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Research Article

Does Public Hospitals Crowd Out Private Hospitals? Evidence from China Province Level Data

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Abstract

Background: China has promulgated a series of policies to promote the development of private hospitals since 2009. However, private hospitals developed only in a growing number but not growing in market share of medical services. This paper aims to investigate whether public hospitals had crowded private hospitals out of healthcare market.

Methods: Using various datasets, this study employed an instrumental variable technique to examine the existence of crowd-out effects in hospital market.

Results: Using instrumental variable technique, more public investment in public hospitals would decrease the volume of inpatient in private hospitals. It indicates that the fast development of public hospitals would crowd private hospitals out of the market, and would limit the expansion of private hospitals, in both developed and under-developed regions.

Conclusion: Chinese public hospitals crowded private hospitals out of inpatient market, and the crowding out effect persisted in all areas with different level of economic development.

Keywords: Private hospitals; Public hospitals; Crowding out; Instrumental variables technique

Introduction

Extensive studies have explored the crowd out effects by public sectors in health insurance [1-6]. Whether crowd-out effects may exist in other health sector, such as hospitals, are still unknown. In most developed countries, private hospitals usually run more efficiently and provide high-quality of care services, compared to public hospitals [7,8]. These differences between public and private hospitals are quite different, though, in developing countries like China, where government-owned healthcare services dominated [9,10]. For several decades, private hospitals in China have limited access to resources, such as lack of tax subsidy, fringe benefits, and public financial support, compared to public hospitals [9,10]. Therefore, private hospitals may lose attraction to quality physicians, nurses and patients [11]. To encourage the development of private hospitals, Chinese government launched the New Medical Reform in 2009 and issued a series of policies, such as the deregulating healthcare market, increasing financial support, strengthening price and tax support, and improving equal benefit in employment [12]. As a result, the total number of private hospitals increased from 30.75% in 2009 to 52.63% in 2015 [13]. However, the relative market shares of private hospitals increased very modestly, from 8.02% of inpatient and 7.69% of outpatient care in 2009, to11.23% of inpatient and 12.01% of outpatient in 2015 [13]. Researchers argued that crowding out effects driven by the public hospitals may be the primary reason for the moderate development in market share of private hospitals in China [14].

However, no existing literature has rigorously examined the crowd out effects in Chinese hospital market. This paper will fill this knowledge gap and aims to examine whether public hospitals would crowd out private hospitals from the market.

Methods

Empirical model

The study starts with a private hospital inpatients model specified in a panel form as follows:

$$y_{i,t} = x_{i,t}\beta + \varepsilon_t, \mathbf{t} = 1 \ldots\ldots \mathbf{T} \quad (1)$$

$$\varepsilon_t = \mu \mathrm{w} + \nu \quad (2)$$

Where *yi,t* is a vector of dependent variables in province i at time t, X is a vector of exogenous variables, including the constant, and β is a vector of coefficients. ε_i is a vector of random errors. Following Baltagi and his colleagues [15], Equation 2 decomposes the error process into a summation of two components: time variant and remainder error process. The error term is spatially correlated with the spatial weights matrix, W, and has spatial autocorrelation parameter μ.

For the purposes of this study, the following model specifications were estimated: 3

$$private\_\mathbf{Hos}_{i,t} = \beta_0 + \beta_1 * public\_\mathbf{Hos}_{i,t} + \gamma X'_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where $\mathrm{private\_Hos}_{i,t}$ is the number of inpatients in private hospitals in province i at year t, and $\mathrm{public\_Hos}_{i,t}$ is the number of public hospital inpatients in province i at time *Xi,t'* indicate control variables (discussed below in Section 3). In this estimation, a negative β_1 indicates that inpatients of private hospital decrease with the increase of public hospital inpatients, namely crowd out effects.

Random effects model was estimated by Generalized Least Squares (GLS) while fixed effects model was estimated by pooled least squares ordinary least squares via GLS (with cross-section weights). Through Hausman test, we chose random effect model for further analysis.

The relationship between inpatients in public hospitals and those in private hospitals may have reciprocal [16]. To address this reverse causality, an Instrumental Variable (IV) technique was applied. One possible IV for the number of inpatients in public hospitals is the medical expenditure by the government because government health expenditure can directly influence the investment in public hospitals

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but may not directly have impact on inpatient in private hospitals [17]. However, government decisions on budgeting medical expenditure may be inter-dependent if provinces in the adjacent areas may compete each other. Furthermore, cyclical economic development may have influence on decision of medical expenditure of each government. This serial correlation may invalidate this instrument variable. To remove this serial correlation, we applied the differences between actual expenditure and national average expenditure by each province as the IV for inpatient in public hospitals [18].

Measures and data sources

Our dependent variable is the number of inpatients in private hospitals ($\text{public\_Hos}_{i,t}$), and the independent variable of interest is the number of inpatients in public hospitals ($\text{public\_Hos}_{i,t}$). The instrumental variable for $\text{public\_Hos}_{i,t}$ was defined as the government additional medical expenditure of each province, i.e., $\text{medicare\_finance}_{i,t} - \frac{population_{i,t}}{population_{nation,t}} * \text{medicare\_finance}_{nation,t}$.

Control variable $(X'_{(i,t)})$ include total population, dependency ratio of population, per capita income and urbanization rate [19], the total number of practicing doctors per thousand population, the registered nurse per thousand population, the population of residents with rural or urban health insurance coverage, and the total expenditure of rural or urban insurance. Dependency ratio of population was defined as the proportion of population older than 65 or younger than 14 years. It was included in the model since people of these age groups have low resistance and is very susceptible to illness [20]. Detailed information is shown in table 1.

Multiple data sets from 2010 to 2015 were applied in this study. Inpatient information ($\text{Private\_Hos}_{i,t}$ and $\text{public\_Hos}_{i,t}$) came from "China Health Statistics Year book" or "China Health and family planning statistical yearbook". As more than 80% of Chinese hospitals have implemented Electronic Medical Record (EMR) or Electronic Information Systems (EIS) since 2012, the information on the number of hospital inpatients is reliable. (Institute of hospital management in Ministry of Health, 2014) Information on registered doctors and nurses came from "China Health Statistics Year book" and "China Health and family planning statistical yearbook". Population and dependency ratio came from "China Population Statistics Yearbook". Income per capital came from "China Statistical Yearbook" and urbanization rate came from "China building industry year-book". In China, there are three basic health insurance, i.e., Urban Residents Medical Insurance, Urban Workers Medical Insurance and New Rural Cooperative Medical Insurance. We merge Urban Residents Medical Insurance and Urban Workers Medical Insurance into city medical insurance, and get coverage and expenditures data of city health insurance and rural insurance from "China Statistical Yearbook". We selected and merged the data from the above year-books and finally got 31 provincial level statistical panel data from 2010-2015.

Results

Trends of private hospitals in China

Summary statistics is shown in Table 2. Figure 1 represents the trends of the development of private hospitals in China. In between 2005-2015, the proportion of the number of private hospitals to the total number of hospitals tripled, from 17% to 52%, while the relative market shares of inpatients in private hospitals only increased from 4% in 2005 to 11% in 2015.

Crowd out effect of public hospital

Table 3 reports the estimated results of the crowding out effect model for inpatients. As the benchmark, column (1) represents the OLS results, where a more inpatients in public hospitals would slightly decrease the inpatient in private hospitals in 2010-2015. Results from the random effect model (Column 2) reported similar trends. As discussed earlier, the OLS model is unable to address reverse causality, these results may be biased. Column (3) reports results using IV estimation. Any 1 million increases in inpatient in public hospitals would decrease 0.644 million inpatients in private hospitals. A joint F-test on the excluded

Variable	Measure	Resource
Dependent variable		
$\text{private\_Hos}_{i,t}$	aggregated data of all private hospitals' inpatients at province i at year t(million)	China Health Statistics Year book
Independent variable		
$\text{public\_Hos}_{i,t}$	aggregated data of all public hospitals' inpatients at province i at year t(million)	China Health Statistics Year book
Instrumental variable		
$\text{medicare\_finance}_{i,t}$	government health expenditure at province i at year t - anticipated government health expenditure at province i at year t(billion ¥)	China Health Statistics Year book
Control variable		
Population	Total Population for each province i in year t(million)	China Population Statistics Yearbook
gdp_per	per capita GDP for each province i in year t (thousand ¥)	China Statistical Yearbook
depend_ratio	proportion of population 65+ or ≤ 14	China Population Statistics Yearbook
city_rate	urban population ratio for each province i	China building industry year-book
doctor_per_thousand	the number of practicing doctors per thousand for each province i	China Health Statistics Year book
nurse_per_thousand	the number of registered nurses per thousand for each province i	China Health Statistics Year book
total_inpatient	Number of inpatients in all medical institutions for each province i	
Number of rural insurance	the number of person who participate in Urban Residents Medical Insurance and Urban Workers Medical Insurance(million)	China Statistical Yearbook
Number of rural insurance	the number of person who participate in Rural cooperative medical insurance (million)	
Pay of city insurance	expenditure of Urban Residents Medical Insurance Fund and Urban Workers Medical Insurance Fund(billion ¥)	
Pay of rural insurance	expenditure of Rural cooperative medical insurance(billion ¥)	

Table 1: Variable Measure and Data Resource.

Variables	Mean (Variation)					
	2010	2011	2012	2013	2014	2015
Dependent variable						
private_Hos$_{i.t}$ (million)	0.258 (0.221)	0.338 (0.293)	0.450 (0.403)	0.546 (0.482)	0.607 (0.542)	0.750 (0.640)
Independent variable						
public_Hos$_{i.t}$ (million)	2.814 (1.790)	3.135 (1.993)	3.655 (2.330)	3.973 (2.491)	4.327 (2.726)	4.426 (2.776)
Control variable						
population(million)	43.027 (27.650)	43.233 (27.686)	43.480 (27.788)	43.715 (27.857)	43.950 (27.978)	44.222 (28.172)
gdp_per (thousand ¥)	33.360 (17.144)	39.442 (18.797)	43.387 (19.739)	47.068 (20.767)	50.739 (22.084)	54.019 (23.048)
city_rate	50.949 (14.717)	52.169 (14.469)	53.429 (14.205)	54.451 (13.941)	55.548 (13.483)	56.644 (12.890)
depend_ratio	34.170 (7.141)	33.875 (6.994)	34.482 (6.883)	34.832 (6.126)	35.446 (6.235)	36.448 (6.063)
doctor_per_thousand	1.592 (0.483)	1.729 (0.491)	1.883 (0.521)	2.069 (0.536)	2.357 (1.081)	2.377 (0.546)
nurse_per_thousand	1.553 (0.439)	1.582 (0.440)	1.646 (.455)	1.741613 (0.443)	1.927 (0.913)	2.248 (0.416)
total_inpatient (million)	4.572 (3.117)	4.935 (3.357)	5.760 (3.933)	6.198 (4.151)	6.588 (4.434)	6.643 (4.7130
Number of rural insurance (million)	139.557 (100.567)	152.807 (125.195)	173.036 (153.108)	184.135 (169.072	192.731 (183.922)	214.779 (227.822)
Pay of city insurance (billion ¥)	11.413 (9.050)	14.295 (11.438)	17.882 (14.220)	20.847 (17.869)	26.237 (21.740)	30.039 (25.102)
Number of rural insurance (million)	278.534 (202.554)	277.211 (202.669)	259.777 (210.583)	258.739 (213.228)	237.508 (209.424)	279.279 (196.298)
Pay of rural insurance (billion ¥)	4.361 (2.996)	6.825 (4.851)	8.015 (6.265)	9.382 (7.321)	9.296 (7.823)	13.694 (9.347)

Table 2: Summary Statistics of the Variables.

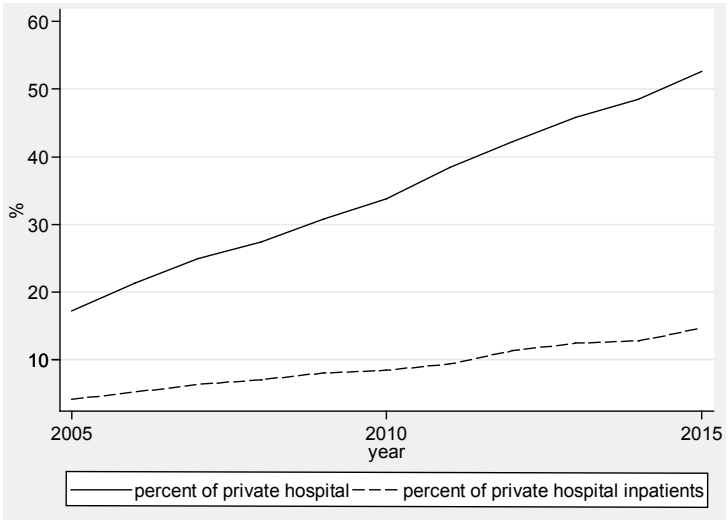

Figure 1: Trends of Private Hospitals Number and Private Hospitals' Inpatients.

instruments in the first stage regressions is 789.13, indicating our IV is valid.

There are substantial geographic variations in healthcare market in China [11]. Hence, the crowding-out effect of public hospitals on private hospitals may vary across regions. Following Yong-song, we created a dichotomous variable, 1 indicating developed regions (i.e., Beijing, Shanghai, Tianjin, Jiangsu, Zhejiang, Shandong, Guangdong, Liaoning, Fujian), and 0 for underdeveloped regions (the remaining 22 provinces) [21]. An interaction term of regional economic development level and public hospital inpatients was included in the model and results were shown in Column (4) of Table 3. The estimated effect of the interaction term is statistically insignificant, meaning that the crowd-out effects are consistent across regions with different economic development. In other words, public hospitals will limit the expansion of inpatient market for private hospitals, in both developed and under-developed regions.

	(1)	(2)	(3)		(4)
	OLS	RE	IV+RE		IV+RE
			STEP1	STEP2	
public_Hos$_{i,t}$	-0.295***	-0.067		-0.644**	-0.306**
	[0.000]	[0.250]		[0.014]	[0.010]
public_Hos$_{i,t}$*development					0.026
					[0.267]
medical_finance			-0.003***		
			[0.002]		
population	0.015***	-0.086**	0.044***	0.030**	0.012*
	[0.005]	[0.028]	[0.000]	[0.024]	[0.085]
Depend_ratio_survey	-0.008	-0.009	-0.017***	-0.011	-0.020***
	[0.212]	[0.231]	[0.031]	[0.142]	[0.010]
gdp_per	0.005*	0.003	0.014	0.009**	0.003
	[0.054]	[0.287]	[0.000]	[0.035]	[0.274]
city_rate	-0.012***	-0.004	-0.022	-0.018**	-0.015**
	[0.001]	[0.691]	[0.000]	[0.018]	[0.021]
nurse	0.019	-0.111	0.472***	0.136	0.061
	[0.761]	[0.166]	[0.000]	[0.317]	[0.553]
doctor_hos	-0.041	0.195**	-0.438***	-0.109	0.044
	[0.658]	[0.030]	[0.000]	[0.449]	[0.650]
total_inpatient	0.159***	0.131***	0.276***	0.284***	0.215***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of city insurance	-0.000	-0.000	0.000	-0.000	-0.000
	[0.720]	[0.887]	[0.603]	[0.910]	[0.119]
Number of rural insurance	-0.002***	-0.002***	-0.003***	-0.003***	-0.002***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]
Pay of city insurance	0.006	0.001	0.004	0.004*	0.001
	[0.194]	[0.461]	[0.104]	[0.063]	[0.292]
Pay of rural insurance	0.061***	0.039***	0.080***	0.085***	0.055***
	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]
_cons	0.687*	4.101**	1.311***	0.927*	1.187**
	[0.052]	[0.019]	[0.006]	[0.065]	[0.014]
N	177	177	177	177	177
adj. R^2	0.741	0.761	-----	------	-----

p-values in brackets; * $p< 0.1$, ** $p< 0.05$, *** $p< 0.01$

Table 3: Regression Result for Inpatients of Private Hospital.

Discussion

Using data at the province level, this study investigated whether the fast-growing public hospitals crowded out private hospitals in China. Our findings supported this hypothesis, representing that the crowding out effect of public hospital may be a pervasive reason for slow development of private hospital. Furthermore, these crowding out effects persist in all areas with different level of economic development.

To our best knowledge, this study is the first one that rigorously examined the crowd-out effects in hospital care market. How patients choose between public or private hospitals may explain this crowd-out effect. In general, three factors will affect patients' decision to choose public hospitals or private hospitals: care quality, price, and waiting time [22]. First, the quality of care in Chinese private hospitals is generally lower than that provided by public hospitals. This phenomenon is primarily driven by variations in the different ability of obtaining advanced medical equipment, and different attraction to quality health care professionals [9]. Public hospitals are managed by government and military establishments, and funded through public funds and concessional loans through which they have lower cost of investing in medical equipment [9,11]. In addition, the presidents of public hospital are a political position -- assigned by the local government according their performance, primarily dependent on the growth of hospital (e.g., the number of beds). Therefore, these presidents are inclined to invest in high-tech diagnosis and treatment equipment, and upgrade medical environment in order to be attractive to patients and enhance hospital competitiveness and growth. Moreover, health care professionals in public hospitals, including physicians, surgeons, medical therapists, nurses and pharmacists, receive unique benefit packages despite the factor their salary is lower than their peers working in private hospitals. These professionals are government-affiliated employees, who have priorities in funding opportunities, career development, bonus, and academic research [10,11,14]. These benefits add substantially to the monetary salary for health professionals in public hospitals, and cause private hospitals to lose attraction to high-quality candidates.

Second, the prices of medical services from the public hospitals are lower than in private hospitals because public hospitals receive subsidies and preferential tax [23,24]. Public hospitals also have advantages in the medical insurance compensation, including claiming higher reimbursement rate for patients who receive care in the public hospitals. Overall, the out-of-pocket payment for patients is lower in public hospitals than in private hospitals.

Third, patients in public hospitals do not have very long waiting time to receive care, compared to those in private hospitals. In developed countries like the United States, patients (excluding patients

in emergency room or need urgent care) usually make an appointment with their doctors and may wait for a few days or several months before getting treated. In China, most patients register in hospitals and wait for a few hours to receive treatment in the same day. Furthermore, to increase patients' satisfaction in public hospitals, Chinese government enacted a series of programs to shorten the waiting time [25,26]. Among the best of Chinese tertiary hospitals, the average waiting time of registration is 32 minutes, and the average waiting time to see the doctor is 45 minutes as of 2010 [21,26].

Overall, in the current health care system in China, public hospitals provide higher quality care with lower care prices, and waiting time is not too long. With the continuous development of public hospitals, private hospitals may be crowded out of the hospital market.

Our results have important implications for future policy. In China, public hospitals have strong competitive advantage over private hospitals and dominated in the health care market for decades. In 2009, Chinese government issued a series of policies to promote private hospitals, although number of private hospitals increased rapidly, but only very modest increase of market shares of private hospitals has been found. These results indicated that the key reason of the limited development of private hospitals may be that they may be crowded out of the market by their competitor – public hospitals.

This study has the following the limitation. First, only the aggregated data at the province level are available. Hence, we were unable to model the patients' choice between private and public hospitals. Second, only five years of panel data were available in this study, which prevented us from examining long-term impact of development of public hospitals on private hospitals. In addition, further study should focus on examining the mechanisms at the patient's level.

Conclusion

This study examined the fast growing public hospitals crowded private hospitals out of medical care market in China. Future policies and interventions should address this issue in order to encourage further development and competition among hospitals.

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