Organizational form and economic efficiency: evidence from U.S. hospitals

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Abstract

This paper investigates the behavior and performance of not-for-profit hospitals, in comparison with for-profit hospitals. The conventional economics theory predicts economic efficiency benefits from for-profit ownership type. However, a broad review of hospital performance in the prior literature provides empirical evidence that is predominantly favoring non-for-profit hospitals. This paper reconciles this performance paradox by setting up a rigorous theoretical model to illustrate the effect of organizational forms on hospital performance, leading to the conclusion that not-for-profit hospitals are generally more efficient than for-profit hospitals. From the theoretical work we develop the hypotheses for empirical testing. Using short-term, general acute care hospital data from State of Californian, we conduct an in-depth empirical analysis. Our results support our model prediction that not-for-profit hospitals are more economically efficient

1 Introduction

Faced with increasingly competitive market environment, non-for-profit (NP) hospitals remain dominant in U.S. healthcare industry. In theory, for-profit firms are more cost efficient and productive relative to nonprofit firms because of the profit-maximizing objective and market-generated incentives (Cutler and Horwitz, 2000). However, studies focusing on relative performance between NP and for-profit (FP) hospitals offer contradicting empirical evidence (Schlesinger and Gray 2006). For instance, Rosenau (2003) reviewed 149 empirical, peer-reviewed journal articles from 1980-2002 and found that about 60 percent of studies reported NP hospitals performed better than FP hospitals in all performance categories, including profit, cost, access and quality.

Prior studies have not offered convincing theoretical explanations for superior performance of NP hospitals over FP hospitals. For example, Newhouse's (1970) model suggests that NP hospitals tend to have a higher average cost and higher staffing ratio than FP hospitals but his model does not consider entry and exit in the industry. Dranove and Satterthwaite (2000) characterize the hospital market as monopolistic competitive and discuss peculiar demand functions without setting up a formal mathematical set for the model. Gaynor and Vogt (2003) study a structural model of competition in short-run, with differential products for a fixed amount of competing hospitals in the market, and find that nonprofit hospitals set lower prices but have higher markups.

This paper investigates the behavior and performance of NP hospitals and explains why NP hospitals can be more economically efficient. In line with the early work in Chang (2013), we set up a theoretical model in a rigorous mathematical format, considering a monopolistic competitive environment with differential preferences of patients. The model demonstrates NP hospitals, in a free market environment, can provide more patient services at lower prices than that of FP hospitals, resulting in maximizing economic welfare and operating at economies of scale. We then conduct empirical tests on the hypotheses derived from the model. The results support the prediction of the model.

The following section develops the model. Section 3 describes methodology for empirical testing. Section 4 presents the results and discussion. Section 5 concludes with limitation and future research directions.

2 The economic model

The health economics literature suggests that the hospital market displays some characteristics of monopolistic competition as hospitals can set price by differentiating their services based on multiple dimensions such as location, services, quality and technologies (Dranove and Satterthwaite, 2000; Gaynor and Vogt, 2003). Under the assumption of monopolistic competition, hospitals provide similar but *differentiable* services and, by economic theory, an individual hospital faces a downward sloping demand curve.

We focus on two important objectives of NP hospitals: quantitative and financial objectives, despite of multiple objectives for nonprofit organizations (Newhouse, 1970). We assume that FP hospitals maximize profit while NP hospitals maximize quantity of patient services subject to a break-even budget constraint. A hospital can enter or exit the industry without any apparent restriction. On the demand side, patients have differential preferences, which lead to two basic groups: price-insensitive and price-sensitive. It is widely recognized that a patient's income level and health insurance plan can affect his or her sensitivity toward the price of medical care service. A price-insensitive patient may be a high income earner or has comprehensive insurance coverage; he is more concerned with who provides the service and the quality of medical care than the price of services, suggesting that his price elasticity of demand ε is lower. The price-demand relationship for a price-insensitive individual patient is set up for simplicity as:

(1) $p = a - bq$

where p is the price, q is the quantity demanded for medical care services by an individual price-insensitive patient, a and b are positive constants. The intercept a represents the "reservation" price, that is, the maximum price a patient is willing to pay for the first unit of the service. The slope b is associated with the price elasticity of demand $\varepsilon = (\frac{1}{b})(\frac{p}{q})$. A price-insensitive patient is characterized to have a higher reservation price a and a greater b, thus lower price elasticity of demand at any given price/quantity ratio.

In contrast, a price-sensitive patient is more likely to be a low-income earner and one who pays high out-of-pocket expenses due to limited or no health insurance coverage, and therefore, is more responsive to reduction in price than who provides the service. The price-demand relationship for a price-sensitive individual patient is set up for simplicity as: $p = \alpha - \beta q$. The corresponding demand curve D of a price-sensitive patient is flatter than that of a price-insensitive patient because a price-sensitive patient has a lower reservation price ($\alpha < a$) and greater price elasticity of demand, which results from $\beta < b$. The elastic demand curve D of a price-sensitive patient suggests that he/she is more willing to switch health care providers whenever there is a drop in the price of medical care services.

2.1 FP hospitals

The objective of an FP hospital is:

(2) $max_{q_{FP}} \pi_{FP} = p_{FP}(q_{FP}, \Omega_{FP})q_{FP} - c(q_{FP})$

where π_{FP} , $p_{FP}(q_{FP}, \Omega_{FP})$, and q_{FP} denote the profit, the price charged and the quantity provided by a representative FP hospital, respectively, and $c(q_{FP})$ is a cost function. The hospital faces a downward sloping inverse demand function $p_{FP}(q_{FP}, \Omega_{FP})$, where Ω_{FP} denotes a vector of other factors that would shift the demand curve, such as competitors' price and services offered. For simplicity of discussion, assume Ω_{FP} is held constant (thus omitted in the demand equation).

Because of the profit-maximizing objective, FP hospitals target the price-insensitive patients (Horwitz 2005) and this finally lead to their market for price-insensitive patents (see the theoretical discussion in Chang 2013). Let the number of price-insensitive patients be n. The aggregate demand for medical care in this market then equals nq. Assume that there are m FP hospitals in the market; each hospital is assumed to be identical with equal share of the market. Then, a representative FP hospital would have the market share of

(3) $q_{FP} = \frac{n}{m}q = \frac{n}{m}\left(\frac{a}{b} - \frac{p}{b}\right) = \frac{n}{mb}(a - p)$

The corresponding price the hospital can charge is therefore:

(4) $p_{FP} = a - \frac{mb}{n}q_{FP}$.

Assume technology is equally available for all hospitals in the market, so each hospital has the same quadratic cost function $c(q_{FP})$ defined as follows:

(5) $c(q_{FP}) = F + q_{FP}^2,$

where F is the fixed cost or sunk cost of the FP hospital. Without any loss of generality, the unit of quantity q_{FP} is normalized to secure $w = 1$ in the more general form $c(q_{FP}) = F + wq_{FP}^2$. The minimum ATC, that is, the economies of scale, can be derived from $\frac{\partial ATC}{\partial q_{FP}} = -Fq_{FP}^{-2} + 1 = 0$, so the quantity provided at the economy of scale is $q_{FP} = \sqrt{F}$, and the monetary value of minimum ATC is

(6) $\frac{c(\sqrt{F})}{\sqrt{F}} = 2\sqrt{F}$.

Notice that for the hospital to have a positive output, the patient's reservation price must be greater than the minimum ATC value, that is,

(7) $a > 2\sqrt{F}.$

This condition is very important in the following analysis and mathematical proofs. Solving for the optimal output and price in the short-run, one obtains:

(8) $q_{FP}^* = \frac{an}{2(mb+n)}$

(9) $p_{FP}^* = a - \frac{mb}{n} q_{FP}^* = a - \frac{mb}{n} \cdot \frac{an}{2(mb+n)} = \frac{a(mb+2n)}{2(mb+n)},$

Because of free entry and exit, in the long run, hospitals are earning zero economic profit because of competition. Therefore,

(10) $p_{FP}q_{FP} = c(q_{FP}) = F + q_{FP}^2.$

In the long run equilibrium, how many FP hospitals would remain in the market? Chang (2013) shows:

(11) $m^{**} = \frac{n}{b}(\frac{a^2}{4F} - 1),$

where superscript "**" refers to the long-run equilibrium value. The output of each hospital is:

(12) $q_{FP}^{**} = \frac{an}{2(m^{**}b+n)} = \frac{an}{2[\frac{n}{b}(\frac{a^2}{4F}-1)b+n]} = \frac{2F}{a}.$

The long run equilibrium price is,

(13) $p_{FP}^{**} = a - \frac{mb}{n} q_{FP}^{**} = a - \frac{n}{b}\left(\frac{a^2}{4F} - 1\right)\frac{b}{n} \cdot \frac{2F}{a} = \frac{a}{2} + \frac{2F}{a}$.

The price markup of an FP hospital is:

(14) $p_{FP}^{**} - \left(\frac{\partial c}{\partial q_{FP}}\bigg| q_{FP}{}^{**}\right) = \frac{a}{2} + \frac{2F}{a} - \frac{4F}{a} = \frac{a}{2} - \frac{2F}{a} = a(\frac{1}{2} - \frac{2F}{a^2}) > 0$

FP produces less than the economies of scale output $q_{FP} = \sqrt{F}$ thus having excess capacity:

(15) $q_{FP}^{**} - \sqrt{F} = \frac{2F}{a} - \sqrt{F} = \frac{\sqrt{F}}{a}(2\sqrt{F} - a) < 0$

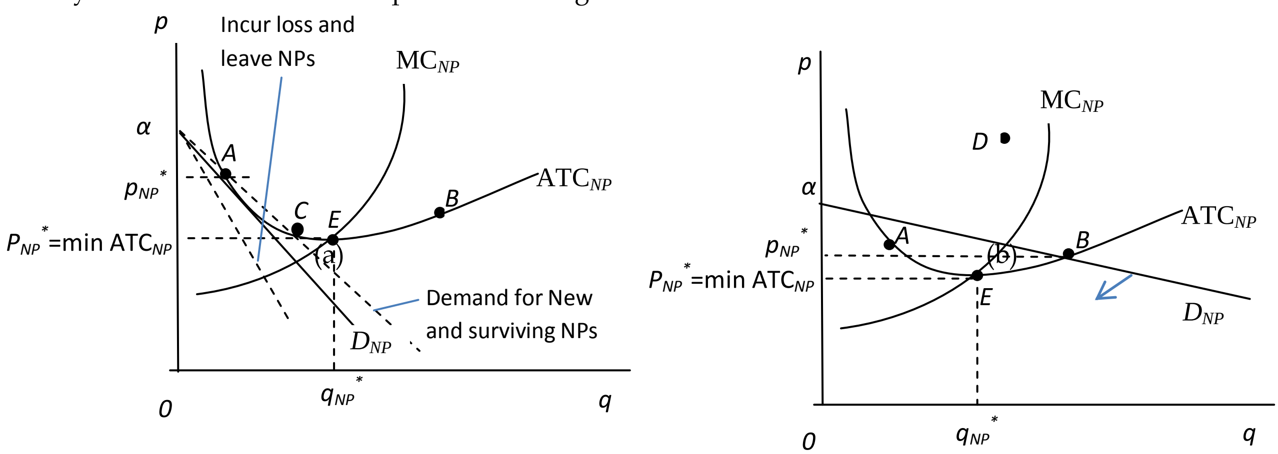
The inefficiency of an FP hospital, as a monopolistically competitive firm, includes deadweight loss and price markup, as discussed in standard economics.

2.2 NP hospitals

The interest of current study is the performance of NP hospitals, in comparison with FP hospitals. Prior literature suggests that an NP hospital generally has multiple objectives. For example, NP hospitals focus on maximizing quantity and/or prestige instead of or in addition to maximizing profit (Newhouse, 1970), fulfilling demand for public goods (Weisbrod, 1988) and meeting unmet local needs (Frank and Salkever, 1991). Although NP hospitals may seek other objectives such as altruism or prestige, quantity and financial solvency are two of the most important. Therefore, let us assume the objective of an NP hospital is to maximize quantity of patient services, subject to the constraint that total revenue is equal to or greater than total cost:

(16) $max_{q_{NP}}\, q_{NP} \qquad \text{s.t.}\ \ p_{NP}(q_{NP}, \Omega_{NP}) \cdot q_{NP} \geq c(q_{NP})$

where q_{NP} is the quantity provided and p_{NP} is the price charged by a representative NP hospital. Ω_{NP} denotes a vector of other factors that would shift the demand curve, such as competitors' price and services offered. Again, I assume other factors Ω_{NP} remain constant to simplify the following discussion. Mathematically, it is to solve for the intersections of the demand function and the average cost function, then to choose the maximum of the quantity solutions. What is important in our model is that there is free entry and exit for other NP hospitals in the long run.



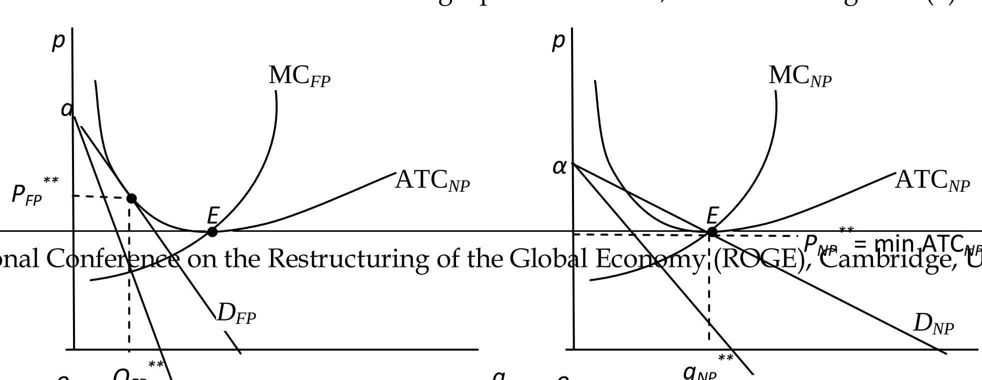
(a) (b)

Figure 1. The behavior of an NP hospital in the short run

Figure 1 illustrates competitive behaviors of an NP hospital. Point *E* is the economies of scale point where MC$_{NP}$ intersects the minimum of ATC (p^*_{NP}), a basic property indicated in economics. In the short run, the quantity serviced by an NP firm depends on the property of its demand curve: it could be smaller than point *E*, as point *A* or *C* in panel (a), or greater than point *E*, as point *B* in panel (b). Any of them might be the optimal solution, depending on the position of the demand curve. Assume NP hospitals target price-sensitive patients and face their demand curves.

Suppose an NP hospital is initially facing the demand curve D_{NP} and operating at point *A* in Figure 1(a). This is the optimal solution for this NP hospital: maximizing the output subject to the break-even constraint. But the hospital faces competition from potential entrants into the market. The neighboring points along the ATC curve to the right of *A* represent more output while satisfying the break-even constraint, say, point *C*. This presents an incentive for other NP hospitals (new or incumbent) to offer at *C*, a lower price for the service, thus taking some price-sensitive patients away from this hospital. When fewer patients are loyal to the hospital, the hospital's demand curve shifts to the left. As a result, demand curve D_{NP} no longer touches the ATC curve. The hospital thus incurs loss, and eventually would be forced to exit the market either by closure or by merging with another hospital, which reduces the number of the hospitals in market *M*. As this hospital leaves the market, the demand curve for a surviving hospital would shift to right and continue, as long as there is a point on the ATC curve to the right that can offer lower price and larger quantity. This process continuous until the point *E* is reached, at which the price is the lowest while still satisfy the break-even constraint.

Similarly, if an NP hospital is initially at point *B* in Figure 1(b), with corresponding price sets above the minimum ATC_{NP}. There is an incentive for new NP hospitals entering the market by offering a lower price, say at point *D*, and attract price-sensitive patients away from the hospital. As the number of NP hospitals in the market *M* increases, the demand curve for an individual NP hospital would shift to the left. This process would continue until point *E* at which the price cannot be further reduced without incurring loss. The market thus reaches the long equilibrium state, as shown in Figure 2 (b).



(a) For-profit hospitals (b) Non-profit hospitals

Figure 2. Comparison of FP and NP hospitals in the long run

In summary, because the market has free entry and exit, the demand curve for a typical NP hospital, regardless what its initial position is, would shift towards the position in which it intersects with the economies of scale point E in the long run equilibrium. Noticed that an NP hospital is operating at the point where MC is greater than MR. This may be said to be "inefficient" from the accounting perspective because the hospital is operating at a point where cost is greater than revenue from the last marginal consumer (i.e., MC is greater than MR at E). However, it is considered to be "efficient" from the viewpoint of the society. In other words, the economic welfare, measured by total consumer and producer surpluses, is maximized in the long run equilibrium because this is where MC intersects the demand curve (representing the marginal utility). The above discussion leads to the following conclusion:

For quantity-maximizing NP hospitals in a free entry and exit market, the long run equilibrium state implies the following efficiencies: (1) the NP hospital operates at the economies of scale, and, passes all savings to the patients; and (2) the quantity produced is where the demand curve intersects the marginal cost, meaning that it maximizes the economic welfare defined as the sum of consumer surplus and producer surplus.

Figure 2(b) graphically illustrates the behavior of NP hospitals in the long run. Here is the mathematical proof. For comparison purpose, assumed that the technology is equally available to both FP and NP hospitals; in other words, they have the same cost function $c(q_{FP}) = F + q_{FP}^2$. Therefore, the quantity provided and price charged at the economies of scale (i.e. in the long run equilibrium state) for an NP hospital are $q_{NP}^{**} = \sqrt{F}$ and $p_{NP}^{**} = 2\sqrt{F}$ respectively.

Comparing NP hospitals to the FP hospitals, an NP hospital provides more service (note the condition $a > 2\sqrt{F}$ in Equation 7).

(17) $$q_{NP}^{**} - q_{FP}^{**} = \sqrt{F} - \frac{2F}{a} > 0,$$

and charges lower price

(18) $$p_{NP}^{**} - p_{FP}^{**} = 2\sqrt{F} - \left(\frac{a}{2} + \frac{2F}{a}\right) = \frac{1}{2a}\left(4a\sqrt{F} - a^2 - 4F\right)$$
$$< \frac{1}{2a}\left[4\left(2\sqrt{F}\right)\sqrt{F} - \left(2\sqrt{F}\right)^2 - 4F\right] = \frac{1}{2a}[8F - 4F - 4F] = 0$$

From the above model we propose the following hypotheses:

H1: *NPs price lower for a comparable service than that of FPs.*

H2: *NPs have higher capacity utilization and lower average fixed cost than that of FPs.*

H3: *Given the same level of investment and capacity, NPs provide more quantity of patient service than that of FPs.*

3 Research Method

3.1 Data

We use a panel data set from California short-term general, acute care hospitals with various ownership types. The data sample excludes (1) hospitals belonged to Kaiser Permanente, an integrated HMO system that admits only patients with Kaiser-run insurance plans and does not report financial data; (2) federal government hospitals; (3) long-term care facilities and specialized care due to the consideration of different production functions, patient mixes, and reimbursement systems; and (4) hospitals with missing data. The final sample consists of 348 hospitals and 2801 hospital years for the period of 2002-2010.

3.2 Dependent variables

The first hypothesis states that NP hospitals are likely to provide comparable services at lower price than that of FP hospitals. Net revenue per adjusted patient day (*NRevPD*) is used to proxy for average price of hospital services, taking into account of both pricing strategy and bad debt collection efforts due to ownership difference. Following prior literature, *NRevPD* is measured as total patient revenues minus deductions and adjustments divided by equivalent patient days, where equivalent patient days include both inpatient days and outpatient visits adjusted by case-mix index.

The second hypothesis suggests that NP hospitals generally have lower average operating cost when compared to FP hospitals. We use clinical expenses (*ExpPD*), measured as average total operating cost of patient care scaled by adjusted patient day, as a proxy for average cost of patient service. The third hypothesis predicts that NP hospitals provide more patient services than FP hospitals given the same level of investment and capacity. Case-mix adjusted admission (*CMAAdm*) is used as a proxy for service volume, measured as total discharges multiply by case-mix indices.

3.3 Independent variables

The main variables of interest are private not-for-profit (*NP*) and government (*Government*) hospitals in order to investigate the effect of ownership form on hospital behavior and performance. *NP* is a binary indicator variable that takes value of 1 for private not-for-profit hospitals and 0 otherwise. *Government* is a binary indicator variable that takes value of 1 for government hospitals and 0 otherwise. For-profit hospital group, serving as the reference group in both ownership data series, is the omitted group in the regressions. Therefore, the coefficients on the ownership dummies reflect their sensitivity to performance relative to for-profit hospitals.

We expect to observe a negative relation between ownership dummy variables and two performance measures (*NrevPD* and *ExpPD*) because both private and public NP hospitals are hypothesized, on average, to have low operating cost and provide comparable services at a lower price than that of FP hospitals. However, the relation between ownership dummies and quantity output (*CMAAdm*) is expected to be positive as NP hospitals tend to provide more patient care services than FP hospitals because of their quantity-maximizing motive.

3.4 Control variables

The structural, operational, and market factors are used to control their effects on hospital performance. The structural control includes firm size (*Size*), system membership (*System*) and teaching orientation (*Teach*). *Size*, measured by natural logarithm of average total assets, is used to control economies of scale of hospital operation. Based on a Cobb-Douglus production function, Yatchak (2000) finds that long run average costs per bed are lower for larger hospitals than for smaller hospitals due to economies of scale. Firm size affects organization behaviors and performance among organizations (French, 1996). *System* is a binary variable indicating whether a hospital belonged to a large healthcare network or system. System membership reflects the strategic flexibility of hospitals in response to demand variations in the market. Teaching hospitals are defined as hospitals that have approved residency programs. *Teach* is a binary variable that takes value of 1 for teaching hospitals to control for market power because these hospitals have the ability to offer advanced and more sophisticated or specialized services (Chang et al. 2004).

Operational factors include patient mix (*PatientMix*), case severity (*CMI* and *ALOS*), occupancy rate (*OR*), and charity ratio (*Charity*). *PatientMix*, measured as the fraction of total patient days that are from Medicare and Medicaid patients, is used to control for the mix of patient pools. The reimbursement scheme for inpatient services under Medicare and MediCal programs is a flat-fee based system (e.g. Diagnosis Related Group, DRG), regardless the actual cost of patient care services. Hospitals with a large percentage of patients from these programs would have stronger incentives to stay profitable; however, such patient mix would negatively affect hospital revenues and costs. Case severity includes case-mix index (*CMI*) and average length of stay (*ALOS*). *CMI*, measured as the sum of Medicare Severity DRG (MS-DRG) weights divided by discharges, is a relative measure of the intensity of hospital services based on the acuity of patients treated. A hospital with higher case mix indices treats more complicated patients than does a hospital with low case mix indices. *ALOS*, measured as inpatient days divided by discharges, is an efficiency measure that reflects the ability of hospitals to control costs of operation (Evans III et al.

2001). *OR*, measured as the percentage of the available capacity, reflects capacity utilization in an inpatient setting. *Charity* (the sum of bad debts and charity care, scaled by gross patient revenue) reflects the usage of hospitals resources in activities that do not generate profits. Both *OR* and *Charity* affects hospital resource utilization.

We use *Competition*, measured by 1 minus Herfindahl Hirschman Index (*HHI*), to control the intensity of market competition in the area where hospitals operate (Martin 1993). The market for each hospital is first identified as the Hospital Referral Regions (HRRs). Following prior literature (Robinson, 2011), we construct *HHI* as follows: (1) calculate market shares for the hospital and its competitors by dividing the number of staffed beds for each hospital by the total number of beds within the market; (2) define as a major competitor for any other hospital that captures at least 10% of the market share; and (3) compute the index as the sum of squared market shares including the hospital and its major competitors only. The *HHI* index is also system adjusted. It is unlikely hospitals belonged to the same healthcare system in the same market would compete with each other, therefore, we treat hospitals owned by the same healthcare system in the same market as part of one organization in calculating market shares and *HHI* (Robinson, 2011). Because the *HHI* is a market concentration index, we subtract it from 1 to derive the competition measure to be used in the analysis, where a resulting negative coefficient on competition means more intense competition.

Hospital location (*Urban*) and median household income (*Income*) of the community are used to control hospital operating environment. *Urban* is a binary variable that takes the value of 1 for hospitals locate in the urban areas and 0 otherwise. Prior studies suggest that size and factor price variations among hospitals bear direct relationship with hospital location (Vitaliano, 1987). In general, urban hospitals are large in size and have relatively high fixed cost structure compared to rural hospitals. Urban hospitals are more expensive than rural ones (Rosko 1996), and those with a high fixed cost structure contribute negatively to hospital performance (Liu et al. 2012). Economic theory suggests that the demand for healthcare is income elastic, that is, higher income would normally trigger more demand for medical services and elective procedures. Therefore, median household income (*Income*) by zip code is used to control the effect of income level on hospital performance.

3.5 Empirical model

To empirically test the hypothesized relationship between ownership type and hospital performance, the following equation is examined using a linear regression model:

$$Performance = a + \beta_1\,(NP) + \beta_2\,(Government) + \beta_3\,(Controls) + \xi$$

where *Performance* consists of three performance variables, average service price (*NRevPD*), average operating cost (*ExpPD*), and service volume (*CMAAdm*) to separately test hypotheses developed in Section 2. Independent variables *NP* and *Government* are binary variables for private and public NP hospitals, respectively, while FP hospital type is an omitted variable serving as a reference group in the regression analysis. The remaining covariates (*Controls*) are designed to control structural, operational, and market factors that might have affected hospital performance (see section 3 for discussion and Appendix for variable definitions).

4 Results and discussion

Table 1 reports the OLS regression results examining the association between ownership type and hospital performance. The overall model fits nicely evidenced by adjusted *R*-square of 56% or above for all models tested. When *NRevPD* is used for proxy of average price, the hypothesis that predicts NP hospitals offer their services at lower prices when compared to FP hospitals is strongly supported, evidenced by negative and strongly significant coefficients on *NP* and *Government*, respectively.

Interestingly, when *ExpPD* is used as a proxy for average operating cost, both coefficients on ownership variables remain negative; however, the significance is lost for government hospitals. In other words, government hospitals are inclined to incur lower operating expense per patient day than that of FP hospitals; however, such association is not statistically significant. Hence, the second hypothesis is partially supported. It is possible that a large proportion of district hospitals included in our government hospital sample may explain such insignificance. District hospitals have publically elected boards with all meetings open to public. Moreover, a very small fraction of total revenue of district hospitals is from tax support; therefore, these hospitals may have same incentive as FP hospitals to control operating cost.

We used CMA adjusted admission as a proxy for service volume and test the ownership effect on hospital output. The coefficients on *NP* and *Government* are both positive and significant at 1% level, suggesting that both private and public NP hospitals provide more quantity of patient services than FP hospitals. Hence, the third hypothesis is strongly supported.

In general, the results behave as expected for structural, operational and market environment controls. For example, size appears to positively affect hospital performance. Compared to small hospitals, large hospitals generate more revenue per patient day and provide higher volume of patient services while operating at a higher cost. Large proportion of Medicare and MediCal patients or longer hospital stay lead to lower performance for all models tested. Finally, more intense competition within the same market appears to increase service volume while driving down both average price and cost of patient services.

5 Limitation and direction for further research

Our theoretical and empirical works demonstrate that both private and public NP hospitals perform better, and, are economically more efficient than FP hospitals. Such finding contradicts the conventional wisdom in economics theory, but consistent with empirical studies (Rosenau, 2003). Therefore, this study contributes to the healthcare literature by providing theoretical explanation to performance paradox of NP hospitals.

There are a number of limitations. First, the healthcare market is much more complicated than a textbook monopolistic market. Between hospitals and patients there are government regulations, managed care and insurance network. Second, the healthcare product is not a pure private good as a manufactured product. The information between buyers (patients) and sellers (hospitals) is grossly asymmetric with high transaction cost. These special characteristics of the healthcare industry could affect the demand and supply functions, thus potentially influence the final outcomes. It will be of academic interest in future studies to investigate these issues when taking into account of these unique characteristics of the health care product.

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7 Appendices

Dependent Variables	
NRevPD	Net revenue per adjusted patient day. (Total Revenue – Deductions & Adjustments) / AdjPD Where: AdjPD =Inpatient Days *((Inpatient Revenue + Outpatient Revenue) / Inpatient Revenue) * Case-Mix Index
ExpPD	Average total cost per adjusted patient day = Total Operating Expenses / AdjPD
CMAdm	CMA adjusted admissions (i.e. discharges) = Total Discharges* Case-Mix Index
Independent Variables	
NP	A binary variable that takes value of 1 for private nonprofit hospitals, and 0 otherwise; for-profit hospitals are treated as reference group
Government	A binary variable that takes value of 1 for government hospitals, and 0 otherwise; for-profit hospitals are treated as reference group
Control Variables	
Size	Nature log of average total assets
System	A binary variable that takes value of 1 for a hospital that is a member of a large healthcare system, and 0 otherwise
PatientMix	Fraction of Medicare and Medicaid patient days in total patient days. (Medicare days + Medicaid patient days) / Total Patient Days
CMI	Case Mix Index = MS-DRG weights / Total number of Discharges, provided by OSHPD
ALOS	Average length of stay = Inpatient Days / Discharges
OR	Occupancy rate = Actual Inpatient Days / Available Patient Days, where Available Patient Days = Staffed Beds * 365 days
Competition	Market competition, measured as 1- Herfindahl Hirschman Index (*HHI*), the sum of the squared market shares of major competing firms in the market
Charity	The sum of bed debts and charity care / gross patient revenue
Urban	A binary variable that takes value of 1 for urban hospitals, and 0 otherwise
Teach	A binary variable that takes value of 1 for hospitals that have residency program, and 0 otherwise
Income	Household median income by zip codes

TABLE 1
OLS Regression Examining the Association between Ownership Type and Hospital Performance
(*t-Statistics* in Parentheses)

$$Performance = a + \beta_1 (NP) + \beta_2 (Government) + \beta_3 (Controls) + \xi$$

Variables	Expected Sign	*NRevPD*	*ExpPD*	CMAAdm
NP	- / +	-0.060***	-0.039**	0.105***
		(-3.586)	(-2.254)	(8.294)
Government	- / +	-0.099***	-0.014	0.049***
		(-5.370)	(-0.755)	(3.516)
System		-0.003	-0.015	-0.066***
		(-0.254)	(-1.092)	(-6.375)
Urban		-0.028*	0.037**	0.042***
		(-1.754)	(2.235)	(3.439)
Teach		0.084***	0.121***	0.088***
		(6.293)	(8.824)	(8.780)
Size		0.235***	0.207***	0.633***
		(12.868)	(11.746)	(46.021)
CMI		-0.161***	-0.172***	0.149***
		(-11.248)	(-11.746)	(13.815)
PatientMix		-0.204***	-0.180***	-0.095***
		(-11.929)	(-10.274)	(-7.406)
OR		-0.009	-0.052***	0.099***
		(-0.694)	(-3.774)	(9.793)
ALOS		-0.471***	-0.482***	-0.030**
		(-30.030)	(-30.070)	(-2.555)
Charity		0.135***	0.143***	0.033***
		(10.186)	(10.484)	(3.319)
Competition		-0.146***	-0.131***	0.060***
		(-10.618)	(-9.338)	(5.779)
Income		0.094***	0.089***	-0.056***
		(6.702)	(6.174)	(-5.305)
Adjusted R^2		0.583	0.563	0.763
F-Statistics		302.5	278.8	695.2

The sample size is 2802 hospital-year observations from California short-term, general acute care hospitals between 2002 and 2010. Intercepts are not reported. See Appendix for variable definitions.
* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.