



Hospital ownership type and treatment choices

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ABSTRACT

In the face of increasing health care costs, taxing not-for-profit hospitals may be seen as the right choice to increase government revenues if not-for-profit hospitals are not different from their for-profit counterparts. This study investigates how hospital ownership type affects treatment choices to show whether ownership type and teaching status are correlated with choosing a procedure as the treatment and how these choices relate to patient insurance type. Not-for-profit hospitals significantly differ from for-profits in terms of treatment choices of less profitable patients and all hospitals are more likely to accord the procedure when the patient is privately insured than uninsured though teaching government hospitals are the most likely to accord the procedures for all insurance types. Considering treatment choices, not-for-profit hospitals have different objectives than for-profit and government hospitals and in terms of profit-seeking behavior, not-for-profit hospitals seem to lie between for-profit and government hospitals.

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1. Introduction

There has been an ongoing debate on whether not-for-profits should be taxed.¹ In the face of increasing health care costs, taxing not-for-profit hospitals may be seen as the right choice to increase government revenues if not-for-profit hospitals are not different from their for-profit counterparts. 60% of all general medical and surgical hospitals in the U.S. are not-for-profit, 25% are government owned and the rest is for-profit. The legal rules hospitals are exposed to differ by ownership type. For-profit hospitals may distribute profits to shareholders whereas not-for-profit hospitals enjoy income and property tax exemptions (Horwitz, 2005). However, since general hospitals treat patients with a mix of needs, operate under the same health regulations and employ staff with the same training and ethical obligations, hospitals are expected to provide similar services and accord similar treatments given patient characteristics. Hence much of the empirical literature on hospital ownership finds little difference among hospital types (Sloan et al., 2001).

In this paper, I consider several not-for-profit hospital theories by investigating the differences between hospitals by ownership type with respect to treatment choices given patient characteristics and insurance type. The first not-for-profit hospital theory is firm output maximization by Newhouse (1970). According to this theory, not-for-profits maximize their own output, which is a weighted average of various measures of quantity and quality of provided care. The second not-for-profit theory I consider is that not-for-profits are for-profits in disguise (Pauly and Redisch, 1973). According to this theory, not-for-profit hospital behavior should not be significantly different from their for-profit counterparts since not-for-profits and for-profits have the same objective function. The third theory regarding ownership is the total market output maximization theory (Weisbrod, 1988). Not-for-profits may attempt to generate more revenue by adding more profitable treatments but they will increase their propensity to offer less profitable treatments or to serve unprofitable patients (uninsured). Finally, the mixture theory states that some not-for-profits are true not-for-profits whereas others are for-profits in disguise (Hirth, 1997, 1999).

Ownership studies have mainly focused on financial topics such as costs, profits, billing and responsiveness to financial pressure (Sloan et al., 2001; Frank and Salkever, 1991). Rosenau and Linder (2003) use two decades of research comparing for-profit and not-for-profit health provider performance in the United States, searching relevant databases and using four performance

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¹ Edquist and O'Connor (2011) discuss a recent Supreme Court decision regarding Wisconsin Case of taxing not-for-profit hospitals.

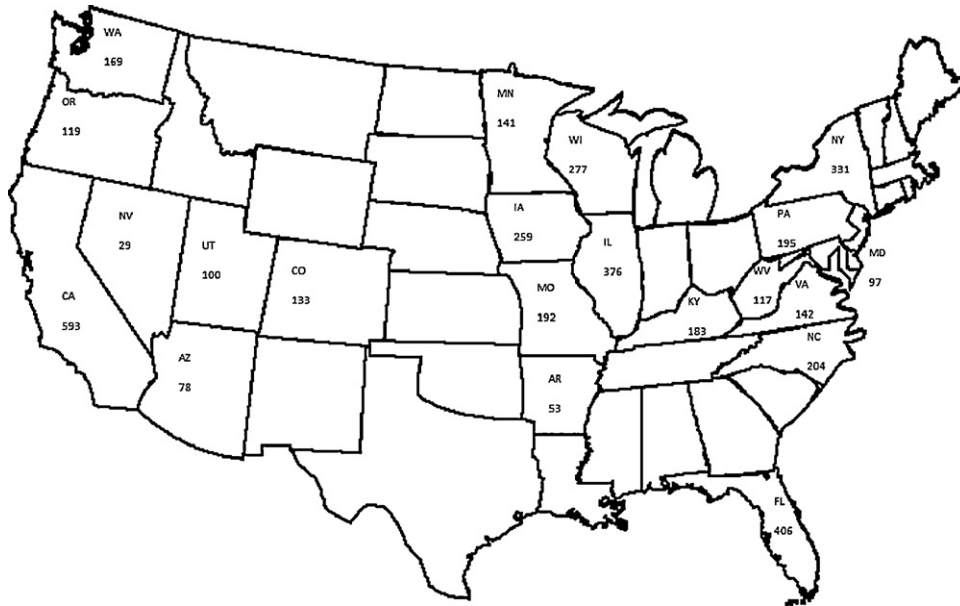


Fig. 1. Number of hospital-years by state in the sample.

criteria: access, quality, cost/efficiency and amount of charity care. Out of 149 studies, not-for-profits are superior 59% of the time, for-profits are superior 12% of the time, and there is no significant difference 29% of the time. In the case of Acute Myocardial Infarction, patient health outcomes are found not to vary by ownership, suggesting for-profit in disguise theory, however for-profit hospitals were more likely to use expensive, high-tech procedures (Sloan et al., 2003) and areas with for-profit hospitals have lower hospital expenditures (Kessler and McClellan, 2002). Patients in for-profit and government hospitals are more likely to suffer several types of preventable adverse events (Thomas et al., 2000) though hospital ownership and teaching status is not a consistent predictor of differences in rates of potentially preventable adverse events (Thornlow and Stukenborg, 2006). Teaching not-for-profit hospitals are found to provide an overall better quality of care as measured by lower mortality than do other hospital types supporting own output maximization theory (Yuan et al., 2000). In mixed ownership markets, for-profit hospitals provide significantly less charity care as not-for-profits in the market provide more, suggesting market output maximization theory (Clement et al., 2002) though not-for-profits provide less than the expected level of community benefits (Nicholson et al., 2000) and the acquisition of not-for-profit hospitals by investor owned corporations does not lead uniformly to less uncompensated care (Young et al., 1997; Young and Desai, 1999). For-profit hospitals are shown to be more likely than not-for-profit hospitals to provide profitable services and government hospitals have the lowest probability of offering profitable services, whereas for-profits are the least likely and government hospitals are the most likely to offer unprofitable services, rejecting the for-profit in disguise theory (Horwitz, 2005; Horwitz and Nichols, 2009).

Researchers have not previously looked broadly at whether any hospital type is more or less likely to accord different treatments given patient's diagnosis or insurance type. To that end, this study evaluates several not-for-profit hospital theories by investigating the differences between hospitals by ownership type with respect to treatment choices given patient characteristics. The mixture theory will not be tested since it is not possible to reject that some not-for-profits are acting as for-profits considering the average differences of treatment choices by ownership type. The aim of

this paper is not to evaluate the appropriateness of procedures given patient characteristics as in the case of Baker et al. (2008), Song et al. (2010) and Franzini et al. (2010). It evaluates 231 procedure groups defined by Healthcare Cost and Utilization Project (HCUP) computer classification software (CCS) to show whether ownership type and teaching status is correlated with choosing a procedure as the treatment and how these choices relate to patient insurance type, suggesting whether the hospitals are engaged in profit-seeking behavior. Since teaching hospitals provide patients for the training or research of interns and residents, they might have different objectives from nonteaching hospitals. Teaching hospitals are expected to focus on providing the "right" treatment without considering the insurance type of the patient, hence they are not expected to be for-profits in disguise and are more likely to be own-output maximizers.

2. Methods

Patient data come from the Nationwide Inpatient Sample (NIS) while hospital characteristics data are taken from the American Hospital Association's annual surveys of hospitals during 1999–2005. The analysis includes a 20% random sample of general medical and surgical acute care community hospitals, excluding military, uncategorized federal and prison hospitals of states participating in the NIS.² Around thirty-eight states participate in the NIS and the number of hospitals by states included in the sample is shown in Fig. 1.

I have included all 231 procedure categories grouped by computer classification software to examine the average differences in treatment choices. For each procedure I have selected the 3 most frequent Diagnosis-related groups (DRGs) in the NIS and included the patient records with one of these three DRGs as potential candidates of receiving the procedure as the treatment (selected DRGs for each procedure are reported in the appendix, Table A1). I then examined whether the average probability of receiving a procedure

² Hospitals participating in the NIS are randomly chosen each year. Therefore, it is not possible to draw convincing conclusions based on panel data analysis relying on changes in ownership status due to unbalanced panel.

differ by hospital ownership type, controlling for hospital characteristics such as bed size, number of nurses per bed, teaching status, location (urban/rural) and patient characteristics such as age, race, sex, and comorbidity of the patient as well as year and state fixed effects and procedure group–DRG interactions. Patient records, which are potential candidates for different procedures are included separately for each procedure with a different procedure group–DRG interaction term. To test whether patient's insurance type (i.e. profitability) affects the treatment choices of hospitals of different ownership types, I have looked at whether the probability of receiving a procedure by patients of different insurance types is differently affected by hospital ownership type using the same controls as in the first analysis. Also I have looked at whether treatment choices of non-teaching and teaching hospitals differ by hospital ownership type. Teaching hospitals are allowed to have different treatment choices from nonteaching hospitals by including interactions of teaching status with insurance type of patients and ownership type of hospitals.

2.1. Study variables

Table 1a reports the summary statistics of the sample and all general medical and surgical hospitals (from AHA) in the US from 1999 to 2005. Organizational structure is measured by ownership type: not-for-profit, for-profit, or government-owned (federal government hospitals are not included in the NIS, therefore government hospitals included in the analysis are state, county, city, city–county and hospital district or authority hospitals). The distribution of hospital types in the sample (68% not-for-profit, 13% for-profit) is roughly representative of distribution of types in the US (60% not-for-profit, 15% for-profit) though not-for-profits, teaching hospitals, hospitals with more beds and higher nurse per bed are overrepresented in the sample. Government hospitals have the highest fraction of Medicaid and uninsured patients whereas the distribution of patient insurance types for not-for-profit and for-profit hospitals are similar (Table 1b).

2.2. Statistical analysis

Three sets of analyses are carried out in this paper. First I analyzed whether ownership is correlated with the probability of according a procedure as the treatment on average for 231 procedure categories using a logistic model, controlling for patient characteristics. Independent variables included ownership type of the hospital and year. I controlled for patient and hospital characteristics and included procedure group and DRG interactions and state fixed effects to correct for potential biases. Patient characteristics included age, race, sex and comorbidities of the patient measured according to the Charlson index.³ Hospital characteristics included teaching status of the hospital, number of nurses per bed, rural/urban dummy and number of beds of the hospital.

The first model is:

$$E(PTP)_{ijt} = F(\beta_0 + \beta_1 O_{it} + \beta_2 Y_t + \beta_3 H_{it} + \beta_4 P_{jt} + \beta_5 P_{jt} \times DRG_{jt} + \beta_6 M_i)$$

where PTP is the dummy for patient treated with the procedure, i represents hospitals, j represents patients and t is the year. O is a set of indicator variables for not-for-profit and government ownership, Y is an indicator variable for year, H is a vector of hospital characteristic variables, P is a vector of patient characteristic variables, p is the vector of procedure group dummies, DRG is the vector of diagnosis related group (DRG) dummies and M is a vector of indicator variables for states. For-profit in disguise theory implies that $\beta_1(\text{not-for-profit}) = \beta_1(\text{for-profit})$, whereas own output maximization theory implies that $\beta_1(\text{not-for-profit}) > \beta_1(\text{for-profit})$.

Second, I looked at whether treatment choice probabilities are affected differently by patient insurance type with respect to hospital ownership type using a logistic model controlling for procedure group and DRG interactions, state and year fixed effects, and patient diagnoses, demographics, comorbidities and hospital characteristics used in the first analysis.

The model used in the second set of analysis is:

$$E(PTP)_{ijt} = F(\beta_0 + \beta_1 O_{it} + \beta_2 I_{ji} + \beta_3 O_{it} \times I_{jt} + \beta_4 Y_t + \beta_5 H_{it} + \beta_6 P_{jt} + \beta_7 P_{jt} \times DRG_{jt} + \beta_8 M_i)$$

where I_j is a set of indicator variables for the insurance type of patient j ; Medicare, Medicaid, privately insured or uninsured. For-profit in disguise theory implies that $\beta_1(\text{not-for-profit}) = \beta_1(\text{for-profit})$, $\beta_3(\text{not-for-profit, Medicare}) = \beta_3(\text{for-profit, Medicare})$, $\beta_3(\text{not-for-profit, Medicaid}) = \beta_3(\text{for-profit, Medicaid})$, $\beta_3(\text{not-for-profit, Private}) = \beta_3(\text{for-profit, Private})$ and $\beta_3(\text{not-for-profit, uninsured}) = \beta_3(\text{for-profit, uninsured})$. Market output maximization theory implies that

$$\beta_1(\text{not-for-profit}) + \beta_3(\text{not-for-profit, Medicaid}) > \beta_1(\text{for-profit}) + \beta_3(\text{for-profit, Medicaid})$$

and

$$\beta_1(\text{not-for-profit}) + \beta_3(\text{not-for-profit, uninsured}) > \beta_1(\text{for-profit}) + \beta_3(\text{for-profit, uninsured}).$$

Third, I looked at whether teaching status affected hospital treatment choices differently.

The model used in the third set of analysis is:

$$E(PTP)_{ijt} = F(\beta_0 + \beta_1 O_{it} + \beta_2 I_{jt} + \beta_3 O_{it} \times I_{jt} + \beta_4 O_{it} \times T_{it} + \beta_5 T_{it} \times I_{jt} + \beta_6 O_{it} \times T_{it} \times I_{jt} + \beta_7 Y_t + \beta_8 H_{it} + \beta_9 P_{jt} + \beta_{10} P_{jt} \times DRG_{jt} + \beta_{11} M_i)$$

where T_{it} is teaching status dummy. If teaching hospitals focus on the “right” treatment, treatment choice should be independent of insurance type of patients, hence

$$\begin{aligned} \beta_5(\text{teaching, Medicare}) &= \beta_5(\text{teaching, Medicaid}) \\ &= \beta_5(\text{teaching, private}) = \beta_5(\text{teaching, uninsured}) \end{aligned}$$

and also independent of interaction of ownership type of hospital and insurance type of patient, hence

$$\begin{aligned} \beta_6(\text{not-for-profit, teaching, Medicare}) &= \beta_6(\text{not-for-profit, teaching, Medicaid}) \\ &= \beta_6(\text{not-for-profit, teaching, private}) = \beta_6(\text{not-for-profit, teaching, uninsured}) \\ &= \beta_6(\text{for-profit, teaching, Medicare}) = \beta_6(\text{for-profit, teaching, Medicaid}) \\ &= \beta_6(\text{for-profit, teaching, private}) = \beta_6(\text{for-profit, teaching, uninsured}) \\ &= \beta_6(\text{government, teaching, Medicare}) = \beta_6(\text{government, teaching, Medicaid}) \\ &= \beta_6(\text{government, teaching, private}) = \beta_6(\text{government, teaching, uninsured}) \end{aligned}$$

³ Since severity measures such as All Patient Refined DRG: Risk of Mortality Subclass, All Patient Refined DRG: Severity of Illness Subclass, Disease Staging: Mortality Level, Disease Staging: Principal Stage are not available until 2002 in the NIS, they are not included as controls. However Charlson Index is included to avoid the problems unobserved severity, which can be correlated with insurance type of patients, will cause in the analysis. When severity measures are regressed on Charlson Index using data from 2002 to 2005, controlling for demographics, coefficient of Charlson Index is large and statistically significant. Regression results are available upon request.

Table 1

(a) Summary statistics, sample and all hospitals. (b) Distribution of observations by insurance type and hospital ownership type (percentages).

	NIS hospitals		All hospitals (AHA)	
	Mean	Std. dev.	Mean	Std. dev.
(a)				
Beds	182.56	182.2	169.65	178.27
Number of operating rooms	7.66	8.01	7.29	27.34
Teaching status	0.07	0.25	0.06	0.23
Number of nurses per bed	1.13	0.56	1.05	0.56
Location (rural/urban)	0.6	0.49		
Not-for-profit	0.68	0.47	0.6	0.49
For-profit	0.13	0.33	0.15	0.36
Government	0.2	0.4	0.25	0.43
Number of hospital-years	4194		37,576	
(b)				
	Not-for-profit	For-profit	Government	
Medicare	38.74	40.45	33.58	
Medicaid	16.68	19.98	26.16	
Private	40.71	35.08	29.40	
Uninsured	3.87	4.48	10.86	

I have used a 5% random sample of patient records in both analyses because of the large size of the data set. Because the probability of a hospital according a procedure is not independent over time, standard errors are corrected by clustering at the hospital level so they are robust to arbitrary serial correlation. The standard errors are also heteroscedasticity robust.

3. Results

Table 2 reports logit regression results of all models. Hispanic patients are significantly less likely to obtain the procedures than white patients. Also, female patients are significantly less likely to receive the procedures than male patients. Small hospitals are less likely to choose the procedure. Teaching and urban hospitals are more likely to accord the procedure.

Fig. 2a shows the predicted probabilities of according a procedure by hospital ownership type. Both not-for-profits and government hospitals are significantly more likely than for-profit hospitals to accord the procedure as the treatment, though the difference between not-for-profit and government hospitals in terms of the probability of according the procedure as the treatment is not statistically significant.

Predicted probabilities of choosing the procedure for the treatment of patients of different insurance types by hospital ownership type, averaged over all procedure groups, are shown in Fig. 2b. Patients of all insurance types have the highest probability of receiving the procedure at government hospitals and are least likely to obtain the procedure at a for-profit hospital.

Table 3a reports the comparison of probabilities of receiving the procedure by patient insurance type and by hospital ownership type using regression II of Table 2 (see Table A2-a in Appendix for the complete comparison). Government hospitals are significantly more likely to accord the procedures for uninsured patients than not-for-profits, who are significantly more likely than for-profits to accord the procedure for uninsured patients. Both not-for-profits and government hospitals are significantly more likely to accord the procedure for Medicaid and uninsured patients than for-profits. Not-for-profit hospitals are more likely to accord the procedure than for-profit hospitals for all insurance types of patients though the difference is statistically insignificant for Medicare and privately insured patients. The difference between not-for-profit and

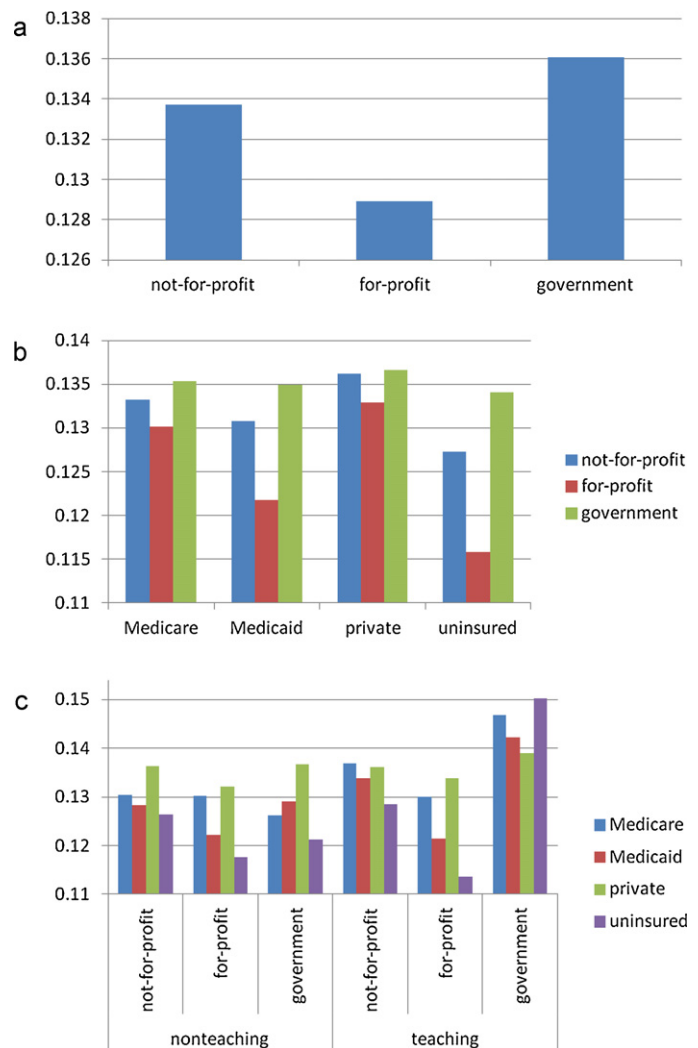


Fig. 2. (a) Average predicted probabilities of receiving the procedure by hospital ownership type. (b) Average predicted probabilities of receiving the procedure by patient insurance type and hospital ownership type. (c) Average predicted probabilities of receiving the procedure by patient insurance type, hospital's teaching status and ownership type. All of the probabilities are calculated using the third model.

Table 2
Logit results.

	I	II	III
Not-for-profit	0.051 [*] (0.030)	0.022 (0.031)	0.002 (0.034)
Government	0.101 ^{**} (0.047)	0.026 (0.052)	−0.060 (0.048)
Medicaid patient	−0.038 ^{**} (0.018)	−0.125 ^{***} (0.048)	−0.119 ^{**} (0.053)
Privately insured	0.036 ^{***} (0.013)	0.025 (0.040)	0.027 (0.047)
Uninsured	−0.055 ^{**} (0.023)	−0.195 ^{***} (0.046)	−0.188 ^{***} (0.050)
Not-for-profit × Medicaid		0.088 [*] (0.053)	0.090 (0.058)
Not-for-profit × private		0.009 (0.045)	0.056 (0.051)
Not-for-profit × uninsured		0.108 ^{**} (0.051)	0.130 ^{**} (0.058)
Government × Medicaid	0.160 ^{**}	0.163 ^{**} (0.075)	(0.076)
Government × private		0.032 (0.062)	0.122 [*] (0.071)
Government × uninsured		0.273 ^{***} (0.075)	0.115 (0.076)
Teaching	0.054 ^{**} (0.027)	0.051 [*] (0.027)	−0.005 (0.068)
Not-for-profit × teaching			0.095 (0.075)
Government × teaching			0.290 ^{**} (0.127)
Medicaid × teaching			−0.007 (0.114)
Private × teaching			0.027 (0.065)
Uninsured × teaching			−0.056 (0.124)
Not-for-profit × Medicaid × teaching		−0.005	(0.123)
Not-for-profit × private × teaching		−0.120	(0.077)
Not-for-profit × uninsured × teaching		−0.002	(0.134)
Government × Medicaid × teaching		−0.098	(0.160)
Government × private × teaching		−0.280 ^{**}	(0.132)
Government × uninsured × teaching		0.172	(0.167)
Charlson index	0.005 (0.005)	0.005 (0.005)	0.005 (0.005)
Female	−0.324 ^{***} (0.011)	−0.324 ^{***} (0.011)	−0.324 ^{***} (0.011)
White	0.017 (0.021)	0.019 (0.021)	0.020 (0.021)
Black	0.017 (0.027)	0.018 (0.026)	0.015 (0.026)
Hispanic	−0.067 ^{**} (0.032)	−0.064 ^{**} (0.032)	−0.065 ^{**} (0.032)
Urban hospital	0.076 ^{**} (0.031)	0.075 ^{**} (0.031)	0.065 ^{**} (0.031)
Number of nurses per bed	0.035 [*] (0.020)	0.035 [*] (0.020)	0.028 (0.021)
Number of beds	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)
Constant	−3.436 ^{***} (0.121)	−3.406 ^{***} (0.117)	−3.387 ^{***} (0.118)
Age group dummies	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes
Procedure group [*]			
DRG interactions	Yes	Yes	Yes

Table 2 (Continued)

	I	II	III
Number of observations	2,714,152	2,714,152	2,714,152
Pseudo R ²	0.395	0.395	0.3953

Standard errors are heteroscedasticity robust and clustered at the hospital level.

* Significance at the 90% confidence level.

** Significance at the 95% confidence level.

*** Significance at the 99% confidence level.

government hospitals is statistically insignificant for all insurance types except uninsured patients.

Table 3b compares the probabilities of receiving the procedure by insurance type separately by ownership using regression II of Table 2 (see Table A2-b in Appendix for the complete comparison). For not-for-profit and for-profit hospitals, uninsured patients are the least likely to receive the procedure and privately insured patients are the most likely to receive the procedure. Medicare patients are more likely to obtain the procedure than Medicaid patients in not-for-profit and for-profit hospitals.

Regression III reports the estimates of the third model and Fig. 2c shows the predicted probabilities for nonteaching and teaching hospitals by patient insurance type and by hospital ownership type. Teaching hospitals are more likely than nonteaching hospitals to accord the procedures in general. Teaching government hospitals are the most likely to accord the procedures and for-profits are the least likely ownership group to accord the procedure among teaching hospitals. Privately insured patients are the most likely and uninsured patients are the least likely to receive the procedure in all nonteaching hospitals and teaching for-profit hospitals. Uninsured patients are the most likely to obtain the procedure at teaching government hospitals.

Table 3c and d reports the statistical significance level of comparisons of probabilities by patient insurance type and by ownership type for nonteaching and teaching hospitals using regression III of Table 2 (see Tables A2-c and A2-d in Appendix for the complete comparison). The difference between teaching not-for-profit and government hospitals is statistically insignificant except for uninsured patients, who are notably more likely to obtain the procedure at a teaching government hospital. Both teaching and nonteaching not-for-profit hospitals are significantly more likely to accord the procedure than for-profit hospitals for uninsured patients. Both teaching and nonteaching government hospitals are more likely to accord the procedure for Medicaid patients than for-profit hospitals. Uninsured patients are the most likely to receive the procedure at a teaching government hospital though the differences in probabilities by insurance type are all insignificant for teaching government hospitals.

When we consider only the statistically significant results, the behavior of teaching hospitals resembles non-teaching hospitals. All hospitals are more likely to accord the procedure when the patient is privately insured than uninsured though teaching not-for-profit and government hospitals are more likely to accord the procedures for all insurance types than nonteaching hospitals.

Table 3

Probabilities of receiving the procedure by insurance type, by ownership type and by teaching status.

(a)						
Medicaid	Not-for-profit		>*		For-profit	
Uninsured	Not-for-profit		>***		For-profit	
Medicaid	Government		>*		For-profit	
Uninsured	Government		>***		For-profit	
Uninsured	Not-for-profit		<*		Government	
(b)						
Not-for-profit hospitals						
Uninsured	<*	Medicaid	<*	Medicare	<*	Private
For-profit hospitals						
Uninsured	<	Medicaid	<***	Medicare	<	Private
	Nonteaching hospitals			Teaching hospitals		
(c)						
Uninsured	Not-for-profit	>***	For-profit	Not-for-profit	>*	For-profit
Uninsured	Not-for-profit	>	Government	Not-for-profit	<***	Government
Medicaid	Government	>	For-profit	Government	>*	For-profit
Uninsured	Government	>	For-profit	Government	>***	For-profit
(d)						
Nonteaching hospitals						
Not-for-profit	Private	>***	Medicare	>	Medicaid	Uninsured
For-profit	Private	>	Medicare	>*	Medicaid	Uninsured
Government	Private	>*	Medicaid	>	Medicare	Uninsured
Teaching hospitals						
Not-for-profit	Medicare	>	Private	>	Medicaid	Uninsured
For-profit	Private	>	Medicare	>	Medicaid	Uninsured
Government	Uninsured	>	Medicare	>	Medicaid	Private

* Significance at the 90% confidence level.

** Significance at the 95% confidence level.

*** Significance at the 99% confidence level.

4. Discussion

In general both not-for-profit and government hospitals are more likely to treat patients with procedures than for-profit hospitals. The results are in line with Horwitz's (2005) findings with hospitals' service choices; not-for-profits are in between government and for-profit hospitals in terms of profit seeking behavior when treatment choices of patients are considered. Since treatment choice probabilities of not-for-profit and for-profit hospitals differ significantly, not-for-profit hospitals should have different objective functions from for-profit hospitals; therefore, we can reject the for-profit in disguise theory. In general, the difference between not-for-profit and government hospitals in terms of treatment choice probabilities is not significant, which supports that they have similar objectives. For the uninsured patients, government hospitals are significantly more likely to accord the procedures than not-for-profit hospitals, which are significantly more likely than for-profits to accord the procedure.

In the absence of budget constraints and profit-seeking behavior, the probability that a patient will receive the procedure as the treatment, should not depend on the insurance type of the patient. The probability that a patient will obtain the procedure as the treatment does not significantly differ by insurance type at the government hospitals. Not-for-profits are more likely to accord the procedure for well-insured patients (privately insured and Medicare patients) than uninsured patients, however they are also more likely to accord the procedure as the treatment for the uninsured patients than for-profit hospitals. Even though not-for-profits are more likely than for-profits to accord the procedure as the treatment, the difference is not statistically significant for well insured patients. If not-for-profits were significantly more likely to accord the procedure than for-profits for patients of all insurance types, we could have concluded that they were own-output maximizers rather than market-output maximizers, however we need further investigation to distinguish between own-output and market output maximization theories. Maybe hospitals of all ownership types are providing the procedure as the treatment for well insured patients at the "right" level but some hospitals cannot provide the procedure to the uninsured patients as much as well insured patients because of their binding budget constraints. Investigation of procedure choice probabilities by market-ownership mix may help to distinguish whether not-for-profit hospitals are own-output or market output maximizers. Not-for-profit hospitals care more about market needs than for-profit hospitals since they are more likely to accord the procedure as the treatment for uninsured patients suggesting that not-for-profit hospitals are market-output

maximizers. Although the results support own and market output maximization theories, we cannot reject the mixture theory-some not-for-profits are for-profits in disguise-based on the analysis in this paper.

5. Conclusion

When considering taxing not-for-profits in the same way as for-profits, in addition to the amount of charity care provided, differences between hospitals by ownership type on service provision and treatment choices should also be considered. This study shows that hospital treatment choices differ significantly by ownership type of the hospital and by insurance type of the patients. There are significant differences between not-for-profit and for-profit hospitals in terms of treatment choices of uninsured and Medicaid patients, who are less profitable than privately insured and Medicare patients and less likely to receive the procedures at for-profit hospitals. Therefore, not-for-profit hospitals seem to lie between for-profit and government hospitals in terms of profit-seeking behavior with statistically significant differences from for-profit hospitals in terms of treatment choices of unprofitable patients supporting that not-for-profits and for-profits have different objective functions and not-for-profits care more about less profitable patients such as Medicaid and uninsured patients than their for-profit counterparts.

Additionally, as a result of Patient Protection and Affordable Care Act, even though the full implementation is not guaranteed, there will be fewer uninsured by 2014. Given the fact that uninsured patients are less likely to obtain a treatment (except at teaching government hospitals), this act will lead to a welfare gain for the uninsured, who will be covered by 2014.

Also it should be noted that the data is from 1999 to 2005 and the performance differences reported in this study might have changed since 2005, therefore it might be necessary to repeat the analysis with up-to-date data before making tax-exemption decisions based on performance differences by hospital ownership type.

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Appendix.

Table A1
Selected DRGs for procedure groups defined by CCS.

CCS #	CCS definition	DRGs
1	Incision and excision of CNS	1, 2, 3
2	Insertion; replacement; or removal of extracranial ventricular shunt	1, 3
3	Laminectomy; excision intervertebral disk	500, 499, 498
4	Diagnostic spinal tap	21, 422, 389
5	Insertion of catheter or spinal stimulator and injection into spinal canal	243, 373, 239
6	Decompression peripheral nerve	6, 8, 228
7	Other diagnostic nervous system procedures	1, 10, 11
8	Other non-OR or closed therapeutic nervous system procedures	25, 24, 243
9	Other OR therapeutic nervous system procedures	1, 4, 234
10	Thyroidectomy; partial or complete	290, 289
11	Diagnostic endocrine procedures	300, 289, 82
12	Other therapeutic endocrine procedures	289, 286

Table A1 (Continued)

CCS #	CCS definition	DRGs
13	Corneal transplant	42, 40
14	Glaucoma procedures	42, 40, 443
15	Lens and cataract procedures	39, 42
16	Repair of retinal tear; detachment	36, 461
17	Destruction of lesion of retina and choroid	48, 40, 386
18	Diagnostic procedures on eye	37, 42
19	Other therapeutic procedures on eyelids; conjunctiva; cornea	40, 42
20	Other intraocular therapeutic procedures	36, 42, 40
21	Other extraocular muscle and orbit therapeutic procedures	37, 40
22	Tympanoplasty	55, 53
23	Myringotomy	62, 61
24	Mastoidectomy	53, 54
25	Diagnostic procedures on ear	73, 55
26	Other therapeutic ear procedures	55, 73, 49
27	Control of epistaxis	66, 134, 63
28	Plastic procedures on nose	56, 55
29	Dental procedures	187, 168, 169
30	Tonsillectomy and/or adenoidectomy	60, 443, 59
31	Diagnostic procedures on nose; mouth and pharynx	64, 73, 57
32	Other non-OR therapeutic procedures on nose; mouth and pharynx	390, 185, 73
33	Other OR therapeutic procedures on nose; mouth and pharynx	50, 52, 57
34	Tracheostomy; temporary and permanent	483, 482
35	Tracheoscopy and laryngoscopy with biopsy	391, 389, 73
36	Lobectomy or pneumonectomy	75, 415
37	Diagnostic bronchoscopy and biopsy of bronchus	76, 82, 89
38	Other diagnostic procedures on lung and bronchus	75, 400
39	Incision of pleura; thoracentesis; chest drainage	85, 82, 127
40	Other diagnostic procedures of respiratory tract and mediastinum	76, 82, 77
41	Other non-OR therapeutic procedures on respiratory system	82, 144, 79
42	Other OR therapeutic procedures on respiratory system and mediastinum	75, 482, 76
43	Heart valve procedures	105, 104, 112
44	Coronary artery bypass graft (CABG)	107, 109, 106
45	Percutaneous transluminal coronary angioplasty (PTCA)	116, 112
46	Coronary thrombolysis	122, 116, 124
47	Diagnostic cardiac catheterization; coronary arteriography	124, 125, 122
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrill	116, 104, 105
49	Other OR heart procedures	110, 112, 108
50	Extracorporeal circulation auxiliary to open heart procedures	105, 104
51	Endarterectomy; vessel of head and neck	5, 478
52	Aortic resection; replacement or anastomosis	110, 111, 108
53	Varicose vein stripping; lower limb	119, 461
54	Other vascular catheterization; not heart	416, 127, 89
55	Peripheral vascular bypass	478, 479, 110
56	Other vascular bypass and shunt; not heart	191, 110, 5
57	Creation; revision and removal of arteriovenous fistula or vessel-to-vessel cannula	120, 315
58	Hemodialysis	127, 316, 144
59	Other OR procedures on vessels of head and neck	1, 5, 7
60	Embolectomy and endarterectomy of lower limbs	478, 479
61	Other OR procedures on vessels other than head and neck	478, 479, 76
62	Other diagnostic cardiovascular procedures	112, 7, 233
63	Other non-OR therapeutic cardiovascular procedures	116, 316, 144
64	Bone marrow transplant	481, 483
65	Bone marrow biopsy	403, 395, 473
66	Procedures on spleen	392, 486, 400
67	Other therapeutic procedures; hemic and lymphatic system	401, 400, 394
68	Injection or ligation of esophageal varices	201, 154, 155
69	Esophageal dilatation	182, 183, 296
70	Upper gastrointestinal endoscopy; biopsy	174, 182, 183
71	Gastrostomy; temporary and permanent	14, 79, 296
72	Colostomy; temporary and permanent	148, 149
73	Ileostomy and other enterostomy	148, 79, 172
74	Gastrectomy; partial and total	154, 155
75	Small bowel resection	148, 149
76	Colonoscopy and biopsy	174, 182, 188
77	Proctoscopy and anorectal biopsy	188, 172, 182
78	Colorectal resection	148, 149, 146
79	Local excision of large intestine lesion (not endoscopic)	157, 158
80	Appendectomy	167, 165, 166
81	Hemorrhoid procedures	158, 157
82	Endoscopic retrograde cannulation of pancreas (ERCP)	204, 207, 208
83	Biopsy of liver	203, 205, 206
84	Cholecystectomy and common duct exploration	494, 493, 197
85	Inguinal and femoral hernia repair	161, 162, 163
86	Other hernia repair	160, 159, 154
87	Laparoscopy (GI only)	361, 171, 170

Table A1 (Continued)

CCS #	CCS definition	DRGs
88	Abdominal paracentesis	202, 205, 188
89	Exploratory laparotomy	170, 171, 365
90	Excision; lysis peritoneal adhesions	150, 151, 365
91	Peritoneal dialysis	452, 188, 316
92	Other bowel diagnostic procedures	152, 188, 174
93	Other non-OR upper GI therapeutic procedures	174, 202, 188
94	Other OR upper GI therapeutic procedures	288, 154, 155
95	Other non-OR lower GI therapeutic procedures	174, 188, 189
96	Other OR lower GI therapeutic procedures	148, 158, 157
97	Other gastrointestinal diagnostic procedures	203, 170, 204
98	Other non-OR gastrointestinal therapeutic procedures	207, 204, 208
99	Other OR gastrointestinal therapeutic procedures	191, 442, 415
100	Endoscopy and endoscopic biopsy of the urinary tract	323, 310, 320
101	Transurethral excision; drainage; or removal urinary obstruction	310, 311
102	Ureteral catheterization	323, 324, 320
103	Nephrotomy and nephrostomy	304, 305
104	Nephrectomy; partial or complete	303, 305, 304
105	Kidney transplant	302, 304
106	Genitourinary incontinence procedures	356, 309, 360
107	Extracorporeal lithotripsy; urinary	323, 320, 324
108	Indwelling catheter	127, 89, 320
109	Procedures on the urethra	312, 341, 313
110	Other diagnostic procedures of urinary tract	331, 316, 332
111	Other non-OR therapeutic procedures of urinary tract	380, 373, 331
112	Other OR therapeutic procedures of urinary tract	305, 303, 304
113	Transurethral resection of prostate (TURP)	336, 337, 306
114	Open prostatectomy	335, 334, 345
115	Circumcision	391, 390, 389
116	Diagnostic procedures; male genital	346, 348, 341
117	Other non-OR therapeutic procedures; male genital	350, 352, 418
118	Other OR therapeutic procedures; male genital	341, 339, 340
119	Oophorectomy; unilateral and bilateral	359, 358, 357
120	Other operations on ovary	359, 358, 384
121	Ligation or occlusion of fallopian tubes	374, 361, 362
122	Removal of ectopic pregnancy	378, 375
123	Other operations on fallopian tubes	359, 378, 358
124	Hysterectomy; abdominal and vaginal	359, 358, 355
125	Other excision of cervix and uterus	359, 358, 360
126	Abortion (termination of pregnancy)	381, 380, 383
127	Dilatation and curettage (D&C); aspiration after delivery or abortion	381, 374, 377
128	Diagnostic dilatation and curettage (D&C)	364, 363
129	Repair of cystocele and rectocele; obliteration of vaginal vault	356, 360, 359
130	Other diagnostic procedures; female organs	364, 363
131	Other non-OR therapeutic procedures; female organs	380, 384, 369
132	Other OR therapeutic procedures; female organs	360, 378, 356
133	Episiotomy	373, 372, 374
134	Cesarean section	371, 370, 384
135	Forceps; vacuum; and breech delivery	373, 372, 374
136	Artificial rupture of membranes to assist delivery	373, 372, 374
137	Other procedures to assist delivery	373, 372, 374
138	Diagnostic amniocentesis	379, 383, 384
139	Fetal monitoring	373, 383, 379
140	Repair of current obstetric laceration	373, 372, 374
141	Other therapeutic obstetrical procedures	372, 384, 373
142	Partial excision bone	231, 415, 292
143	Bunionectomy or repair of toe deformities	225, 227
144	Treatment; facial fracture or dislocation	63, 185, 37
145	Treatment; fracture or dislocation of radius and ulna	224, 223, 252
146	Treatment; fracture or dislocation of hip and femur	210, 211, 212
147	Treatment; fracture or dislocation of lower extremity (other than hip or femur)	219, 218, 225
148	Other fracture and dislocation procedure	219, 220, 218
149	Arthroscopy	232, 503, 415
150	Division of joint capsule; ligament or cartilage	503, 225, 224
151	Excision of semilunar cartilage of knee	503, 501
152	Arthroplasty knee	209, 471, 503
153	Hip replacement; total and partial	209, 471
154	Arthroplasty other than hip or knee	491, 223, 224
155	Arthrocentesis	244, 242, 248
156	Injections and aspirations of muscles; tendons; bursa; joints and soft tissue	248, 277, 243
157	Amputation of lower extremity	113, 285, 114
158	Spinal fusion	498, 497, 496
159	Other diagnostic procedures on musculoskeletal system	216, 226
160	Other therapeutic procedures on muscles and tendons	227, 226, 224
161	Other OR therapeutic procedures on bone	233, 219, 212
162	Other OR therapeutic procedures on joints	231, 219, 415
163	Other non-OR therapeutic procedures on musculoskeletal system	243, 462, 244

Table A1 (Continued)

CCS #	CCS definition	DRGs
164	Other OR therapeutic procedures on musculoskeletal system	63, 213, 441
165	Breast biopsy and other diagnostic procedures on breast	274, 262, 259
166	Lumpectomy; quadrantectomy of breast	260, 259, 262
167	Mastectomy	258, 257, 261
168	Incision and drainage; skin and subcutaneous tissue	277, 278, 279
169	Debridement of wound; infection or burn	263, 217, 415
170	Excision of skin lesion	266, 270, 265
171	Suture of skin and subcutaneous tissue	280, 281, 28
172	Skin graft	217, 439, 263
173	Other diagnostic procedures on skin and subcutaneous tissue	283, 277, 272
174	Other non-OR therapeutic procedures on skin and breast	144, 462, 127
175	Other OR therapeutic procedures on skin and breast	261, 268, 288
176	Other organ transplantation	480, 103, 495
177	Computerized axial tomography (CT) scan head	14, 15, 24
178	CT scan chest	89, 88, 127
179	CT scan abdomen	183, 182, 204
180	Other CT scan	243, 236, 239
181	Myelogram	243, 239, 19
182	Mammography	430, 127, 276
183	Routine chest X-ray	127, 89, 88
184	Intraoperative cholangiogram	200, 199
185	Upper gastrointestinal X-ray	184, 182, 183
186	Lower gastrointestinal X-ray	181, 182, 180
187	Intravenous pyelogram	324, 323, 320
188	Cerebral arteriogram	14, 15, 25
189	Contrast aortogram	130, 131, 15
190	Contrast arteriogram of femoral and lower extremity arteries	130, 131, 144
191	Arterio- or venogram (not heart and head)	78, 130, 144
192	Diagnostic ultrasound of head and neck	14, 15, 141
193	Diagnostic ultrasound of heart (echocardiogram)	127, 14, 138
194	Diagnostic ultrasound of gastrointestinal tract	204, 182, 208
195	Diagnostic ultrasound of urinary tract	322, 316, 320
196	Diagnostic ultrasound of abdomen or retroperitoneum	204, 182, 183
197	Other diagnostic ultrasound	383, 130, 277
198	Magnetic resonance imaging	14, 243, 15
199	Electroencephalogram (EEG)	26, 25, 24
200	Nonoperative urinary system measurements	320, 462, 383
201	Cardiac stress tests	143, 132, 127
202	Electrocardiogram	143, 127, 430
203	Electrographic cardiac monitoring	143, 127, 132
204	Swan-Ganz catheterization for monitoring	127, 416, 121
205	Arterial blood gases	88, 89, 127
206	Microscopic examination (bacterial smear; culture; toxicology)	430, 391, 390
207	Radioisotope bone scan	239, 243, 277
208	Radioisotope pulmonary scan	78, 127, 88
209	Radioisotope scan and function studies	143, 127, 132
210	Other radioisotope scan	14, 462, 243
211	Therapeutic radiology for cancer treatment	10, 239, 363
212	Diagnostic physical therapy	462, 243, 14
213	Physical therapy exercises; manipulation; and other procedures	462, 14, 466
214	Traction; splints; and other wound care	253, 254, 235
215	Other physical therapy and rehabilitation	462, 430, 14
216	Respiratory intubation and mechanical ventilation	475, 386, 127
217	Other respiratory therapy	98, 88, 89
218	Psychological and psychiatric evaluation and therapy	430, 426, 435
219	Alcohol and drug rehabilitation/detoxification	435, 434, 433
220	Ophthalmologic and otologic diagnosis and treatment	391, 390, 389
221	Nasogastric tube	180, 181, 188
222	Blood transfusion	395, 174, 127
223	Enteral and parenteral nutrition	79, 416, 387
224	Cancer chemotherapy	410, 492, 403
225	Conversion of cardiac rhythm	138, 139, 127
226	Other diagnostic radiology and related techniques	323, 324, 320
227	Other diagnostic procedures (interview; evaluation; consultation)	25, 26, 141
228	Prophylactic vaccinations and inoculations	391, 390, 389
229	Nonoperative removal of foreign body	190, 189, 188
230	Extracorporeal shock wave lithotripsy; other than urinary	324, 323, 204
231	Other therapeutic procedures	391, 389, 89

Table A2-a

Comparison of probabilities of receiving the procedure by ownership type by insurance type.

Medicare	Not-for-profit	>	For-profit
Medicaid	Not-for-profit	> ^{**}	For-profit
Private	Not-for-profit	>	For-profit
Uninsured	Not-for-profit	> ^{***}	For-profit
Medicare	Government	>	For-profit
Medicaid	Government	> ^{**}	For-profit
Private	Government	>	For-profit
Uninsured	Government	> ^{***}	For-profit
Medicare	Not-for-profit	<	Government
Medicaid	Not-for-profit	<	Government
Private	Not-for-profit	<	Government
Uninsured	Not-for-profit	< ^{**}	Government

^{**} Significance at the 95% confidence level.^{***} Significance at the 99% confidence level.**Table A2-b**

Comparison of probabilities of receiving the procedure by insurance type by ownership type.

Not-for-profit hospitals		
Medicaid	< [*]	Medicare
Private	> ^{**}	Medicare
Uninsured	< ^{***}	Medicare
Private	> ^{***}	Medicaid
Uninsured	< [*]	Medicaid
Private	> ^{***}	Uninsured
For-profit hospitals		
Medicaid	< ^{***}	Medicare
Private	>	Medicare
Uninsured	< ^{***}	Medicare
Private	> ^{***}	Medicaid
Uninsured	<	Medicaid
Private	> ^{***}	Uninsured
Government hospitals		
Medicaid	>	Medicare
Private	>	Medicare
Uninsured	>	Medicare
Private	>	Medicaid
Uninsured	>	Medicaid
Private	<	Uninsured

^{*} Significance at the 90% confidence level.^{**} Significance at the 95% confidence level.^{***} Significance at the 99% confidence level.**Table A2-c**

Comparison of probability of getting a procedure by insurance type.

Nonteaching hospitals			Teaching hospitals		
Medicare	Not-for-profit	>	For-profit	Not-for-profit	>
Medicaid	Not-for-profit	>	For-profit	Not-for-profit	>
Private	Not-for-profit	>	For-profit	Not-for-profit	>
Uninsured	Not-for-profit	> ^{***}	For-profit	Not-for-profit	> ^{**}
Medicare	Not-for-profit	> [*]	Government	Not-for-profit	<
Medicaid	Not-for-profit	<	Government	Not-for-profit	<
Private	Not-for-profit	<	Government	Not-for-profit	<
Uninsured	Not-for-profit	>	Government	Not-for-profit	< ^{***}
Medicare	Government	<	For-profit	Government	> [*]
Medicaid	Government	>	For-profit	Government	> ^{**}
Private	Government	>	For-profit	Government	>
Uninsured	Government	>	For-profit	Government	> ^{***}

^{*} Significance at the 90% confidence level.^{**} Significance at the 95% confidence level.^{***} Significance at the 99% confidence level.**Table A2-d**

Comparison of probabilities of receiving the procedure by insurance type by ownership type.

Not-for-profit hospitals			For-profit hospitals			Government hospitals		
Nonteaching hospitals								
Medicaid	<	Medicare	Medicaid	< ^{**}	Medicare	Medicaid	>	Medicare
Private	> ^{***}	Medicare	Private	>	Medicare	Private	> ^{***}	Medicare
Uninsured	<	Medicare	Uninsured	< ^{***}	Medicare	Uninsured	<	Medicare
Private	> ^{***}	Medicaid	Private	> ^{***}	Medicaid	Private	> ^{**}	Medicaid
Uninsured	<	Medicaid	Uninsured	<	Medicaid	Uninsured	< ^{**}	Medicaid
Private	> ^{***}	Uninsured	Private	> ^{***}	Uninsured	Private	> ^{***}	Uninsured
Teaching hospitals								
Medicaid	<	Medicare	Medicaid	<	Medicare	Medicaid	<	Medicare
Private	<	Medicare	Private	>	Medicare	Private	<	Medicare
Uninsured	< ^{***}	Medicare	Uninsured	< ^{**}	Medicare	Uninsured	>	Medicare
Private	>	Medicaid	Private	> [*]	Medicaid	Private	<	Medicaid
Uninsured	< ^{**}	Medicaid	Uninsured	<	Medicaid	Uninsured	>	Medicaid
Private	> ^{***}	Uninsured	Private	> ^{***}	Uninsured	Private	<	Uninsured

^{*} Significance at the 90% confidence level.^{**} Significance at the 95% confidence level.^{***} Significance at the 99% confidence level.

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