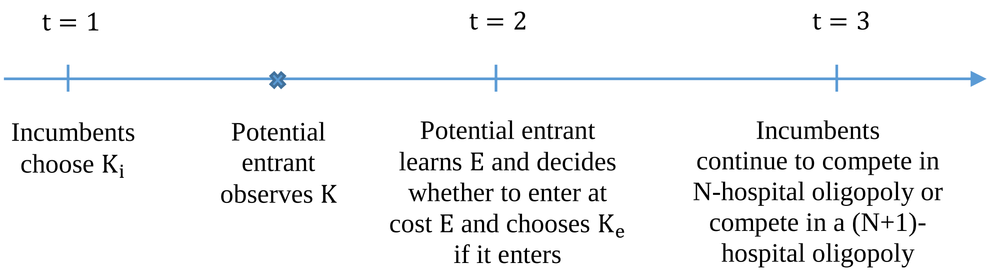

Figure 6. Timing of the capacity investment game with entry-deterrence motives

[82] See Chapter 1 of the thesis for the description of the industry environment and its transformation during the HTP.

[83] Rather, if it was assumed that E is a random variable which is uniformly distributed over $[\underline{E}, \overline{E}]$, $E \sim U[\underline{E}, \overline{E}]$, where $(\overline{E} - \underline{E}) = \varepsilon > 0$; when the difference between the upper bound and lower bound of the distribution is zero, that is $\varepsilon = 0$, then the model setting would reduce to a deterministic model with certainly known entry cost $E = \underline{E} = \overline{E}$. In this case, E is not stochastic, then the level of K_i needed to deter entry would be known to the established hospitals. See Appendix C for the analysis of such a prototypical deterministic strategic entry-deterrence capacity investment model.

Before the second stage begins, the potential entrant hospital observes the total investments K made by the established hospitals and then makes its entry decision.[84] In the second stage, the potential entrant decides whether to enter the market at a sunk fixed cost of E and chooses its capacity level K_e if it enters. At the third and the last stage, the incumbent hospitals continue to compete in an N-hospitals oligopoly; or if entry occurs, they compete in an (N+1)-hospital oligopolistic market environment. If the entry occurs, each incumbent hospital and the entrant hospital earn profits $\pi_i^{N+1}(K_i, K_{-i}, K_e)$ and $\pi_e^{N+1}(K, K_e)$, respectively; otherwise, each incumbent hospital continues to earn profits $\pi_i^{N}(K_i, K_{-i})$.

3.3 Characterization of the equilibrium

The appropriate solution concept for the game is Perfect Bayesian Equilibrium. We use the backward induction to characterize the equilibrium. Firstly, for a given total capacity level K of the established hospitals in the market, the potential entrant hospital's problem is solved. Then, given the entrant's best response to the capacity choices of the incumbent hospitals, the capacity investment choices of the incumbent hospitals are solved.

The entrant hospital chooses its capacity level K_e to maximize its profit

$$\pi_e(K, K_e) = (a - K - K_e)K_e - (E + cK_e)$$

where $K = \sum_{i=1}^{N} K_i$ is the total capacity of the established hospitals. Then, the first-order condition for the profit maximization of the entrant hospital is

$$\frac{\partial \pi_e}{\partial K_e} = (a - K - 2K_e) - c \equiv 0$$

[84] This feature of the game setting makes the strategic entry-deterrence thinking of the incumbent hospitals functional. We make use of it to capture the effect of entry preventing incentives of hospitals through capacity investments.

Solving for K_e gives the entrant's best response to the capacity choices of incumbent hospitals as a function of K,

$$K_e(K) = \begin{cases} \dfrac{a-c-K}{2}, & \pi_e \geq 0 \\ 0, & \pi_e < 0 \end{cases}$$

This capacity level function $K_e(K)$ represents the best response of the entrant if it results in nonnegative profits for the entrant hospital, so we need to solve for K that satisfies $\pi_e \geq 0$:

$$\left(a - c - K - \frac{a-c-K}{2}\right)\left(\frac{a-c-K}{2}\right) - E \geq 0$$

Thus, $\pi_e \geq 0$ when $K \leq K^b \equiv (a-c) - 2\sqrt{E}$. Recall that E is assumed to be uniformly distributed over $[0, \varepsilon]$. Therefore, the following assumption must hold in order to have $K^b > 0$.

Assumption 1. $\varepsilon < \bar{\varepsilon} \equiv \frac{1}{4}(a-c)^2$.

The potential entrant hospital chooses to enter and invest a positive capacity given by the reaction function $K_e(K)$ as long as the total industry capacity of incumbent hospitals K does not exceed K^b; otherwise, it does not enter the market to refrain from negative profits. This result is summarized in Lemma 1 below.

Lemma 1. (i) The best response capacity function of the entrant hospital is

$$K_e(K) = \begin{cases} \frac{a-c-K}{2} & if \quad K < a-c \\ 0 & if \quad K \geq a-c \end{cases}.$$

(ii) The potential entrant hospital chooses to enter and invest in positive capacity given by the reaction function $K_e(K)$ if $K \leq K^b$.

Now we move to the first stage, where incumbent hospitals choose their capacity simultaneously. Given the capacity levels of other incumbent hospitals and the best response function of the entrant hospital, each incumbent hospital chooses its capacity level K_i at the first stage of the game to maximize its expected profit:

$$E\big(\pi_i(K_i;\ K_{-i}, K_e)\big) = F\big(\pi_e(K)\big)\pi_i^{N+1}(K_i; K_{-i}, K_e) + \Big(1 - F\big(\pi_e(K)\big)\Big)\pi_i^N(K_i; K_{-i})$$

where N is the number of incumbent hospitals.

An incumbent hospital believes that the potential entrant will enter the market if $K \leq K^b = (a - c) - 2\sqrt{E}$ which implies that if $E \leq E^b(K) \equiv \frac{(a-c-K)^2}{4}$. In other words, $E^b(K)$ is the threshold level of entry cost where the potential entrant just breaks even; at higher entry costs, the potential entry is blocked. Then, the profit of incumbent hospital i is

$$\pi_i(K_i;\ K_{-i}, K_e) = \begin{cases} \pi_i^{N+1}(K_i; K_{-i}, K_e) = \big(a - K - K_e(K)\big)K_i - cK_i & if\ \ E < E^b(K) \\ \pi_i^N(K_i; K_{-i}) = (a - K)K_i - cK_i & if\ \ E \geq E^b(K) \end{cases}$$

where $K_e(K) = \frac{a-c-K}{2}$ is the entrant hospital's best response to the capacity choices of incumbent hospitals. Substituting the corresponding profit functions for the appropriate post-entry number of firms, the expected profit of the incumbent hospital i becomes:

$$E\big(\pi_i(K_i)\big) = \frac{E^b(K)}{\varepsilon}\left[\left(a - c - K_i - \sum\nolimits_{j\neq i} K_j - K_e(K)\right)K_i\right] + \left(1 - \frac{E^b(K)}{\varepsilon}\right)\left[\left(a - c - K_i - \sum\nolimits_{j\neq i} K_j\right)K_i\right] \qquad (1)$$

which is equivalent to $E\big(\pi_i(K_i)\big) = (a - c - K)K_i - \frac{E^b(K)}{\varepsilon}K_e(K)K_i$ after some simplifications. The component $(a - c - K)K_i$ represents the profit if there is no potential entry, $\frac{E^b(K)}{\varepsilon}$ is the probability of entry, $K_e(K)K_i$ represents the lost profits if entry occurs. Therefore, the term $\frac{E^b(K)}{\varepsilon} K_e(K) K_i$ represents the loss from expected profits due to the entry.

Let $K_{i,ED}^*$ denote the equilibrium capacity investments of incumbent hospitals with strategic entry deterrence motives that maximize $E\big(\pi_i(K_i)\big)$ given in (1) subject to $E^b(K) = \frac{(a-c-K)^2}{4} < \varepsilon$.[85] Proposition 1 characterizes the equilibrium capacity choices in the strategic entry deterrence game. [Proofs are presented in Appendix D.]

Proposition 1. Equilibrium capacities of the hospitals in the model with strategic entry deterrence incentives $(K_{i,ED}^*, K_{e,ED}^*)$ *for* $i = 1, \ldots, N$ *are characterized by*

$$\left(a - c - K_{ED}^* - K_{i,ED}^*\right) - \frac{(a - c - K_{ED}^*)^3}{8\varepsilon} + \frac{K_{i,ED}^*(a - c - K_{ED}^*)^2}{8\varepsilon} + \frac{K_{i,ED}^*(a - c - K_{ED}^*)^2}{4\varepsilon} \equiv 0 \quad (2)$$

$$K_{e,ED}^* = \begin{cases} \dfrac{a - c - K_{ED}^*}{2} & if \quad K_{ED}^* < K^b \\ 0 & if \quad K_{ED}^* \geq K^b \end{cases}$$

provided that $\left(-2 + \frac{6(a-c-K_{ED}^*)\left[a-c-K_{ED}^*-K_{i,ED}^*\right]}{8\varepsilon}\right) < 0$.[86]

In order to discover the degree of strategic entry deterrence incentives, we next solve a 'nonstrategic' benchmark model with no entry-deterrence motive as in Ellison and Ellison (2011). The comparison of the equilibrium solutions from these two settings allows us to discuss the effects of strategic entry-deterrence incentives on the capacity investment choices of incumbents within an uncertain industry environment.

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[85] Throughout the paper, ED and ND refers to the game setting with and without strategic entry-deterrence motives, respectively.

[86] The condition in Proposition 1, which is required for the S.O.C. of the incumbents' problem to be satisfied, becomes less constraining with larger number of incumbents or/and higher level of uncertainty. See Appendix D for the derivations.

3.3.1 Characterization of the equilibrium of the model without strategic entry-deterrence incentives

In this 'nonstrategic' benchmark model with no entry-deterrence motive, the potential entrant does not observe the capacity investments made by established hospitals before the second stage begins. Once it enters and incurs the cost of entry, the entrant observes K before choosing its own capacity. Figure 7 summarizes the timing of the game with no entry-deterrence motive. Therefore, the expected profits of each incumbent hospital depend both on the actual value of the capacity investment level K_i and the entrant hospital's belief about the value of optimal capacity investment choice of incumbent hospitals. In perfect Bayesian equilibrium, the entrant hospital correctly predicts that symmetric incumbent hospitals have chosen their equilibrium level of capacities, $K_{i,ND}^{*}$, as in Ellison and Ellison (2011).

The expected profit function of each incumbent hospital is then

$$E\left(\pi_i\left(K_i, K_{i,ND}^{*};\ K_{-i}, K_e\right)\right) = F\left(\pi_e\left(K_{i,ND}^{*}\right)\right)\pi_i^{N+1}(.)\ + \left(1 - F\left(\pi_e\left(K_{i,ND}^{*}\right)\right)\right)\pi_i^{N}(.)$$

where N is the number of incumbent hospitals.

The profit function of an incumbent firm i is as calculated before. After substituting them into the incumbent hospitals' expected profit function, we obtain

$$\begin{aligned} E\left(\pi_i\left(K_i, K_{i,ND}^{*}\right)\right) &= \frac{E^b\left(K_{ND}^{*}\right)}{\varepsilon}\left[\left(a - c - K_i - \sum\nolimits_{j\neq i} K_j - K_e(K)\right)K_i\right] \\ &\quad + \left(1 - \frac{E^b\left(K_{ND}^{*}\right)}{\varepsilon}\right)\left[\left(a - c - K_i - \sum\nolimits_{j\neq i} K_j\right)K_i\right] \end{aligned} \tag{3}$$

where $K_e(K) = \frac{a-c-K}{2}$ represents the reaction curve of the entrant hospital to incumbent hospitals' capacity choices. In this setting with no entry-deterrence motives, $F(.) = \frac{E^b\left(K_{ND}^{*}\right)}{\varepsilon}$ has been already determined by the equilibrium capacity levels; therefore, it acts as a constant term during the derivations for $K_{i,ND}^{*}$.

In this benchmark model with no entry-deterrence motive, the potential entrant does not observe the investment made by incumbent hospitals before its entry decision; but right after it enters and before investing in capacity. Given the capacity choices of other incumbents, the best response function of the entrant, and the constant $E^b(K^*_{ND})$, each incumbent hospital chooses its capacity level K_i at the first stage of the game to maximize its expected profit.

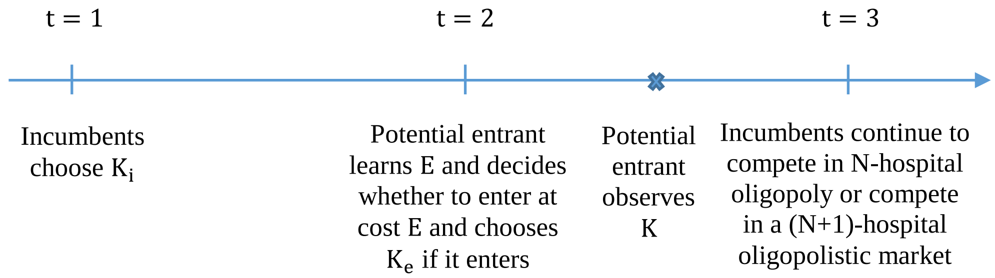

Figure 7. Timing of the capacity investment game without entry-deterrence

Let $K^*_{i,ND}$ denote the equilibrium capacity investments of incumbent hospitals that maximize $E\left(\pi_i\left(K_i, K^*_{i,ND}\right)\right)$ given in (3). Proposition 2 characterizes the equilibrium capacities of the game. [Proofs are presented in Appendix D.]

Proposition 2. Equilibrium capacities of the hospitals in the model without strategic entry deterrence incentives $(K^*_{i,ND}, K^*_{e,ND})$ *for* $i = 1, \dots, N$ *are characterized by*

$$\left(a - c - K^*_{ND} - K^*_{i,ND}\right) - \frac{(a - c - K^*_{ND})^3}{8\varepsilon} + \frac{K^*_{i,ND}(a - c - K^*_{ND})^2}{8\varepsilon} \tag{4}$$

$$K^*_{e,ND} = \begin{cases} \dfrac{a - c - K^*_{ND}}{2} & if \quad K^*_{ND} < K^b \\ 0 & if \quad K^*_{ND} \geq K^b \end{cases}$$

provided that $\left(-2+\frac{(a-c-K_{ND}^{*})^{2}}{4\varepsilon}\right)<0$ *is satisfied.*[87]

In comparison with the equation that characterizes $K_{i,ND}^{*}$ in Proposition 2, the equation for $K_{i,ED}^{*}$ in Proposition 1 has additionally the final term $\frac{K_i(a-c-K)^2}{4\varepsilon}$. This additional term corresponds to the one in Ellison and Ellison's (2011) closed-form duopoly model, representing the "strategic entry-deterrence" incentives. This strategic motive of incumbent hospitals distorts their capacity investment choices for entry prevention. In the notation of Ellison and Ellison's (2011) model, it is $\left[\pi_{i,ED}^{N+1}(K_i^*,K_{-i}^*,K_e^*)-\pi_{i,ED}^{N}(K_i^*,K_{-i}^*)\right]\frac{\partial F\left(\pi_e(K_{ED}^*)\right)}{\partial K_i}$. Remember that $F\left(\pi_e(K_{ED}^*)\right)=\frac{E^b(K_{ED}^*)}{\varepsilon}$ in our specific model. Thus, the strategic entry-deterrence term in our model is equal to $-K_e(K_{ED}^*)K_{i,ED}^*\frac{1}{\varepsilon}\frac{\partial E^b(K_{ED}^*)}{\partial K_i}$ which gives $\frac{K_{i,ED}^*(a-c-K_{ED}^*)^2}{4\varepsilon}$. Note that the strategic entry-deterrence incentive term is larger for the smaller levels of ε,[88] and/or lower number of incumbent hospitals, holding other things constant.[89]

Proposition 1 and 2 in the previous section characterize the equilibria of the models with and without strategic entry deterrence motives. Next, Proposition 3 compares the equilibrium investment levels $K_{i,ND}^{*}$ and $K_{i,ED}^{*}$ of the symmetric incumbent hospitals. It states that the equilibrium solutions of the model provide evidence of strategic overinvestment in capacity for entry prevention.

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[87] It is easily seen that the condition that is required for the S.O.C. in Proposition 2 is satisfied as a result of the definition of $E^b(K)=\frac{(a-c-K)^2}{4}<\varepsilon$.

[88] We should be cautious on the interpretation of ε since it both captures the level of uncertainty and the spread of the level of fixed entry cost E.

[89] Appendix E presents the first-order conditions that correspond to the equations in Proposition 1-2, if it was rather assumed that E is a random variable that is uniformly distributed over $[\underline{E},\overline{E}]$, $E\sim U[\underline{E},\overline{E}]$, where $(\overline{E}-\underline{E})=\varepsilon>0$.

Proposition 3. $K^*_{i,ED} > K^*_{i,ND}$ *and* $K^*_{ED} > K^*_{ND}$ *whenever* $K^*_{i,j} > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$ *for* $j \in \{ED, ND\}$.

3.4 Comparative statics

Further, the equilibrium framework allows us to have some comparative statics, as stated in Proposition 4.

Proposition 4. For the parameter spaces that satisfy $K^*_{i,j} > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$ *for* $j \in \{ND, ED\}$,

i. $0 < \frac{dK^*_{i,ED}}{da} < 1, \frac{dK^*_{i,ED}}{dc} < 0, \frac{dK^*_{i,ED}}{dN} < 0, \frac{dK^*_{i,ED}}{d\varepsilon} \lesseqqgtr 0$

ii. $0 < \frac{dK^*_{i,ND}}{da} < 1, \frac{dK^*_{i,ND}}{dc} < 0, \frac{dK^*_{i,ND}}{dN} < 0, \frac{dK^*_{i,ND}}{d\varepsilon} \lesseqqgtr 0$

iii. $0 < \frac{dK^*_{ED}}{da} < 1, \frac{dK^*_{ED}}{dc} < 0, \frac{dK^*_{ED}}{dN} > 0, \frac{dK^*_{ED}}{d\varepsilon} \lesseqqgtr 0$

iv. $0 < \frac{dK^*_{ND}}{da} < 1, \frac{dK^*_{ND}}{dc} < 0, \frac{dK^*_{ND}}{dN} > 0, \frac{dK^*_{ND}}{d\varepsilon} \lesseqqgtr 0$

v. $0 < \frac{dK^*_{e,ND}}{da} < 1 , \frac{dK^*_{e,ND}}{dc} < 0, \frac{dK^*_{e,ND}}{dN} < 0, \frac{dK^*_{e,ND}}{d\varepsilon} \lesseqqgtr 0$

vi. $0 < \frac{dK^*_{e,ED}}{da} < 1, \frac{dK^*_{e,ED}}{dc} < 0, \frac{dK^*_{e,ED}}{dN} < 0, \frac{dK^*_{e,ED}}{d\varepsilon} < 0$.

Firstly, as market size a rises, equilibrium capacity investments increase. Secondly, the optimal investment levels are decreasing with the cost of capacity c. Thirdly, as the number of incumbents, N, grows, the equilibrium capacity choices of each incumbent decrease while the equilibrium total market capacity rises. Lastly, increased uncertainty, which is represented by ε, raises the equilibrium capacities of incumbents while it reduces the entrant's equilibrium capacity choice.

Proposition 5 further suggests that as the number of incumbent hospitals, N, increases, the capacity investments with the strategic entry deterrence motives decrease. Also, as the entry cost uncertainty parameter rises, the strategic entry deterrence incentive dies out. Moreover, Table 29 in Appendix F presents a numerical exercise that illustrates the results from the comparative statics analysis. We observe that as N increases, both K_{ED}^* and K_{ND}^* increases, but K_{ND}^* rises faster with N, so their difference $K_{ED}^* - K_{ND}^*$ converges to zero.[90] To sum up, as the number of incumbents grows or when the fixed entry cost is higher, the value of deterring entry falls, making entry prevention relatively less attractive to incumbent hospitals.

Proposition 5. For the parameter spaces that satisfy $K_{i,j}^* > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$ *for* $j \in \{ND, ED\}$,

i. $\frac{d(K_{ED}^* - K_{ND}^*)}{dN} < 0$

ii. $\frac{d(K_{ED}^* - K_{ND}^*)}{d\varepsilon} < 0.$

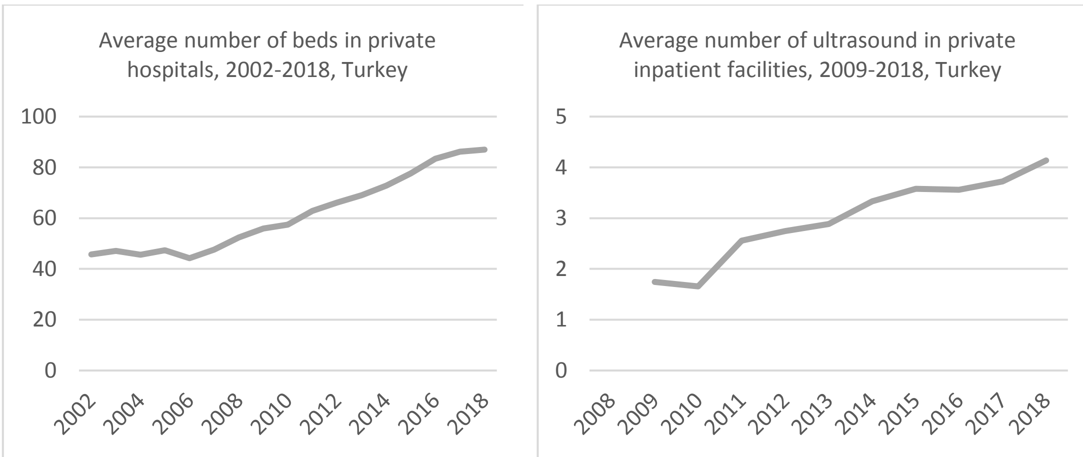
3.5 Empirical analysis

We now investigate the theoretical model's prediction with data from local hospital markets in Turkey between 2010-2014, in which there have been both price and entry regulations.

Our dataset combines data on the hospitals, their medical technology, and the characteristics of the local districts of Turkey. During the study period, in a mixed

[90] This is compatible with the results of the deterministic model presented in Appendix C, in which $(\widetilde{K}_{\text{large}} - K^*)$ converges to zero as N increases, that is, the deterrence region disappears as the number of incumbents rises.

private-public hospital industry environment under heavy regulations, a salient feature of the private hospitals was the noticeable expansion in their capacities. Figure 8 shows the countrywide aggregate levels of the capacity expansion of private hospitals for two specific measures of hospital capacity, namely, the average number of beds and the average number of ultrasonography medical devices between the years 2002 and 2018.[91] There appears to have been a continuous rise in both measures of hospital capacity between the years 2010 and 2014. Our empirical analysis examines variation in terms of hospital beds and medical technology in local geographic markets of Turkey over the sample period 2010 and 2014.



Source: Author`s tabulations by compiling the data from the MoH Health Statistics Yearbooks.

Figure 8. Aggregate capacity expansions of the private hospital in Turkey

[91] We also investigate the patterns for some other diagnostic imaging devices including MRI, CT, Doppler USG and ECHO before deciding to use the number of USG as a measure of medical technology capacity of hospitals. In addition to our preliminary investigations of data patterns, we have consulted to the expert views from the sector before reaching to the conclusion that USG is distinct from other medical devices in various ways. Among the diagnostic imaging devices, ultrasonography is widely recognized as a safe and effective tool with minimal side effects; it is easy to use for physicians during examinations, and it is considered a less costly technology investment for hospitals, especially, compared to CT and MRI (see Ostensen and WHO, 2001; Bercovich and Javitt, 2018). Also, there is no specific regulation for hospitals on the purchase of USG. Moreover, while the number of ultrasound devices in private institutions increased dramatically between 2010 and 2014, the use of ultrasound imaging has not increased in proportion to the increase in their numbers.

Two key parameters that affect the equilibrium capacity investment choices of incumbent hospitals in the theoretical model in Section 2 are the changes in the fixed entry costs and the number of incumbent hospitals operating in the market. We do not have available data on the variance in entry cost, and it is beyond the scope of this analysis to construct a variable or index that can help to measure unobserved fixed entry cost. Thus, our particular focus is on the impact of local competition on the investment in capacities of local hospital markets. In doing so, we implicitly assume that the size of fixed costs does not vary across districts.

There can be different factors behind the new capacity investments of established hospitals in the local markets. First, it might simply be a result of the change in demand conditions. Second, some districts might, for some reason, already have formerly higher levels of hospital capacity that can adequately meet the local hospital care demand. Third, the changes in the capacities of public hospitals in a local market might leave less profit opportunity for private hospitals through new capacity investment in a mixed private-public healthcare delivery environment. Finally, the competition between private hospitals in local markets and strategic motives may force them to invest excessively in their supply capacity. Thus, we model the changes in hospital capacity in local districts of Turkey from the year 2010 to 2014 as a function of variables on the changes in the residential population of the local districts, existing private and public hospital capacities of each district in the baseline year 2010 and the number of competing established private hospitals.

Then, the estimated equation that tests the relationship between market structure and capacity change becomes

$$\Delta \ln(Capacity)_m = f\ (COMP, \vec{X}_m)$$

where Δ denotes the changes from 2010 to 2014, and m denotes the local districts. The dependent variable is the log change of local district m's total private hospital capacity in terms of the number of hospital beds and the number of ultrasonography devices.

The key variables of interest on the right-hand side of the equation $COMP$ include the number of incumbent hospitals N competing in local districts and square of it, N^2, in order to add nonlinearity to the estimations. Alternatively, we decompose the variable N to a set of market structure dummy variables for monopoly, duopoly, triopoly, or oligopoly markets to capture nonlinear relationships between the capacity change and the extent of competition. $\vec{X}_m$ includes the log change in local district m's population between 2010-2014, an index measuring socio-economic development, the log of private and public hospital beds/ultrasound per capita in the baseline year 2010, and the log change in the capacities of public hospitals in local districts over 2010-2014.[92]

The relevant local geographic market for general hospital care products is supposed to be districts (*ilçe*) of Turkey. We started by identifying all 927 districts of Turkey in 2010 as prospective geographical local markets. Then we applied some market selection criteria to ensure they were geographically non-overlapping local markets.[93] The elimination procedures leave a sample of 213 districts with 217 private and 241 public hospitals. We next dropped 128 of these districts because they lacked private hospitals. Finally, the remaining sample consists of 85 districts as

[92] Available dataset did not include measure of local cost variations among districts.

[93] To summarize, we dropped the districts with population less than 50,000 and greater than 600,000 in 2010. Also, if a province has several central districts that are close to each other or if a district has been partitioned into separate close districts, we treated the geographical union of such contiguous districts as single local markets. See Chapter 2 of the thesis for more description of the relevant market definition and how markets are selected.

local markets with 214 private and 114 MoH public hospitals in 2010 and 234 private and 111 MoH public hospitals in 2014. Lastly, we exclude the districts with more than five private hospitals. Thus, we have a final sample of 77 local districts with 150 private and 98 public hospitals in 2010 and 160 private and 93 public hospitals in 2014 for the empirical analysis.

Table 21 shows the descriptive statistics on the hospital capacity in sample districts for the years 2010 and 2014. The mean hospital bed capacity has expanded by 22%, with a 54% increase in private hospitals and 14% in public hospitals. Hospital capacity expansion in terms of the number of ultrasounds appears to be more noticeable. The mean change between 2010 and 2014 in the total ultrasound capacity of the hospitals in the sample districts is 126%; it is 144% for private hospitals and 112% for public hospitals. However, the mean population of the sample districts has grown only 5% during the same period.

Table 21. Descriptive Statistics of Hospital Capacity of Sample Local District in 2010 and 2014

	2010		2014	
District level variables	Mean	Std Dev	Mean	Std Dev
Bed capacity				
Private	99.04	76.89	152.84	129.33
Public	419.01	265.99	477.44	305.98
Total	518.05	312.80	630.29	397.05
Ultrasound capacity				
Private	3.14	2.78	7.60	7.54
Public	3.96	3.46	8.40	6.79
Total	7.10	4.92	16.00	11.66
Population	225,540	155,558	235,787	166,527

Source: Author`s tabulations.

Table 22 decomposes the changes in the private hospital capacity of the sample local districts by the sources of changes. It shows that existing hospitals are responsible for a greater portion of the capacity expansion of private hospitals in our sample districts. The changes in capacity measures of existing private hospitals, 40 percent in the number of beds and 118 percent in the number of ultrasounds, account for the 54 percent and 142 percent net gains in the private hospital capacity of the sample districts in terms of hospital beds and ultrasound devices, respectively; on the other hand, private hospital entry and exit appears to make relatively minor contributions to the changes in hospital capacity of local districts. Our focus is on explaining the strategic capacity investments of existing hospitals. Therefore, we further customized our sample data so that the market-level dependent variables used in the estimations do not include the private hospital capacity changes of local districts due to new hospital entry and exit.[94]

Table 22. Sources of Changes in the Hospital Capacity of Sample Local Districts Between 2010-2014

	Private beds	Private USG
Total		
2010 Total	7,626	242
2014 Total	11,769	585
Net change	4,143	343
Net change in % of 2010 total	54.33%	141.74%
2010-2014 changes due to entry and exit		
Net change	1,126	57
Net change in % of 2010 total	14.77%	23.55%
2010-2014 changes due to existing hospitals		
Net change	3,017	286
Net change in % of 2010 total	39.56%	118.18%

Source: Author`s tabulations using the MoH data for the year 2010 and 2014.

[94] Alternatively, we could leave the data about the districts with new hospital entry and exit out of the sample; but in that case, there would be even fewer observations for estimations and this could also lead to sample selection bias.

Table 23 contains the number of incumbent private hospitals in our sample local districts in the year 2010. The majority of our sample districts are monopoly and duopoly markets, and the number of districts with three hospitals seems moderate. In fact, sample districts with more than three private hospitals are relatively rare; therefore, we treat the sample districts with four and five private hospitals together as oligopoly markets in the estimations.

Table 23. Number of Incumbent Hospitals in Sample Local District in 2010

Number of Private Hospitals in Market (N)	Number of Districts	Percent
1	37	48.05
2	22	28.57
3	9	11.69
4	3	3.90
5	6	7.79
Total	77	100.00

Source: Author`s tabulations.

3.5.1 Estimation results

Table 24 contains the estimation results for the effects of local market characteristics on the log changes in local private and public hospital market capacities, namely, the number of hospital beds and the number of private ultrasonography devices. In Table 24, we repeat the analysis using a set of market structure dummies instead of the number of incumbents variable used in the estimations displayed in Table 23.

The estimation results show that population change variables do not have a statistically significant impact on the change in local districts' hospital capacity during the study period. It appears to have a puzzlingly negative statistically significant effect on the change in private ultrasound capacity.[95]

Higher levels of socio-economic development index are associated with greater changes in private bed capacity of local districts; however, it does not have a statistically significant effect on the change in private ultrasound capacity.

There appear to be statistically significant negative effects of the baseline hospital beds and ultrasound capacities per capita of local districts in 2010. Hospital capacity expansions in both forms of capacity measures are stronger in districts with a formerly lower per capita hospital capacity of the same ownership forms. Interestingly, the variable on the change in public hospital capacity of local districts during the study period does not have a statistically significant effect on the change in private hospital capacities and vice versa, which does not provide evidence for the possibility of public-private substitution in capacity investments.

The estimations in Table 24 provide evidence that local markets with higher numbers of incumbent hospitals are associated with greater rises in hospital beds capacity of local districts, which is consistent with the result of the theoretical model. However, among the market structure dummy variables that help to capture the nonlinear relationship between the capacity change and the number of firms in a local market in Table 25, only the duopoly market dummy appears to have a statistically significant effect on the private hospital capacity change of local districts. On the medical technology front, as the results of the theoretical model suggest, the estimation results in Tables 24 and 25 provide support for that the

[95] One factor that influenced the population in Turkey during the study period is the increasing population of Syrian refugees after 2011. However, due to the local market selection procedures, our sample does not include the provinces that have the highest Syrian population (like İstanbul, Adana, Gaziantep, Şanlıurfa) except several provinces like Hatay. Also, our experimentation by excluding the provinces with high Syrian population convinced us that the estimation results are not affected.

growth of ultrasound capacity of local districts is increasing with the number of incumbent hospitals operating in the local market. Further, the effect of market structure on the growth rate of local districts' ultrasound capacity is diminishing as the number of hospitals operating in the market increases.

Table 24. Estimations of the Changes in Hospital Capacities of Local Districts With the Number of Incumbent Hospitals Between 2010-2014

Dependent Variable:	ΔLn(bed capacity)		ΔLn(USG capacity)	
Variables	Private	Public MoH	Private	Public MoH
Δln(population) if increases	-0.758	0.545	0.233	0.652
	(0.847)	(0.790)	(2.139)	(2.652)
Δln(population) if decreases	0.040	-0.375	-2.837**	-0.854
	(0.621)	(0.487)	(1.301)	(1.000)
Socio-economic development,	0.080**	-0.060*	-0.070	0.023
SEGE04 index	(0.040)	(0.032)	(0.117)	(0.083)
Ln(private beds/ultrasound per capita 2010)	-0.135***	-0.007	-0.653***	0.083
	(0.052)	(0.064)	(0.128)	(0.147)
Ln(public MoH beds/ultrasound per capita 2010)	-0.058	-0.224***	0.226	-0.785***
	(0.060)	(0.081)	(0.159)	(0.158)
Number of incumbent hospitals in 2010 (N)	0.264**	0.051	0.580**	-0.092
	(0.119)	(0.126)	(0.268)	(0.433)
Number of incumbent hospitals in 2010 (N^2)	-0.041*	-0.004	-0.067	-0.015
	(0.022)	(0.021)	(0.046)	(0.084)
Constant	-0.152	0.224	0.036	1.299
	(0.161)	(0.207)	(0.338)	(0.516)
Observations	76	77	68	68
R2	0.32	0.24	0.45	0.34

Notes: Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

Table 25. Estimations of the Changes in Hospital Capacities of Local Districts With Market Structure Dummies Between 2010-2014

Dependent Variable:	ΔLn(bed capacity)		ΔLn(USG capacity)	
Variables	Private	Public MoH	Private	Public MoH
Δln(population) if increases	-0.741	0.558	0.261	0.837
	(0.838)	(0.812)	(2.175)	(2.829)
Δln(population) if decreases	-0.010	-0.355	-2.867**	-0.934
	(0.538)	(0.500)	(1.262)	(1.052)
Socio-economic development,	0.073*	-0.059*	-0.076	0.007
SEGE04 index	(0.042)	(0.032)	(0.115)	(0.078)
Ln(private beds/ultrasound per capita 2010)	-0.132***	-0.009	-0.660***	0.066
	(0.051)	(0.065)	(0.130)	(0.152)
Ln(public MoH beds/ultrasound per capita 2010)	-0.064	-0.224***	0.227	-0.783***
	(0.063)	(0.082)	(0.158)	(0.161)
Monopoly dummy				
Duopoly dummy	0.204***	0.033	0.411**	-0.066
	(0.080)	(0.075)	(0.211)	(0.220)
Triopoly dummy	0.133	0.087	0.599***	-0.367
	(0.096)	(0.142)	(0.235)	(0.401)
Oligopolistic markets dummy (with four or five private hospitals)	0.142	0.092	0.736**	-0.589
	(0.141)	(0.103)	(0.324)	(0.426)
Constant	0.072	0.267	0.546	1.184
	(0.091)	(0.135)	(0.188)	(0.265)
Observations	76	77	68	68
R2	0.34	0.24	0.40	0.34

Notes: Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

3.5.2 Hospital-level estimations

In this subsection, we repeat the estimations at the individual hospital level. The dependent variable now represents the capacity changes of individual hospitals instead of the changes in local districts' total private hospital capacity. We consider whether individual hospitals in more competitive markets invest more in their capacity. For this, we estimate the following equation that explains whether individual hospitals in local districts with higher numbers of competing hospitals have larger capacity changes. The estimated equation is

$$\Delta \ln(Capacity)_{i,m} = f\ (COMP, \vec{X}_m)$$

where Δ denotes the changes between 2010 and 2014; and the subscript i, m denotes private hospital i that operates in the local district m in 2010 and 2014.

The dependent variable is the log change of private hospital i's capacity in terms of the number of hospital beds and the number of ultrasonography medical devices. We control for the same market factors $\vec{X}_m$ with the market-level estimations. The market selection procedures that we applied before to ensure local geographic markets leave a final sample of 137 private hospitals for the estimation of the change in bed capacity and 118 private hospitals for the estimation of the change in ultrasound capacity.[96]

Table 26 presents the descriptive statistics on the capacity of the sample individual hospitals for the years 2010 and 2014. The mean private hospital bed capacity has expanded by 42%, from 52 beds in 2010 to 74 beds in 2014, on average.

[96] The hospital-level sample includes private hospitals that continue to operate in both 2010 and 2014. There were relatively small number of hospitals that do not have data on ultrasound number in 2010; for them, we treated the number of ultrasound that they have in 2011 as the base year hospital capacity. However, since taking logarithm is problematic when the value of the observation is zero, we have lost some of the observations for the ultrasound capacity change. So the number of observations is not same for bed capacity and ultrasounds.

The private hospital capacity in terms of the number of ultrasounds has risen more noticeably by 128%, from 1.77 ultrasound devices in 2010 to 4.04 ultrasounds in 2014, on average. In Table 26, there appears to be variation in levels and log change capacity measures over the sample.

Table 26. Descriptive Statistics of Sample Private Hospital Capacity at Cross-Section Individual Level Between 2010 and 2014

Hospital level variables	Mean	Std Dev	Min	Max
Bed capacity				
2010	52.24	26.69	13	138
2014	74.26	39.64	14	201
# of observations: 137				
Ultrasound capacity				
2010	1.77	1.30	0	6
2014	4.04	2.87	0	15
# of observations: 118				
Log change in bed capacity, 2010-14	0.34	0.36	-0.17	1.81
Log change in USG capacity, 2010-14	0.75	0.83	-1.39	2.48

Source: Author`s tabulations.

Table 27 shows the estimation results for the impacts of local market characteristics on the log changes in individual hospital capacity measures. Table 28 repeats the estimations using the market structure dummies instead of the number of incumbent hospitals. Since the individual hospitals are naturally grouped by local districts in which they are located, clustered standard errors at the district level are used.

The estimation results in Table 27 show that the number of hospitals operating in local districts has a statistically significant effect on the bed capacity changes of individual private hospitals, but it does not have a statistically significant impact on their ultrasound capacity changes. It appears in Table 28 that only the duopoly dummy among the market structure dummies has a statistically significant impact on the bed capacity changes of individual private hospitals.

Table 27. Estimation of the Changes in Individual Private Hospital Capacities With the Number of Incumbent Hospitals Between 2010-2014

Dependent Variable:	ΔLn(private hospital bed capacity)	ΔLn(private hospital USG capacity)
Δln(population) if increases	-0.865	-0.470
	(0.851)	(1.733)
Δln(population) if decreases	-0.267	-1.670*
	(0.603)	(1.031)
Socio-economic development,	0.032	0.014
SEGE04 index	(0.042)	(0.102)
Ln(private beds/ultrasound per capita 2010)	-0.147***	-0.503***
	(0.056)	(0.139)
Ln(public MoH beds/ultrasound per capita 2010)	-0.017	0.142
	(0.062)	(0.161)
Number of incumbent hospitals in 2010 (N)	0.233**	0.241
	(0.115)	(0.258)
Number of incumbent hospitals in 2010 (N^2)	-0.033	-0.025
	(0.021)	(0.043)
Constant	-0.100	0.405
	(0.188)	(0.321)
Observations	137	118
R2	0.12	0.21

Notes: Cluster-robust standard errors are in parentheses. They are adjusted at the district level for seventy-six clusters for bed capacity and sixty-seven clusters for ultrasound capacity. ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

Table 28. Estimation of the Changes in Individual Private Hospital Capacities With Market Structure Dummies Between 2010-2014

Dependent Variable:	ΔLn(private hospital bed capacity)	ΔLn(private hospital USG capacity)
Δln(population) if increases	-0.912	-0.630
	(0.832)	(1.810)
Δln(population) if decreases	-0.327	-1.877*
	(0.491)	(0.997)
Socio-economic development,	0.020	-0.011
SEGE04 index	(0.041)	(0.098)
Ln(private beds/ultrasound per capita 2010)	-0.143***	-0.518***
	(0.054)	(0.137)
Ln(public MoH beds/ultrasound per capita 2010)	-0.033	0.150
	(0.064)	(0.161)
Monopoly dummy		
Duopoly dummy	0.243***	0.273
	(0.078)	(0.189)
Triopoly dummy	0.150	0.219
	(0.094)	(0.244)
Oligopolistic markets dummy	0.221	0.481
(with four or five private hospitals)	(0.141)	(0.330)
Constant	0.099	0.622
	(0.114)	(0.180)
Observations	137	118
R2	0.14	0.21

Notes: Cluster-robust standard errors are in parentheses. They are adjusted at the district level for seventy-six clusters for bed capacity and sixty-seven clusters for ultrasound capacity. ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

3.6 Concluding discussion

In this part of the research, we analyze the capacity investment choices of hospitals in Turkey. First, we investigate the strategic incentives of hospitals through capacity investments with a theoretical model of strategic hospital capacity choice in an oligopoly game setting. The model provides an equilibrium framework for examining the impacts of the changes in local market conditions on the strategic entry-deterrence motives of hospitals through their capacity investment choices. It gives us empirically testable insights into the relationship between the capacity investment choices of hospitals and local competition among hospitals. Next, we estimate an empirical model in order to test whether the industry data confirm the results from the theoretical model. Our estimation results suggest that local districts with a higher number of competing hospitals have larger capacity growth.

In explaining hospital capacity choice in local districts of Turkey over the sample period 2010-2014, the empirical analysis specifically focuses on the effects of the local competition among hospitals on the changes in hospital capacities of local districts from 2010 to 2014 for two different capacity measures, hospital beds and medical technology. Another important factor that may influence the capacity investment choices of private hospitals during the study period is the changing regulatory environment. However, since the hospital market regulations are applied countrywide, we are unable to distinguish the effects of the regulatory environment among local markets in the estimations. For this reason, our empirical model implicitly assumes that the costs due to regulatory uncertainty, which we discussed in the theoretical model, do not vary across districts.

Our market-level estimations reveal that local districts with a higher number of hospitals have greater growth in their hospital capacities, which is consistent with the entry deterrence literature. This can be interpreted as evidence that the capacity investment of hospitals is affected by strategic motives. However, when we reestimate the model to explain the changes in capacity measures at the individual hospital level, there appears to be some evidence that hospitals in local districts with a higher number of competing hospitals have larger bed capacity growth, but there appears no evidence for the medical technology capacity investment due to local competitive pressure. This seems inconsistent with the prediction of the theoretical model about the capacity choice of individual hospitals. This inconsistency might be due to the assumption of symmetric incumbent hospitals in the theoretical model.

Overall, this research provides a theoretical framework and some empirical evidence for the discussion of whether the private hospitals in Turkey engage in a medical arms race in the form of strategic capacity expansion as a result of the local competitive pressures on them. Nevertheless, our analysis is incomplete in the sense that it primarily focuses on the hospital capacity of local markets. It does not account properly for the asymmetric relationship of individual hospitals with different sizes in local markets. The impact of size asymmetry among local hospitals on their strategic capacity choices is another important issue to be addressed suitably. Hence, a direction for future research is to allow for asymmetry among hospitals.

APPENDIX A

REGION-BASED HEALTHCARE PLANNING – HEALTH SERVICE AREAS

In 2011, the Ministry of Health (MoH) published Inpatient Health Facilities Planning Guidebook (*Yataklı Sağlık Tesisleri Planlama Rehberi*).[97] The guidebook identifies the districts that have more pivotal roles in their region. It presents long-term foresight of the allocation of health facilities and their bed capacities.

According to the projections in the guidebook, considering the healthcare needs of the local areas, a range of services for every catchment population is provided in each region so that citizens can timely navigate to receive healthcare. The criteria considered during this district-based partition of the country land are stated in the guidebook as population, geographic features, transportation, and habits of local residents in receiving healthcare. With this region-based planning practice, the MoH aims that patients can receive the public healthcare services they need in the most appropriate setting within the geographic boundaries of the health service area they live in.

According to the guidebook, the Health Services Planning Department of the MoH identifies 30 Health Service Areas (HSAs) countrywide. Each healthcare service area covers one or more provinces that are together relatively self-contained in terms of hospital care. Each area hierarchically comprises central provinces *(bölge merkezi konumundaki iller)*, subcentral provinces, pivotal districts *(güçlendirilmiş ilçeler)* of provinces, and other districts that are associated with these more central pivotal districts.

[97] See Akdağ (2011).

The MoH located a total of 243 pivotal districts in these 30 HSAs. They consist of one or more adjacent districts to the core district with a higher degree of geographic, social, and economic integration. As of 2010, the pivotal districts have a 303,387 population on average, ranging from 21,519 to 2,854,798, with a standard deviation of 469,231. Such a classification of all the districts has been helpful for the empirical analysis in defining the geographic boundaries of the neighboring population of each local market.[98]

[98] We also redid the baseline analysis in which the geographical market definition relies directly on the HSA classification of the MoH. The results of the paper do not sensitive to this change.

APPENDIX B

SOCIO-ECONOMIC DEVELOPMENT RANKING SURVEY OF DISTRICTS – SEGE-INDEX

In 1996, with the aim of measuring comparatively the level of development of the provinces, the State Planning Organization of Turkey (later the Ministry of Development) published research that provides rankings of all 76 provinces (at that time) of Turkey in terms of socio-economic development level. The study uses Principal Component Analysis based on 58 different social and economic indicators; social indicators include demographic, education, health, employment, and infrastructure variables; economic indicators consist of manufacturing, construction, agriculture, and financial variables. The Ministry repeated the research with the same design in 2003 and 2011 for all 81 provinces. Moreover, in 2004, the development ranking was also published at the district level. The index for 2004, based on 32 variables, ranks all 872 districts of Turkey.

The SEGE-index, providing a countrywide ranking of 81 provinces, constitutes the basis of the government incentive programs on local development support. The most recent SEGE-2011 index layers all 81 provinces of Turkey into six development categories. For instance, the first group of SEGE-2011 consists of the most developed eight provinces: İstanbul, Ankara, İzmir, Kocaeli, Bursa, Antalya, Muğla, and Eskişehir.[99]

Although SEGE-indexes were calculated with the same research design and provide ranking on the development level of provinces/regions for different years, it does not allow for a direct comparison of the level of SEGE-2011 with SEGE-2003.

[99] We refer the interested readers to Ministry of Development of the Republic of Turkey (2004, 2013) for the full texts of the publications on Research on Socio-Economic Development Index (SEGE).

Since the dataset used for the calculations of the environmental, technological, living standards, economic, and social aspects were altered in 2011. The SEGE-2011 utilizes 61 variables from eight different dimensions. In addition to the indicator groups on demography, employment, education, health and finance, some more variables on competitive and innovative capacity, accessibility and life quality are included into the calculations published in 2011.

APPENDIX C

THE DETERMINISTIC TEXTBOOK MODEL OF STRATEGIC ENTRY-DETERRENCE INVESTMENT IN CAPACITY

Consider an oligopolistic hospital market environment. Suppose that N established hospitals operate in the market and they face the threat of entry by a single potential entrant. The model has a multistage strategic entry-deterrence game setting with complete information. In the first stage, incumbent hospitals simultaneously and independently choose their capacity investment levels K_i for $i = 1,2, \ldots, N$. In the second stage, taking the established hospitals' capacity levels as given, a potential entrant decides whether to enter and chooses its capacity level K_e in case of entry. At the third stage, incumbents continue to operate in an N-oligopoly market; or if entry occurs, they compete in the market with the new entrant hospital as well.

The appropriate solution concept for the game is subgame perfect equilibrium. We use the backward induction to solve the sequential capacity choice game. Firstly, for a given total capacity level K of established hospitals in the market, the entrant hospital's problem is solved. Thereafter, given the optimal capacity investment choice of the entrant hospital, the capacity investment choices of the incumbent hospitals are solved.

The entrant hospital chooses its capacity level K_e at the final stage, given the capacity choice of established hospitals. The profit function of the entrant hospital is

$$\pi_e(K, K_e) = (a - K - K_e)K_e - (E + cK_e)$$

where $K = \sum_{i=1}^{N} K_i$ is the total capacity of the established hospitals. Then, the first-order condition for the profit maximization of the entrant hospital is

$$\frac{\partial \pi_e}{\partial K_e} = (a - K - 2K_e) - c \equiv 0.$$

Solving for K_e gives the entrant's best response to the capacity choices of incumbent hospitals as

$$K_e(K) = \begin{cases} \dfrac{a-c-K}{2}, & \pi_e > 0 \\ 0 \quad , & \pi_e \leq 0 \end{cases}$$

This capacity level function represents the best response of the entrant if it results in nonnegative profits for the entrant hospital, so we need to solve for K that satisfies $\pi^e \geq 0$:

$$\pi_e(K, K_e) = \left[\left(a - c - K - \frac{a-c-K}{2}\right)\left(\frac{a-c-K}{2}\right) - E\right] \geq 0$$

Thus, $\pi_e \geq 0$ when $K \leq K^b \equiv (a-c) - 2\sqrt{E}$. We assume that $E < \bar{\varepsilon} \equiv \frac{1}{4}(a-c)^2$ in order to have $K^b > 0$. The potential entrant hospital chooses to enter and invest to the positive capacity given by the reaction function $K_e(K)$ as long as the total industry capacity of incumbent hospitals does not exceed K^b; otherwise, it does not enter the market to refrain from negative profits. Hence,

$$\pi_e^*(K) = \begin{cases} \left(\dfrac{a-c-K}{2}\right)^2 - E, & K \leq K^b \\ 0 \quad , & K > K^b \end{cases}$$

Regarding the decisions of incumbent hospitals at the first stage of the game, there are three possibilities to consider. The first one is the case of *blockaded entry*, in which entry is not profitable by itself, and established hospitals simultaneously choose their capacity investment levels without considering entry. Each incumbent hospital i then chooses K_i for $i = 1,2,..,N$ that maximizes

$$\pi_i^N(K_i; K_{-i}) = \left(a - K_i - \sum\nolimits_{j=1, j\neq i}^{N} K_\mathrm{j}\right) K_i - cK_i$$

It gives the first-order condition as $(a - c - K - K_i) \equiv 0$. Then, the equilibrium capacity level of each symmetric incumbent hospital is $K_i^* = \frac{a-c}{N+1}$, and thereby total capacity is $K^* = \frac{N(a-c)}{N+1}$. Entry is *blockaded* if the N-incumbent industry's total capacity is larger than K^b over which new hospital entry becomes unprofitable and $K_e^* = 0$ when $K^* > K^b$, which gives $E > E^+ := \frac{1}{4}\left(\frac{a-c}{N+1}\right)^2$. Then, we have the equilibrium profits as

$$\pi_i(K^*; blockaded) = \left(\frac{a-c}{N+1}\right)^2;\ \pi_e(K_e^*; blockaded) = 0.$$

The other two possibilities at the first stage of the game correspond to the case of accommodated and deterred entry when $K^* \leq K^b$ and so $E \leq E^+$. When the potential entrant knows that the maximum amount of the total capacity of the established hospitals is below K^b, it finds entry profitable. Under this condition, in the face of entry, incumbent hospitals will behave as 'Stackelberg leaders'. Then, given the capacity levels of other incumbent hospitals and the best response function of the entrant hospital, each incumbent hospital chooses its capacity level K_i at the first stage of the game in order to maximize

$$\pi_i^{N+1}(K_i;\ K_{-i}, K_e) = \left(a - K_i - \sum_{j=1, j\neq i}^{N} K_{\mathrm{j}} - K_e(K)\right) K_i - cK_i$$

By plugging the best response function of the entrant hospital $K_e(K) = \frac{a-c-K}{2}$ into the objective function of incumbent hospitals, and thereafter, taking their derivatives with respect to K_i, we have the first-order conditions as $\frac{1}{2}(a - c - K - K_i) \equiv 0$ for $i = 1, \ldots, N$. Thus, for symmetric incumbent hospitals, we have $K_i^* = \frac{a-c}{N+1}$, $K^* = \frac{N(a-c)}{N+1}$ and $K_e^* = \frac{1}{2}\left(\frac{a-c}{N+1}\right)$. Then, we have the equilibrium profits as

$$\pi_i(K^*; accommodate) = \frac{1}{2}\left(\frac{a-c}{N+1}\right)^2;\ \pi_e(K_e^*; accommodate) = \frac{1}{4}\left(\frac{a-c}{N+1}\right)^2 - E.$$

On the other hand, in order to deter entry, incumbent hospitals must install a higher total capacity $K^b > K^*$, which can make the entry unprofitable for a new hospital. In that case, the profit function of each symmetric incumbent hospital at K^b is

$$\pi_i(K^b; deter) = (a - c - K^b)\frac{K^b}{N} = \left(a - c - \left(a - c - 2\sqrt{E}\right)\right)\left(\frac{a - c - 2\sqrt{E}}{N}\right)$$

$$= \frac{1}{N}2\sqrt{E}\left(a - c - 2\sqrt{E}\right)$$

It can be shown that $\pi_i(deterred)$ is an increasing function of the entry cost E for $E < E^+$. Hence, as the fixed entry cost E approaches to E^+, incumbent hospitals prefer deterrence over accommodation. Thus, $\pi_i^N(deterred) >$ $\pi_i^{N+1}(Accomodated)$ for some $\tilde{E} < E < E^+$.

Hence, for smaller entry costs $E < \tilde{E}$, incumbent hospitals prefer to *accommodate entry* and behave as 'Stackelberg leaders'; for intermediate entry costs $\tilde{E} < E < E^+$, incumbent hospitals choose to *deter entry* by expanding their capacity levels; and, for larger entry costs $E^+ < E < \bar{\varepsilon}$, incumbent hospitals behave as unconstrained oligopolists as entry is *blockaded*. The line diagram in Figure 9 summarizes these three possible cases related to the decisions of incumbents and the corresponding threshold levels of the fixed entry cost E.

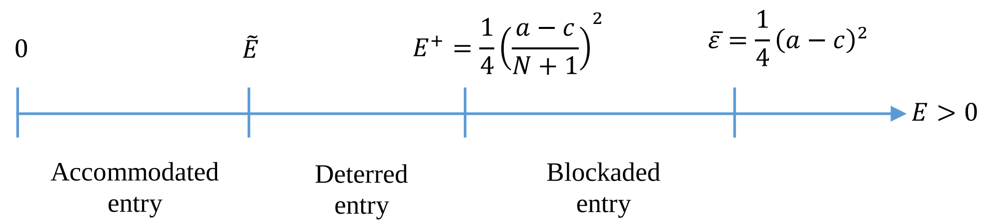


Figure 9. Summary diagram for the threshold levels of the fixed entry cost E

Further, Figure 10 summarizes the entry deterrence analysis related to the decisions of incumbents and the corresponding threshold levels in terms of the total capacity investment K of incumbents. When $\mathrm{K^b} < \mathrm{K}^*$, it is *blockaded* entry case. But when $\mathrm{K^b} > \mathrm{K}^*$, it might be either *accommodated* or *deterred* entry cases. For $\mathrm{K}^* < \mathrm{K^b} < \widetilde{\mathrm{K}}_{large}$, incumbents choose Deter to Accommodate, since $\pi_i(K^b; deter) > \pi_i(K^*; accommodate)$; for $\widetilde{\mathrm{K}}_{\mathrm{large}} < \mathrm{K^b} < (\mathrm{a} - \mathrm{c})$, incumbents choose Accommodate to Deter, since $\pi_i(K^b; deter) < \pi_i(K^*; accommodate)$. At the threshold capacity $\widetilde{\mathrm{K}}$ in Figure 10 such that $\pi_i(\widetilde{\mathrm{K}}; deter) = \pi_i(\mathrm{K}^*; accommodate)$ where $\pi_i(\mathrm{K}^*; accommodate) = \frac{1}{2}\left(\frac{a-c}{N+1}\right)^2$ and $\pi_i(\widetilde{\mathrm{K}}; deter) = \frac{\widetilde{\mathrm{K}}}{N}(a - c - \widetilde{\mathrm{K}})$. By solving $\widetilde{\mathrm{K}}$'s that satisfy $\pi_i(\widetilde{\mathrm{K}}; deter) = \pi_i(\mathrm{K}^*; accommodate)$, we have $\widetilde{\mathrm{K}}_{\mathrm{small}} = \frac{(\mathrm{a}-\mathrm{c})[(\mathrm{N}+1)-\sqrt{\mathrm{N}^2+1}]}{2(\mathrm{N}+1)}$ and $\widetilde{\mathrm{K}}_{\mathrm{large}} = \frac{(\mathrm{a}-\mathrm{c})[(\mathrm{N}+1)+\sqrt{\mathrm{N}^2+1}]}{2(\mathrm{N}+1)}$. Note that $0 < \widetilde{\mathrm{K}}_{\mathrm{small}} < K^* = \frac{N(a-c)}{N+1} < \widetilde{\mathrm{K}}_{\mathrm{large}} < (a - c)$. Remember that $K^b \equiv (a - c) - 2\sqrt{E}$. Thus, $\widetilde{\mathrm{K}}_{\mathrm{large}}$ in Figure 10 corresponds to the $\tilde{E}$ in Figure 9.

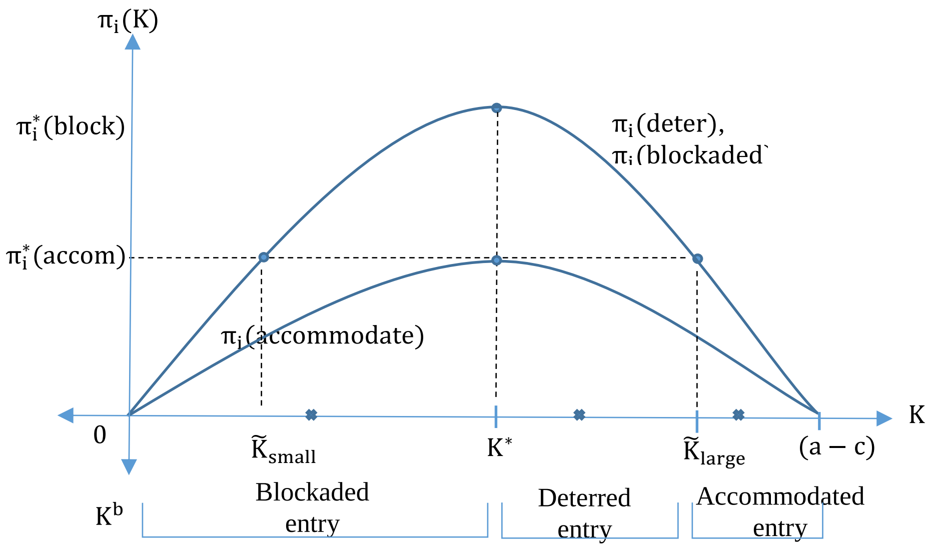


Figure 10. Critical levels of the incumbents' total capacity investments K

APPENDIX D

PROOFS

This appendix contains the proofs of the propositions.

Proof of Lemma 1: Given in the text.

Proof of Proposition 1: The expected profit function of each incumbent hospital is

$$E\big(\pi_i(K_i)\big) = \frac{E^b(K)}{\varepsilon}\big[\big(a-c-K-K_e(K)\big)K_i\big] + \left(1-\frac{E^b(K)}{\varepsilon}\right)[(a-c-K)K_i]$$

$$= (a-c-K)K_i - \frac{E^b(K)}{\varepsilon}K_e(K)K_i$$

Given K_{-i}'s, $K_e(K) = \frac{(a-c-K)}{2}$ and $E^b(K) = \frac{(a-c-K)^2}{4}$, each incumbent hospital's problem is $\max\limits_{K_i} E\big(\pi_i(K_i)\big)$. Then, the first-order conditions for optimal investment levels $K_{i,ED}^*$ of the incumbent hospitals are given by

$$(a-c-K-K_i) - \frac{(a-c-K)^3}{8\varepsilon} + \frac{K_i(a-c-K)^2}{8\varepsilon} + \frac{K_i(a-c-K)^2}{4\varepsilon} \equiv 0$$

which is equivalent to the following representations

$$8\varepsilon(a-c-K-K_i) - (a-c-K)^2(a-c-K-K_i) + 2K_i(a-c-K)^2 \equiv 0$$

$$[8\varepsilon - (a-c-K)^2](a-c-K-K_i) + 2K_i(a-c-K)^2 \equiv 0$$

$$8\varepsilon(a-c-K-K_i) - (a-c-K)^2(a-c-K-3K_i) \equiv 0$$

$$8\varepsilon(a-c-K-K_i) - (a-c-K)^3 + 3K_i(a-c-K)^2 \equiv 0$$

The S.O.C for a maximum $K_{i,ED}^*$ is $\left(-2 + \frac{6(a-c-K)[a-c-K-K_i]}{8\varepsilon}\right) < 0$ which is equivalent to $\left(-2 + 3\frac{E^b(K^*)}{\varepsilon} - \frac{3K_i(a-c-K)}{4\varepsilon}\right) < 0$. The equilibrium level of total capacity for the symmetric incumbent hospitals is $K^* = NK_i^*$, so the equilibrium capacity levels of the symmetric incumbent hospitals are characterized with the equation for $K_{i,ED}^*$ as $\left[a-c-(N+1)K_{i,ED}^*\right]-\frac{\left(a-c-NK_{i,ED}^*\right)^3}{8\varepsilon}+\frac{3K_{i,ED}^*\left(a-c-NK_{i,ED}^*\right)^2}{8\varepsilon}=0$ for some $\varepsilon<\bar{\varepsilon}=\frac{1}{4}(a-c)^2$. Rearranging the equation, we have $8\varepsilon\left[\left(a-c-(N+1)K_{i,ED}^*\right)\right]-\left(a-c-NK_{i,ED}^*\right)^3+3K_{i,ED}^*\left(a-c-NK_{i,ED}^*\right)^2\equiv 0$, and the equilibrium capacity investment of the entrant is determined by $K_{e,ED}^*=\frac{(a-c-K_{ED}^*)}{2}$. □

Proof of Proposition 2: The expected profit function of each incumbent hospital is

$$E\left(\pi_i\left(K_i,K_{i,ND}^*\right)\right)=\frac{E^b}{\varepsilon}[(a-c-K-K_e)K_i]+\left(1-\frac{E^b}{\varepsilon}\right)[(a-c-K)K_i]$$

$$=(a-c-K)K_i-\frac{E^b}{\varepsilon}K_e(K)K_i$$

Given K_{-i}'s, $K_e(K)=\frac{(a-c-K)}{2}$ and the constant $E^b(K_{ND}^*)=\frac{(a-c-K^*)^2}{4}$, each incumbent hospital's problem is $\max_{K_i}E\left(\pi_i\left(K_i,K_{i,ND}^*\right)\right)$. Then, the first-order conditions for the optimal investments $K_{i,ND}^*$ of the incumbent hospitals are given by

$$(a-c-K-K_i)-\frac{E^b}{\varepsilon}\left(\frac{a-c-K-K_i}{2}\right)\equiv 0$$

The S.O.C for a maximum $K_{i,ND}^*$ is $\left(-2+\frac{E^b}{\varepsilon}\right)=\left(-2+\frac{(a-c-K_{ND}^*)^2}{4\varepsilon}\right)<0.$

Note that the probability of entry $\frac{E^b}{\varepsilon}$ is less than one by its definition; this implies $8\varepsilon-(a-c-K_{ND}^*)^2>0.$

Substituting $E^b=E^b(K_{ND}^*)=\frac{(a-c-K^*)^2}{4}$ into the F.O.C. equation, we have

$$(a-c-K^*-K_i^*)-\frac{(a-c-K^*)^3}{8\varepsilon}+\frac{K_i^*(a-c-K^*)^2}{8\varepsilon}\equiv 0$$

which is equivalent to the following representations

$$8\varepsilon(a-c-K^*-K_i^*)-(a-c-K^*)^3+K_i^*(a-c-K^*)^2\equiv 0$$

$$[8\varepsilon-(a-c-K^*)^2](a-c-K^*-K_i^*)\equiv 0$$

The equilibrium level of total capacity for the symmetric incumbent hospitals is $K^* = NK_i^*$, so the equilibrium capacity levels of the symmetric incumbent hospitals are characterized by the equation for $K_{i,ND}^*$ as $\left(a - c - (\mathrm{N}+1)K_{i,ND}^*\right) - \frac{\left(a-c-\mathrm{NK}_{\mathrm{i,ND}}^*\right)^3}{8\varepsilon} + \frac{K_{i,ND}^*\left(a-c-\mathrm{NK}_{\mathrm{i,ND}}^*\right)^2}{8\varepsilon} \equiv 0$ for some $\varepsilon < \bar{\varepsilon} = \frac{1}{4}(a-c)^2$. Rearranging the equation, we have $8\varepsilon\left[\mathrm{a - c - (N+1)K_{i,ND}^*}\right] - \left(\mathrm{a - c - NK_{i,ND}^*}\right)^3 + K_i^*\left(a - c - \mathrm{NK_{i,ND}^*}\right)^2 \equiv 0$, and the equilibrium capacity investment of the entrant is determined by $K_{e,ND}^* = \frac{(a-c-K_{ND}^*)}{2}$. □

Proof of Proposition 3: Let us first denote $k \coloneqq K_i$ and thereby $K \coloneqq Nk$, then define the functions $f(.)$, $F(.)$, $h(.)$, $H(.)$ and $s(.)$, $S(.)$ as:

$$f(k; a, c, N, \varepsilon) \coloneqq 8\varepsilon[(a-c) - (N+1)k] - (a-c-Nk)^3 + k(a-c-Nk)^2$$

$$F(K; a, c, N, \varepsilon) \coloneqq 8\varepsilon\left[(a-c) - \frac{(N+1)}{N}K\right] - (a-c-K)^3 + \frac{K}{N}(a-c-Nk)^2$$

$$h(k; a, c, N, \varepsilon) \coloneqq 8\varepsilon[(a-c) - (N+1)k] - (a-c-Nk)^3 + 3k(a-c-Nk)^2$$

$$H(K; a, c, N, \varepsilon) \coloneqq 8\varepsilon\left[(a-c) - \frac{(N+1)}{N}K\right] - (a-c-K)^3 + 3\frac{K}{N}(a-c-K)^2$$

$$s(k; a, c, N) \coloneqq\ 2k(a-c-Nk)^2\ ;\ S(K; a, c, N) \coloneqq\ 2\frac{K}{N}(a-c-K)^2$$

Then, $h(k) = f(k) + s(k)$ and $H(K) = F(K) + S(K)$. From the F.O.C.s at Equations (2) and (4), we have $f\left(K_{i,ND}^*\right) = 0$, $F(K_{ND}^*) = 0$ and $h\left(K_{i,ED}^*\right) = 0$, $H(K_{ED}^*) = 0$. Since $h(k_{ED}^*) = f(k_{ED}^*) + s(k_{ED}^*)$, then $-f(k_{ED}^*) = s(k_{ED}^*)$. For $k > 0$, there are two possible cases for the sign of $s(k) = 2k(a-c-Nk)^2$: (i) $s(k) = 0$ when $k = \frac{a-c}{N}$; and (ii) $s(k) > 0$ otherwise. Then, Case (i) implies $K_{i,ND}^* = K_{i,ED}^*$, but we know that $K < a - c$ which do not satisfy the $k = \frac{a-c}{N}$, so contradiction. Now, suppose that $s(k) > 0$, then $f(k_{ED}^*) < 0$ since $-f(k_{ED}^*) = s(k_{ED}^*) > 0$. First, note that $f'(k) = \left(-(N+1)[8\varepsilon - 3(a-c-Nk)^2] - 2(a-c-Nk)^2 - 2kN(a-c-Nk)\right) < 0$ when $(8\varepsilon - 3(a-c-Nk)^2) > 0$, which is indeed required as the S.O.C.s of the incumbent hospitals' maximization problem. Thus, f is a decreasing function of k for $k > \underline{k} := \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$ when the inequality $8\varepsilon > 3(a-c-Nk)^2$ is satisfied. Putting together, we know that $f(k_{ND}^*) = 0$, $f(k_{ED}^*) < 0$, and f is decreasing for $k > \underline{k}$. Hence, $f(k_{ED}^*) < f(k_{ND}^*)$ requires $k_{ED}^* > k_{ND}^*$. Thus, $K_{i,ED}^* > K_{i,ND}^*$ and similarly $K_{ED}^* > K_{ND}^*$ when $> \underline{K} := (a-c) - \sqrt{\frac{8\varepsilon}{3}}$. □

Proof of Proposition 4: (i) By taking total derivative of the Equation (2) for $K_{i,ED}^*$ with respect to the market size parameter a, and then solving for $\frac{dK_{i,ED}^*}{da}$ gives

$$\frac{\mathrm{dK}_{\mathrm{i,ED}}^*}{\mathrm{da}} = \frac{8\varepsilon - 3\left(a-c-NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*\left(a-c-NK_{i,ED}^*\right)}{8\varepsilon(N+1) - 3N\left(a-c-NK_{i,ED}^*\right)^2 - 3\left(a-c-NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a-c-NK_{i,ED}^*\right)}$$

$$= \frac{8\varepsilon - 3\left(a-c-NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*(a-c-NK_{i,ED}^*)}{N\left(8\varepsilon - 3\left(a-c-NK_{i,ED}^*\right)^2\right) + 8\varepsilon - 3\left(a-c-NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a-c-NK_{i,ED}^*\right)}$$

$$= \frac{8\varepsilon - 3\left(a-c-NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*(a-c-NK_{i,ED}^*)}{(N+1)\left(8\varepsilon - 3\left(a-c-NK_{i,ED}^*\right)^2\right) + 6NK_{i,ED}^*\left(a-c-NK_{i,ED}^*\right)}$$

Then, in the parameter space that satisfies $K_{i,ED}^* > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$, the term $8\varepsilon - 3\left(a-c-NK_{i,ND}^*\right)^2$ in the numerator and denominator appears as positive. Thus, $\frac{dK_{i,ED}^*}{da} = \frac{(+)}{(+)} > 0$ for $N > 0$ and $\varepsilon > 0$. Also, we have $\frac{dK_{i,ED}^*}{dc} = -\frac{dK_{i,ED}^*}{da} < 0$.

Likewise, separately differentiating it with respect to incumbent hospital number N and fixed entry cost ε, we obtain $\frac{dK_{i,ED}^*}{dN}$ and $\frac{dK_{i,ED}^*}{d\varepsilon}$ as

$$\frac{dK_{i,ED}^*}{dN} = \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)\right]K_{i,ED}^*}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ED}^*\right)^2 - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$= \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)\right]K_{i,ED}^*}{N\left(8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2\right) + 8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)} =$$

$$= \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)\right]K_{i,ED}^*}{(N+1)\left(8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2\right) + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$\frac{dK_{i,ED}^*}{d\varepsilon} = \frac{8\left[a - c - (N+1)K_{i,ED}^*\right]}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ED}^*\right)^2 - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$= \frac{8\left[a - c - (N+1)K_{i,ED}^*\right]}{N\left(8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2\right) + 8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$= \frac{8\left[a - c - (N+1)K_{i,ED}^*\right]}{(N+1)\left(8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2\right) + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

Then, one can conclude that $\frac{dK_{i,ED}^*}{dN} = \frac{(-)}{(+)} < 0$; and $\frac{dK_{i,ED}^*}{d\varepsilon} = \frac{(-)}{(+)} < 0$ when the term $\left[a - c - (N+1)K_{i,ED}^*\right]$ in the numerator of $\frac{dK_{i,ED}^*}{d\varepsilon}$ is negative; $\frac{dK_{i,ED}^*}{d\varepsilon} = \frac{(+)}{(+)} > 0$ otherwise. □

(ii) Similarly, by taking total derivative of the Equation (4) for $K_{i,ND}^*$ with respect to the market size parameter a, and then solving for $\frac{dK_{i,ND}^*}{da}$ gives

$$\frac{dK_{i,ND}^*}{da} = \frac{8\varepsilon - 3\left(a - c - NK_{i,ND}^*\right)^2 + 2K_{i,ND}^*\left(a - c - NK_{i,ND}^*\right)}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ND}^*\right)^2 - \left(a - c - NK_{i,ND}^*\right)^2 + 2NK_{i,ND}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$= \frac{8\varepsilon - 3\left(a - c - NK_{i,ND}^*\right)^2 + 2K_{i,ND}^*(a - c - NK_{i,ND}^*)}{N\left(8\varepsilon - 3\left(a - c - NK_{i,ND}^*\right)^2\right) + 8\varepsilon - \left(a - c - NK_{i,ND}^*\right)^2 + 2NK_{i,ND}^*\left(a - c - NK_{i,ND}^*\right)}$$

$$= \frac{8\varepsilon - 3\left(a - c - NK_{i,ND}^*\right)^2 + 2K_{i,ND}^*(a - c - NK_{i,ND}^*)}{(N+1)\left(8\varepsilon - 3\left(a - c - NK_{i,ND}^*\right)^2\right) + 2\left(a - c - NK_{i,ND}^*\right)^2 + 2NK_{i,ND}^*\left(a - c - NK_{i,ND}^*\right)}$$

Then, in the parameter space that satisfies $K_{i,ND}^* > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$, the first term $8\varepsilon - 3\left(a - c - NK_{i,ND}^*\right)^2$ in the numerator and denominator appears as positive, and the remaining terms are also positive since $K_{i,ED}^{*} > 0$ and $\left(a - c - NK_{i,ED}^{*}\right) > 0$.

Thus, $\frac{dK_{i,ED}^{*}}{da} = \frac{(+)}{(+)} > 0$ for $N > 0$ and $\varepsilon > 0$. Also, we have $\frac{dK_{i,ND}^{*}}{dc} = -\frac{dK_{i,ND}^{*}}{da} < 0$.

Likewise, separately differentiating it with respect to incumbent hospital number N and fixed entry cost ε, we obtain $\frac{dK_{i,ND}^{*}}{dN}$ and $\frac{dK_{i,ND}^{*}}{d\varepsilon}$ as

$$\frac{\mathrm{d}K_{\mathrm{i,ND}}^{*}}{\mathrm{dN}} = \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2} + 2K_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)\right]K_{i,ND}^{*}}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ND}^{*}\right)^{2} - \left(a - c - NK_{i,ND}^{*}\right)^{2} + 2NK_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)}$$

$$= \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2} + 2K_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)\right]K_{i,ED}^{*}}{N\left(8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2}\right) + 8\varepsilon - \left(a - c - NK_{i,ND}^{*}\right)^{2} + 2NK_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)} =$$

$$= \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2} + 2K_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)\right].K_{i,ND}^{*}}{(N+1)\left(8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2}\right) + 2\left(a - c - NK_{i,ND}^{*}\right)^{2} + 2NK_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)}$$

$$\frac{\mathrm{d}K_{\mathrm{i,ND}}^{*}}{\mathrm{d}\varepsilon} = \frac{8\left[a - c - (N+1)K_{i,ND}^{*}\right]}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ND}^{*}\right)^{2} - \left(a - c - NK_{i,ND}^{*}\right)^{2} + 2NK_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)}$$

$$= \frac{8\left[a - c - (N+1)K_{i,ND}^{*}\right]}{N\left(8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2}\right) + 8\varepsilon - \left(a - c - NK_{i,ND}^{*}\right)^{2} + 2NK_{i,ND}^{*}\left(a - c - NK_{i,ND}^{*}\right)}$$

$$= \frac{8\left[a - c - (N+1)K_{i,ND}^{*}\right]}{(N+1)\left(8\varepsilon - 3\left(a - c - NK_{i,ND}^{*}\right)^{2}\right) + 2\left(a - c - NK_{i,ND}^{*}\right)^{2} + 2NK_{i,ND}^{*}\left(a - c - NK_{i,nD}^{*}\right)}$$

Then, one can conclude that $\frac{dK_{i,ND}^{*}}{dN} = \frac{(-)}{(+)} < 0$ and $\frac{dK_{i,ND}^{*}}{d\varepsilon} = \frac{(.)}{(+)} \lesseqgtr 0$. □

(iii) Equation (2) can be rewritten in terms of K_{ED}^{*} as

$$8\varepsilon\left[(a-c) - \frac{(N+1)}{N}K_{ED}^{*}\right] - (a - c - K_{ED}^{*})^{3} + 3\frac{K_{ED}^{*}}{N}(a - c - K_{ED}^{*})^{2} \equiv 0.$$

Then, by separately differentiating it with respect to a, N, and ε; and then solving for $\frac{dK_{ED}^{*}}{da}$, $\frac{dK_{ED}^{*}}{dN}$ and $\frac{dK_{ED}^{*}}{d\varepsilon}$ gives

$$\frac{\mathrm{dK}_{\mathrm{ED}}^*}{\mathrm{da}} = \frac{\mathrm{N}\left(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)\right)}{8\varepsilon(\mathrm{N}+1) - 3\mathrm{N}(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$= \frac{\mathrm{N}\left(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)\right)}{\mathrm{N}(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2) + 8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$= \frac{\mathrm{N}\left(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)\right)}{(\mathrm{N}+1)(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2) + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$\frac{\mathrm{dK}_{\mathrm{ED}}^*}{\mathrm{dc}} = -\frac{\mathrm{dK}_{\mathrm{ED}}^*}{\mathrm{da}}$$

$$\frac{\mathrm{dK}_{\mathrm{ED}}^*}{\mathrm{dN}} = \frac{8\varepsilon\frac{1}{\mathrm{N}^2}\mathrm{K}_{\mathrm{ED}}^* - 3\frac{1}{\mathrm{N}^2}\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2}{8\varepsilon\frac{(\mathrm{N}+1)}{\mathrm{N}} - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 - 3\frac{1}{\mathrm{N}}(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\frac{1}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$= \frac{8\varepsilon\frac{1}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^* - 3\frac{1}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2}{\mathrm{N}(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2) + 8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$= \frac{\frac{1}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2)}{(\mathrm{N}+1)(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2) + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$\frac{\mathrm{dK}_{\mathrm{ED}}^*}{\mathrm{d}\varepsilon} = \frac{8\left[\mathrm{a}-\mathrm{c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*\right]}{8\varepsilon\frac{(\mathrm{N}+1)}{\mathrm{N}} - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 - 3\frac{1}{\mathrm{N}}(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\frac{1}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$= \frac{8\mathrm{N}\left[\mathrm{a}-\mathrm{c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*\right]}{\mathrm{N}(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2) + 8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2 + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

$$= \frac{8\mathrm{N}\left[\mathrm{a}-\mathrm{c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*\right]}{(\mathrm{N}+1)(8\varepsilon - 3(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)^2) + 6\mathrm{K}_{\mathrm{ED}}^*(\mathrm{a}-\mathrm{c}-\mathrm{K}_{\mathrm{ED}}^*)}$$

Then, in the parameter space that satisfies $K_{i,ED}^* > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$, with a similar argument in the proof of (i), for $N > 0$ and $\varepsilon > 0$, one can conclude $\frac{dK_{ED}^*}{da} = \frac{(+)}{(+)} > 0$; and $\frac{dK_{i,ED}^*}{d\varepsilon} = \frac{(-)}{(+)} < 0$ when the term $\left[\mathrm{a}-\mathrm{c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K}_{\mathrm{ED}}^*\right]$ in the numerator of $\frac{dK_{i,ED}^*}{d\varepsilon}$ is negative; $\frac{dK_{i,ED}^*}{d\varepsilon} = \frac{(+)}{(+)} > 0$ otherwise. However, unlike the result of (i), $\frac{dK_{ED}^*}{dN} > 0$. □

(iv) Equation (4) can be rewritten in terms of K_{ED}^* as

$$8\varepsilon\left[(a-c) - \frac{(N+1)}{N}K_{ND}^*\right] - (a-c-K_{ND}^*)^3 + \frac{K_{ND}^*}{N}(a-c-K_{ND}^*)^2 \equiv 0$$

Then, by separately differentiating it with respect to a, N, and ε; and then solving for $\frac{dK_{ND}^*}{da}$, $\frac{dK_{ND}^*}{dN}$ and $\frac{dK_{ND}^*}{d\varepsilon}$ gives

$$\frac{\mathrm{dK_{ND}^*}}{\mathrm{da}} = \frac{\mathrm{N}\big(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})\big)}{8\varepsilon(\mathrm{N}+1) - 3\mathrm{N}(\mathrm{a-c-K_{ND}^*})^2 - (\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$= \frac{\mathrm{N}\big(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})\big)}{\mathrm{N}(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2) + 8\varepsilon - (\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$= \frac{\mathrm{N}\big(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})\big)}{(\mathrm{N}+1)(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2) + 2(\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$\frac{\mathrm{dK_{ND}^*}}{\mathrm{dN}} = \frac{8\varepsilon\frac{1}{\mathrm{N}^2}\mathrm{K_{ND}^*} - \frac{1}{\mathrm{N}^2}\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})^2}{8\varepsilon\frac{(\mathrm{N}+1)}{\mathrm{N}} - 3(\mathrm{a-c-K_{ND}^*})^2 - \frac{1}{\mathrm{N}}(\mathrm{a-c-K_{ND}^*})^2 + 2\frac{1}{\mathrm{N}}\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$= \frac{8\varepsilon\frac{1}{\mathrm{N}}\mathrm{K_{ND}^*} - \frac{1}{\mathrm{N}}\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})^2}{\mathrm{N}(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2) + 8\varepsilon - (\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$= \frac{\frac{1}{\mathrm{N}}\mathrm{K_{ND}^*}(8\varepsilon - (\mathrm{a-c-K_{ND}^*})^2)}{(\mathrm{N}+1)(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2) + 2(\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$\frac{\mathrm{dK_{ND}^*}}{\mathrm{d\varepsilon}} = \frac{8\left[\mathrm{a-c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K_{ND}^*}\right]}{8\varepsilon\frac{(\mathrm{N}+1)}{\mathrm{N}} - 3(\mathrm{a-c-K_{ND}^*})^2 - \frac{1}{\mathrm{N}}(\mathrm{a-c-K_{ND}^*})^2 + 2\frac{1}{\mathrm{N}}\mathrm{K_{ND}^*}(\mathrm{a-c-K_{nD}^*})}$$

$$= \frac{8\mathrm{N}\left[\mathrm{a-c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K_{ND}^*}\right]}{\mathrm{N}(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2) + 8\varepsilon - (\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

$$= \frac{8\mathrm{N}\left[\mathrm{a-c}-\frac{(\mathrm{N}+1)}{\mathrm{N}}\mathrm{K_{ND}^*}\right]}{(\mathrm{N}+1)(8\varepsilon - 3(\mathrm{a-c-K_{ND}^*})^2) + 2(\mathrm{a-c-K_{ND}^*})^2 + 2\mathrm{K_{ND}^*}(\mathrm{a-c-K_{ND}^*})}$$

Then, in the parameter space that satisfies $K_{i,ND}^* > \frac{1}{N}\left[(a-c) - \sqrt{\frac{8\varepsilon}{3}}\right]$, with a similar argument in the proof of (ii), one can conclude $\frac{dK_{ND}^*}{da} = \frac{(+)}{(+)} > 0$ and $\frac{dK_{ND}^*}{d\varepsilon} = \frac{(+)}{(+)} > 0$ for $N > 0$ and $\varepsilon > 0$. However, unlike the result of (ii), we have $\frac{dK_{ND}^*}{dN} > 0$. □

(v) By differentiating the Equation for $K_{e,ED}^* = \frac{(a-c-K_{ED}^*)}{2}$ with respect to a,

$$\frac{\mathrm{dK_{e,ED}^*}}{\mathrm{da}} = \frac{1}{2}\left(1 - \frac{\mathrm{dK_{ED}^*}}{\mathrm{da}}\right)$$

Since $0 < \frac{dK_{ED}^*}{da} < 1$ from (iii), we have $0 < \frac{dK_{e,ED}^*}{da} < 1$ as well. Likewise, separately differentiating it with respect to incumbent hospital number N and fixed entry cost ε, we have $\frac{dK_{e,ED}^*}{dN} = -\frac{1}{2}\frac{dK_{ED}^*}{dN} < 0$ since $\frac{dK_{ED}^*}{dN} > 0$, $\frac{dK_{e,ED}^*}{d\varepsilon} = -\frac{1}{2}\frac{dK_{ED}^*}{d\varepsilon} \lesseqgtr 0$, $\frac{dK_{ED}^*}{d\varepsilon} \lesseqgtr 0$. □

(vi) Similar to the proof of (v).

Proof of Proposition 5: By using the derivations below, it can be shown that $\frac{dK_{ED}^*}{dN} < \frac{dK_{ND}^*}{dN}$, then $\frac{d(K_{ED}^* - K_{ND}^*)}{dN} = \frac{dK_{ED}^*}{dN} - \frac{dK_{ND}^*)}{dN} < 0$. Similarly, it can be shown that $\frac{dK_{ED}^*}{d\varepsilon} < \frac{dK_{ND}^*}{d\varepsilon}$, then $\frac{d(K_{ED}^* - K_{ND}^*)}{d\varepsilon} = \frac{dK_{ED}^*}{d\varepsilon} - \frac{dK_{ND}^*)}{d\varepsilon} < 0$.

$$\frac{dK_{i,ED}^*}{dN} = \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6K_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)\right]K_{i,ED}^*}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ED}^*\right)^2 - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$\frac{dK_{ED}^*}{dN} = \frac{8\varepsilon\frac{1}{N^2}K_{ED}^* - 3\frac{1}{N^2}K_{ED}^*(a - c - K_{ED}^*)^2}{8\varepsilon\frac{(N+1)}{N} - 3(a - c - K_{ED}^*)^2 - 3\frac{1}{N}(a - c - K_{ED}^*)^2 + 6\frac{1}{N}K_{ED}^*(a - c - K_{ED}^*)}$$

$$\frac{dK_{i,ED}^*}{d\varepsilon} = \frac{8\left[a - c - (N+1)K_{i,ED}^*\right]}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ED}^*\right)^2 - 3\left(a - c - NK_{i,ED}^*\right)^2 + 6NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$\frac{dK_{ED}^*}{d\varepsilon} = \frac{8\left[a - c - \frac{(N+1)}{N}K_{ED}^*\right]}{8\varepsilon\frac{(N+1)}{N} - 3(a - c - K_{ED}^*)^2 - 3\frac{1}{N}(a - c - K_{ED}^*)^2 + 6\frac{1}{N}K_{ED}^*(a - c - K_{ED}^*)}$$

$$\frac{dK_{i,ND}^*}{dN} = \frac{-\left[8\varepsilon - 3\left(a - c - NK_{i,ED}^*\right)^2 + 2K_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)\right]K_{i,ED}^*}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ED}^*\right)^2 - \left(a - c - NK_{i,ED}^*\right)^2 + 2NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$\frac{dK_{ND}^*}{dN} = \frac{8\varepsilon\frac{1}{N^2}K_{ED}^* - \frac{1}{N^2}K_{ED}^*(a - c - K_{ED}^*)^2}{8\varepsilon\frac{(N+1)}{N} - 3(a - c - K_{ED}^*)^2 - \frac{1}{N}(a - c - K_{ED}^*)^2 + 2\frac{1}{N}K_{ED}^*(a - c - K_{ED}^*)}$$

$$\frac{dK_{i,ND}^*}{d\varepsilon} = \frac{8\left[a - c - (N+1)K_{i,ED}^*\right]}{8\varepsilon(N+1) - 3N\left(a - c - NK_{i,ED}^*\right)^2 - \left(a - c - NK_{i,ED}^*\right)^2 + 2NK_{i,ED}^*\left(a - c - NK_{i,ED}^*\right)}$$

$$\frac{dK_{ND}^*}{d\varepsilon} = \frac{8\left[a - c - \frac{(N+1)}{N}K_{ED}^*\right]}{8\varepsilon\frac{(N+1)}{N} - 3(a - c - K_{ED}^*)^2 - \frac{1}{N}(a - c - K_{ED}^*)^2 + 2\frac{1}{N}K_{ED}^*(a - c - K_{ED}^*)}$$

APPENDIX E

FURTHER EXERCISE: ASSUME E ~ U($\underline{E}$, $\bar{E}$)

Now suppose that E is uniformly distributed over $\left[\underline{E}, \bar{E}\right]$ where $\left(\bar{E} - \underline{E}\right) = \varepsilon > 0$.

ED case:

$$\mathrm{E}\big(\pi_i(K_i)\big) = \left(\frac{E^b(K) - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)\left[\big(a - c - K - K_e(K)\big)K_i\right] + \left(1 - \frac{E^b(K) - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)\left[(a - c - K)K_i\right] \qquad (1')$$

$$= (a - c - K)K_i - \left(\frac{E^b(K) - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)K_e(K)K_i$$

The F.O.C. for $K_{i,ED}$ becomes:

$$(a - c - K - K_i) - \frac{(a - c - K)^3}{8\varepsilon} + \frac{K_i(a - c - K)^2}{8\varepsilon} + \frac{K_i(a - c - K)^2}{4\varepsilon} + \frac{\underline{E}}{\varepsilon}\frac{(a - c - K - K_i)}{2} \equiv 0$$

ND case:

$$\mathrm{E}\left(\pi_i\big(K_i, K_{i,ND}^*\big)\right) = \left(\frac{E^b - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)\left[(a - c - K - K_e)K_i\right] + \left(1 - \frac{E^b - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)\left[(a - c - K)K_i\right] \qquad (3')$$

$$= (a - c - K)K_i - \left(\frac{E^b - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)K_e(K)K_i$$

F.O.C. for $K_{i,ND}$ becomes:

$$(a - c - K - K_i) - \left(\frac{E^b - \underline{E}}{\left(\bar{E} - \underline{E}\right)}\right)\left(\frac{a - c - K - K_i}{2}\right) \equiv 0$$

$$(a - c - K - K_i) - \frac{E^b}{\varepsilon}\left(\frac{a - c - K - K_i}{2}\right) + \frac{\underline{E}}{\varepsilon}\left(\frac{a - c - K - K_i}{2}\right) \equiv 0$$

Substituting $E^b = E^b(K_{ND}^*) = \frac{(a-c-K^*)^2}{4}$ into the F.O.C. equation, we have

$$(a - c - K^* - K_i^*) - \frac{(a - c - K^*)^3}{8\varepsilon} + \frac{K_i^*(a - c - K^*)^2}{8\varepsilon} + \frac{\underline{E}}{\varepsilon}\left(\frac{a - c - K - K_i}{2}\right) \equiv 0$$

APPENDIX F

NUMERICAL EXERCISE

Table 29. Numerical Solutions for the Equilibrium Capacity Investments for a Particular Parameter Space: K_{ED}^*, K_{ND}^*, (K_{ED}^* - K_{ND}^*)

$a - c = 120$												
	$\varepsilon = 30$		$\varepsilon = 150$		$\varepsilon = 300$		$\varepsilon = 600$		$\varepsilon = 900$		$\varepsilon = 1200$	
N	K_{ND}^*	K_{ED}^*	K_{ND}^*	K_{ED}^*	K_{ND}^*	K_{ED}^*	K_{ND}^*	K_{ED}^*	K_{ND}^*	K_{ED}^*	K_{ND}^*	K_{ED}^*
1	60	111,3	60	101,35	60	94	60	86,46	60	81,32	60	77,76
2	80	111,54	80	102,72	80	97	80	91,98	80	89,08	80	87,3
3	90	111,78	90	104,04	90	100	90	96,36	90	94,65	90	93,66
4	96	112,04	96	105,28	96	102	96	99,72	96	98,68	96	98,08
N	$K_{ED}^* - K_{ND}^*$		$K_{ED}^* - K_{ND}^*$		$K_{ED}^* - K_{ND}^*$		$K_{ED}^* - K_{ND}^*$		$K_{ED}^* - K_{ND}^*$		$K_{ED}^* - K_{ND}^*$	
1	51,3		41,35		34		26,46		21,32		17,76	
2	31,54		22,72		17		11,98		9,08		7,3	
3	21,78		14,04		10		6,36		4,65		3,66	
4	16,04		9,28		6		3,72		2,68		2,08	

REFERENCES

Abraham, J. M., Gaynor, M., & Vogt, W. B. (2007). Entry and competition in local hospital markets. *The Journal of Industrial Economics, 55*(2), 265-288.

Adaman, F., Ardıç, O.P., Erus, B., & Tüzemen, D. (2009). Hospital choice: Survey evidence from İstanbul. *Turkish Studies, 10*(3), 443-468.

Akdağ, R. (2011). *TC Sağlık Bakanlığı yataklı sağlık tesisleri planlama rehberi [Ministry of Health of the Republic of Turkey planning guide for inpatient healthcare facilities]*. Ankara, Turkey: General Directorate of Treatment Services.

Akdağ, R. (2012). *Turkey health transformation program assessment report (2003-2011).* Ankara, Turkey: Ministry of Health of the Republic of Turkey.

Akinci, F., Esatoğlu, A. E., Tengilimoglu, D., & Parsons, A. (2004). Hospital choice factors: a case study in Turkey. *Health marketing quarterly, 22*(1), 3–19.

Aksan, H. A. D., Ergin, I., & Ocek, Z. (2010). The change in capacity and service delivery at public and private hospitals in turkey: A closer look at regional differences. *BMC Health Services Research, 10,* 300.

American Hospital Association (AHA). (2019). *AHA Hospital Statistics Annual Survey*. From https://www.aha.org/statistics/2020-01-07-archived-fast-facts-us-hospitals-2019

Atasever, M. (2018). *Şehir hastaneleri araştırması*. SASAM Enstitüsü Sağlık-Sen Yayınları.

Atılgan, E. (2016). The technical efficiency of hospital inpatient care services: an application for Turkish public hospitals. *Business and economics research journal, 7*(2), 203-214.

Atun, R., Aydın, S., Chakraborty, S., Sümer, S., Aran, M., Gürol, I., Nazlıoğlu, S., Ozgülcü, S., Aydoğan, U., Ayar, B., Dilmen, U., & Akdağ, R. (2013). Universal health coverage in Turkey: enhancement of equity. *Lancet (London, England), 382*(9886), 65-99.

Bakan, I., Buyukbese, T., & Ersahan, B. (2014). The impact of total quality service (TQS) on healthcare and patient satisfaction: an empirical study of Turkish private and public hospitals. *The International journal of health planning and management, 29*(3), 292–315.

Balmer, E. R. (2013). *Entry and Competition in Local Newspaper Retail Markets – When Two Are Enough* (Chapter in PhD Thesis), University of Rome I, Rome, Italy.

Barros, P. P., Brouwer, W. B., Thomson, S., & Varkevisser, M. (2016). Competition among health care providers: helpful or harmful? *The European journal of* *health economics: HEPAC: health economics in prevention and care, 17*(3), 229–233.

Bercovich, E., & Javitt, M. C. (2018). Medical Imaging: From Roentgen to the Digital Revolution, and Beyond. *Rambam Maimonides medical journal, 9*(4), e0034.

Bilsel, M., & Davutyan, N. (2014). Hospital efficiency with risk adjusted mortality as undesirable output: the Turkish case. *Annals of Operations Research*, *221*, 73-88.

Bokhari, F. A. S., & Yan, W. (2019). *Product Proliferation as Entry Deterrence: The Case of UK Pharmaceuticals*. Unpublished manuscript. Retrieved from https://www.cresse.info/wp-content/uploads/2020/02/2019_ps8_pa2_Product-proliferation.pdf

Bowblis, J. R., & North, P. (2011). Geographic market definition: The case of Medicare-reimbursed skilled nursing facility care. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing, 48*(2), 138–154.

Boyacı, İ. (2017). *Private hospitals and enhancement of geographic equity in health access: The case of Turkey*. Yale Fox International Fellowship 2017 Policy Brief Series.

Boyacı, İ. (2021). Türkiye sağlık sisteminin dönüşümü (2003-13): Sağlık hizmet bölgeleri planlaması ve şehir hastaneleri. *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi*, *20*(40), 358-376.

Bresnahan, T. F., & Reiss, P. C. (1987). Do entry conditions vary across markets? *Brookings Papers on Economic Activity (Special Issue on Microeconomics), 18*(3), 833-881.

Bresnahan, T. F., & Reiss, P. C. (1990). Entry in monopoly markets. *The Review of Economic Studies*, *57*(4), 531-553.

Bresnahan, T. F., & Reiss, P. C. (1991). Entry and competition in concentrated markets. *Journal of Political Economy, 99*(5), 977-1009.

Can, G., & Işın, F. B. (2018). Which criteria determine the winner for patient? *Journal of Turkish Operations Management, 2*(2), 161-183.

Cetin, A. T., Aksu M., & Ozer, G. (2012). Technology investments, performance and the effects of size and region in Turkish hospitals. *The Service Industries Journal*, *32*(5), 747-771.

Conlin, M., & Kadiyali, V. (2006). Entry-deterring capacity in the Texas lodging industry. *Journal of Economics & Management Strategy, 15*(1), 167-185.

Cooper, Z., Gibbons, S., Jones, S., & McGuire, A. (2011). Does hospital competition save lives? Evidence from the English NHS patient choice reforms. *The Economic Journal (London, England), 121*(554), F228–F260.

Dafny, L.S. (2005). Games hospitals play: Entry deterrence in hospital procedure markets. *Journal of Economics & Management Strategy, 14*(3), 513-542.

Dixit, A. (1979). A model of duopoly suggesting a theory of entry barriers. *The Bell Journal of Economics, 10*(1), 20-32.

Dixit, A. (1980). The role of investment in entry-deterrence. *The Economic Journal, 90*(357), 95-106.

Dranove, D., Gron, A., & Mazzeo, M. J. (2003). Differentiation and competition in HMO markets. *The Journal of Industrial Economics*, *51*(4), 433–454.

Dredge, R. (2009). Hospital global budgeting. In J. N. Langenbrunner, C. Cashin, & S. O'Dougherty (Eds.), *Designing and implementing health care provider payment systems: How-to manuals* (chapter 3, pp. 215-254). Washington, DC: The World Bank.

Docteur, E., & Oxley, H. (2003). *Health-care systems: Lessons from the reform experience.* (OECD Health Working Papers No. 9). Paris: OECD Publishing.

Dündar C. (2017). Health-seeking behavior and medical facility choice in Samsun, Turkey. *Health policy (Amsterdam, Netherlands), 121*(9), 1015–1019.

Ellison, G., & Ellison, S. F. (2011). Strategic entry deterrence and the behavior of pharmaceutical incumbents prior to patent expiration. *American Economic Journal: Microeconomics, 3*(1), 1–36.

Elzinga, K. G., & Hogarty, T. F. (1973). The problem of geographic market delineation in antimerger suits. *The Antitrust Bulletin, 18*(1), 45–81.

Elzinga, K. G., & Hogarty, T. F. (1998). The problem of geographic market delineation in antimerger suits (Reprinted from 18 Antitrust Bulletin 45, 1973). *Journal of Reprints for Antitrust Law and Economics, 28*(1), 203-242.

Ersoy, K., Kavuncubasi, S., Ozcan, Y.A., & Harris II, M. J. (1997). Technical efficiencies of Turkish hospitals: DEA approach. *Journal of Medical Systems, 21*(2), 67–74.

Erus, B., & Hatipoglu, O. (2013). *On the efficiency of public hospitals in Turkey*. Bogazici University Department of Economics Working Papers 2013/08.

European Commission. (2015). *Investigating policy options regarding competition among providers of health care services in EU Member States*. Report of Expert Panel on effective ways of investing in Health (EXPH), Brussels.

Fang, L., & Yang, N. (2020). *Insights about Entry Deterrence Motives from Non-Monotonic Entry Patterns in Retail*. Unpublished manuscript. Retrieved from https://sites.google.com/site/nathanccyang/research-1

Fudenberg, D., & Tirole, J. (1984). The fat-cat effect, the puppy-dog ploy, and the lean and hungry look. *The American Economic Review, 74*(2), 361-366.

Gaynor, M. (2006). What do we know about competition and quality in health care markets? *Foundations and Trends in Microeconomics, 2*(6), 441-508.

Gaynor, M., & Town, R. J. (2011). Competition in health care markets. In M. V. Pauly, T. G. McGuire & P. P. Barros (Eds.), *Handbook of health economics, volume 2* (Chapter 9, pp. 499-637). Elsevier.

Gaynor, M., Ho, K., & Town, R. J. (2015). The industrial organization of health-care markets. *Journal of Economic Literature, 53*(2), 235–284.

Gilbert, R., & Vives, X. (1986). Entry deterrence and the free rider problem. *The Review of Economic Studies, 53*(1), 71–83.

Gresenz, C. R., Rogowski, J., & Escarce, J. J. (2004). Updated variable-radius measures of hospital competition. *Health Services Research, 39*(2), 417–430.

Joumard, I., André, C. & Nicq, C. (2010). *Health care systems: Efficiency and institutions.* (OECD Economics Department Working Papers No. 769). Paris: OECD Publishing.

Insurance Association of Turkey. (2019). *Sektör Raporu*. Retrieved from https://tsb.org.tr/media/attachments/2019_Y%C4%B1l%C4%B1_Sektor_Raporu.pdf

International Health Care System Profiles. (n.d.). Retrieved April 24, 2018, from http://international.commonwealthfund.org/countries/

Kessler, D., & McClellan, M. (2000). Is hospital competition socially wasteful? *The Quarterly Journal of Economics, 115*(2), 577-615.

Kleiner, S. A., Lyons, S., & White, W. (2012). Provider concentration in markets for physician services for patients with traditional Medicare. *Health Management, Policy and Innovation, 1*(1), 3-18.

Küçük, A., Özsoy, V. S., & Balkan, D. (2020). Assessment of technical efficiency of public hospitals in Turkey. *European Journal of Public Health, 30*(2), 230-235.

Langenbrunner, J. C., & Wiley M. M. (2002). Hospital payment mechanisms: Theory and practice in transition countries. In M. McKee & J. Healy (Eds.), *Hospitals in a changing Europe* (chapter 8, pp. 150-176). Buckingham, UK: Open University Press.

Lorenzoni, L., et al. (2019). *Health systems characteristics: A survey of 21 Latin American and Caribbean countries.* (OECD Health Working Papers No. 111). Paris: OECD Publishing.

Mazzeo, M. (2002). Product choice and oligopoly market structure. *RAND Journal of Economics, 33*(2), 221-242.

Ministry of Development of the Republic of Turkey (formerly Stata Planning Organization). (2004). *İlçelerin sosyo-ekonomik gelişmişlik sıralaması* *araştırması (2004)* [Research on socio-economic development index of districts]. Ankara, Turkey: Bülent Dincer, Metin Özaslan.

Ministry of Development of the Republic of Turkey. (2013). *İllerin ve bölgelerin sosyo-ekonomik gelişmişlik sıralaması araştırması (SEGE-2011)* [Research on socio-economic development index of provinces and regions]. Ankara, Turkey.

Ministry of Health of the Republic of Turkey. (2001-2019). *Health statistics yearbook*. Ankara, Turkey.

Ministry of Health of the Republic of Turkey. (2003). *Sağlıkta dönüşüm programı* [Health transformation program]. Ankara, Turkey: Recep Akdağ.

Ministry of Health of the Republic of Turkey. (2009). *Health transformation program in Turkey - Progress report*. Ankara, Turkey: Recep Akdağ.

Ministry of Health of the Republic of Turkey. (2011). *Turkey health transformation program - Assessment report (2003-2011)*. Ankara, Turkey: Recep Akdağ.

Ministry of Health of the Republic of Turkey. (2011). *Sağlık bakanlığı yataklı sağlık tesisleri planlama rehberi* [Inpatient healthcare facilities planning guidebook]. Tedavi Hizmetleri Genel Müdürlüğü, Ankara, Turkey: Recep Akdağ.

Ministry of Health of the Republic of Turkey. (n.d. -a). *Şehir hastaneleri* [City hospitals]. General Directorate of Public Hospitals. Retrieved April 24, 2018, from https://khgm.saglik.gov.tr/DB/37/14688_sehir-hastaneleri-ya.

Ministry of Health of the Republic of Turkey. (n.d. -b). *Sağlık yatırımları* [Health investments]. General Directorate of Health Investments. Retrieved April 24, 2018, from http://www.saglikyatirimlari.gov.tr/.

Ministry of Health of the Republic of Turkey. (n.d. -c). *Sağlık bölge haritaları modülü* [Healthcare region maps module]. Department of Statistics, Analysis, and Reporting. Retrieved April 24, 2018, from http://rapor.saglik.gov.tr/TEKKANAT/saglikbolgeleri.html.

Ministry of Health of the Republic of Turkey. (2017). *Sağlık hizmet bölgesi* [Healthcare service region]. Healthcare Services Planning Agency. Retrieved April 24, 2018, from http://planlamadb.saglik.gov.tr/TR,5708/saglik-hizmet-bolgesi.html.

Mollahaliloglu, S., Kavuncubasi, S., Yılmaz, F., Younis, M.Z., Simsek, F., Kost, M., Yıldırım, S., & Nwagwu, E. (2018). Impact of health sector reforms on hospital productivity in Turkey: Malmquist index approach. *International Journal of Organization Theory and Behavior*, *21*(2), 72-84.

Morrisey, M., Sloan, F., & Valvona, J. (1988). Defining geographic markets for hospital care. *Law and Contemporary Problems*, *51*(2), 165-194.

Organisation for Economic Co-operation and Development (OECD). (2006). *Competition in the provision of hospital services*. (Policy Roundtables 2005). Directorate for Financial and Enterprise Affairs, Competition Committee [DAF/COMP(2006)20]. Paris, France.

Organisation for Economic Co-operation and Development (OECD). (2012). *Competition in hospital services.* (Policy Roundtables 2012). Directorate for Financial and Enterprise Affairs, Competition Committee [DAF/COMP(2012)9]. Paris, France.

Organisation for Economic Co-operation and Development (OECD). (2012). *Market definition.* (Policy Roundtables 2012). Directorate for Financial and Enterprise Affairs, Competition Committee. Paris, France.

Organisation for Economic Co-operation and Development (OECD). (2014). *OECD Reviews of health care quality: Turkey 2014 Raising Standards*. OECD Reviews of Health Care Quality. Paris, France: OECD Publishing.

Organisation for Economic Co-operation and Development (OECD). (2016). *Universal health coverage and health outcomes.* (Final Report 22 July 2016 Paris). Retrieved from https://www.oecd.org/els/health-systems/Universal-Health-Coverage-and-Health-Outcomes-OECD-G7-Health-Ministerial-2016.pdf

Organisation for Economic Co-operation and Development (OECD). *Financing of health care*. In Health at a glance 2017: OECD indicators. Paris, France: OECD Publishing.

Organisation for Economic Co-operation and Development (OECD). (2022). *Private health insurance spending*. (Brief, March 2022). Retrieved from https://www.oecd.org/els/health-systems/private-health-insurance.htm

Organisation for Economic Co-operation and Development (OECD)/The World Bank. (2009). *OECD Reviews of Health Systems: Turkey 2008*. OECD Reviews of Health Systems, Paris, France: OECD Publishing.

Ostensen, H., & World Health Organization (WHO). (2001). *Diagnostic imaging: what is it? When and how to use it where resources are limited?* Geneva, Switzerland: Team Diagnostic Imaging and Laboratory Technology, World Health Organization.

Ozgen, H., Sahin, B., Belli, P., Tatar, M., & Berman, P. (2010). Predictors of informal health payments: the example from Turkey. *Journal of Medical Systems, 34*(3), 387–396.

Özgen Narcı, H., Ozcan, Y. A., Şahin, İ., Tarcan, M., & Narcı, M. (2015). An examination of competition and efficiency for hospital industry in Turkey. *Health Care Management Science, 18*(4), 407–418.

Paköz, M. Z., & Yüzer, M. A. (2014). Access to healthcare: A field survey in Istanbul. *A|Z ITU Journal of the Faculty of Architecture, 11*(2), 271–290.

Paris, V., Devaux, M., & Wei, L. (2010). *Health systems institutional characteristics: A survey of 29 OECD countries.* (OECD Health Working Papers No. 50). Paris, France: OECD Publishing.

Republic of Turkey Official Gazette. (2008). *Özel hastaneler yönetmeliğinde değişiklik yapılmasına dair yönetmelik* [Bylaw on the establishment of private hospitals]. T.C. Resmi Gazete Number: 26788. Retrieved July 10, 2020, from http://www.resmigazete.gov.tr/eskiler/2008/02/20080215-5.htm.

Republic of Turkey Official Gazette. (2009). *Bakanlar kurulu kararı* [Decision of the council of ministers]. T.C. Resmi Gazete Number: 27426. Retrieved July 10, 2020, from http://www.resmigazete.gov.tr/eskiler/2009/12/20091208M1-1.htm.

Republic of Turkey Official Gazette. (2010). *Sosyal Güvenlik Kurumu sağlık uygulama tebliği* [Social Security Institution communiqué on healthcare practices]. T.C. Resmi Gazete Number: 27532. Retrieved July 10, 2020, from http://www.resmigazete.gov.tr/eskiler/2010/03/20100325M1-1.htm.

Republic of Turkey Official Gazette. (2012). *Bakanlar kurulu kararı* [Decision of the council of ministers]. T.C. Resmi Gazete Number: 28236. Retrieved July 10, 2020, from http://www.resmigazete.gov.tr/main.aspx?home=http://www.resmigazete.gov.tr/eskiler/2012/03/20120317.htm&main=http://www.resmigazete.gov.tr/eskiler/2012/03/20120317.htm.

Republic of Turkey Official Gazette. (2013a). *Bakanlar kurulu kararı* [Decision of the council of ministers]. T.C. Resmi Gazete Number: 28793. Retrieved July 10, 2020, from http://www.resmigazete.gov.tr/eskiler/2013/10/20131012-23.htm.

Republic of Turkey Official Gazette. (2013b). *Sağlık bakanlığınca kamu özel iş birliği modeli ile tesis yaptırılması, yenilenmesi ve hizmet alınması ile bazı kanun ve kanun hükmünde kararnamelerde değişiklik yapılması hakkında kanun* [Law on building, renovating, getting service on facilities with the cooperation of public and private organized by Ministry of Health with the addition of changes in some laws and decree laws]. T.C. Resmi Gazete Number: 28582. Retrieved July 10, 2020, from http://www.resmigazete.gov.tr/eskiler/2013/03/20130309-1.htm.

Sagan, A., & Thomson, S. (2016). Voluntary health insurance in Europe: role and regulation. (Observatory Studies Series 43). European Observatory on Health Systems and Policies, Copenhagen, Denmark: World Health Organization.

Sahin, I., & Ozcan, Y. A. (2000). Public sector hospital efficiency for provincial markets in Turkey. *Journal of Medical Systems, 24*(6), 307–320.

Sahin, I., Ozcan, Y.A. & Ozgen, H. (2011). Assessment of hospital efficiency under health transformation program in Turkey. *Central European Journal of Operations Research, 19*, 19–37.

Schaumans, C., & Verboven, F. (2008). Entry and regulation: Evidence from health care professions. *The RAND Journal of Economics, 39*(4), 949-972.

Social Security Institution. (n.d.). *Tamamlayıcı sigorta*. Retrieved April 14, 2022, from http://www.sgk.gov.tr/wps/portal/sgk/tr/saglik/alo170_BimerSSS/saglik_hizmetleri/tamamlayici_sigorta

Social Security Institution. (n.d.). *Universal health insurance*. Retrieved April 14, 2022, from http://www.sgk.gov.tr/wps/portal/sgk/en/detail/universal_health_ins

Spence, A. (1977). Entry, capacity, investment and oligopolistic pricing. *The Bell Journal of Economics, 8*(2), 534-544.

Spence, A. (1979). Investment strategy and growth in a new market. *The Bell Journal of Economics, 10*(1), 1-19.

Sulku S. N. (2012). The health sector reforms and the efficiency of public hospitals in Turkey: Provincial markets. *European Journal of Public Health, 22*(5), 634–638.

Taner, T., & Antony, J. (2006). Comparing public and private hospital care service quality in Turkey. *Leadership in Health Services, 19*(2), 1-10.

Tatar, M., Mollahaliloğlu, S., Şahin, B., Aydın, S., Maresso, A., Hernández-Quevedo, C. (2011). Turkey: Health system review. *Health Systems in Transition, 13*(6), 1–186.

Tay, A. (2003). Assessing competition in hospital care markets: the importance of accounting for quality differentiation. *RAND Journal of Economics, 34*(4), 786–814.

Tengilimoglu, D., Kisa, A., & Dziegielewski, S.F. (1999). Patient satisfaction in Turkey: Differences between public and private hospitals. *Journal of Community Health, 24*(1), 73–91.

Top, M., & Sungur, C. (2019). Opinions and evaluations of stakeholders in the implementation of the public-private partnership (PPP) model in integrated health campuses (city hospitals) in Turkey. *The International Journal of Health Planning and Management, 34*(1), 241-263.

Torun, N., Çelik, Y., & Younis, M. Z. (2013). Competition among Turkish hospitals and its effect on hospital efficiency and service quality. *Journal of Health Care Finance, 40*(2), 42–58.

Yıldız, M.S., Heboyan, V., & Khan, M.M. (2018). Estimating technical efficiency of Turkish hospitals: Implications for hospital reform initiatives. *BMC Health Services Research, 18*(1), 401.

Yıldırım, H.H., Hughes, D., & Yıldırım, T. (2011). Markets, modernisation and national interest: Three faces of patient choice policy in Turkey. *Health & Social Care in the Community, 19*(2), 168-177.

Yıldırım, H. H., & Yıldırım, T. (2011). Healthcare financing reform in Turkey: Context and salient features. *Journal of European Social Policy, 21*(2), 178–193.

Yılmaz, V. (2021). Exploring patient experiences of the internal market for healthcare provision in turkey: Publicness under pressure. *Journal of Social Policy, 50*(3), 588-605.

Waldman, M. (1987). Noncooperative entry deterrence, uncertainty, and the free rider problem. *The Review of Economic Studies, 54*(2), 301–310.

Wolfe, P. R., & Moran, D. W. (1993). Global budgeting in the OECD countries. *Health Care Financing Review, 14*(3), 55–76.

World Health Organization. (n.d.). *Stewardship*. Retrieved April 24, 2018, from http://www.who.int/healthsystems/stewardship/en/.

World Health Organization. (2008a). *Integrated health services - what and why*. (Technical Brief No.1). Retrieved April 24, 2018, from http://www.who.int/healthsystems/technical_brief_final.pdf.

World Health Organization. (2008b). *The world health report 2008 - primary health care (now more than ever)*. Geneva, Switzerland: World Health Organization. Retrieved April 24, 2018, from http://www.who.int/whr/2008/en/

World Health Organization. (2019, January 24). *Universal health coverage (UHC)* [Fact Sheet]. Retrieved from http://www.who.int/en/news-room/fact-sheets/detail/universal-health-coverage-(uhc).

World Health Organization Regional Office for Europe. (n.d.). *About Health 2020*. Retrieved April 24, 2018, from http://www.euro.who.int/en/health-topics/health-policy/health-2020-the-european-policy-for-health-and-well-being/about-health-2020.

World Health Organization. (2012). *Successful health system reforms: The case of Turkey.* Report by WHO Regional Office for Europe, Denmark. Retrieved from https://disab.saglik.gov.tr/Eklenti/2106/0/successful-health-system-reforms-the-case-of-turkeypdf.pdf.

Zoeller, J., A., Muller, J. M., & Janiga, N., J. (2020). *Understanding the value of a Certificate of Need* [Business Valuation]. Retrieved from https://healthcareappraisers.com/understanding-the-value-of-a-certificate-of-need/