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The Impact of Privatization on Efficiency and Productivity: The Case of US Public Hospitals

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This Special Issue of the *Journal of Health Care Finance* honors Dr. Louis C. Gapenski for his contributions to the fields of health care finance, public health finance and health administration. In his writing, teaching and mentoring, he served as a role model for all of us.

The Impact of Privatization on Efficiency and Productivity: The Case of US Public Hospitals

Abstract

Public hospitals typically operate in more challenging environments than private hospitals. Research suggests that privatization is one of the strategies that struggling public hospitals adopt to stay competitive. The purpose of this study was to examine whether privatization of public hospitals enhances efficiency and productivity. We used a national sample of non-federal acute care public hospitals in 1997 that was tracked through 2013, resulting in a cohort of 436 hospitals (7,386 hospital-year observations). Privatization was defined as conversion from public to either private not-for-profit or private for-profit status. Efficiency was measured by current assets turnover (CATO), fixed assets turnover (FATO), occupancy rate, full-time equivalent (FTE) employees per occupied bed, and work hours per adjusted patient day. Productivity was measured by case mix adjusted admissions per FTE. We controlled for organizational and market factors. Linear regressions with hospital and year fixed-effects models were used to test the hypotheses. Privatization from public to private status was associated with increased efficiency in terms of its positive associations with CATO (β =0.63) and FATO (β =0.23) and its negative association with FTE employees per occupied bed (β =-0.93) all at ($p \leq 0.001$). Privatization was associated with increased productivity (β= 0.83; $p \leq 0.001$).

Keywords: Public hospitals, privatization, efficiency, productivity, agency theory, property rights theory

Introduction

As safety net providers, government-owned or public hospitals play a vital role in the US health care delivery system. They are expected to provide health care services to everyone regardless of health insurance status or ability to pay, provide important but unprofitable specialized services, provide medical education, and conduct research (Villa and Kane, 2013; Ko, et al., 2014). However, the number of public hospitals has dramatically decreased from an estimated 1,761 hospitals in 1975 to 1,037 hospitals in 2012 (Health, United States, 2015). This decline can be attributed, in part, to privatization (Villa and Kane, 2013; Ko, et al., 2014). Privatization refers to ownership conversion from public to either private-for-profit (FP) or private not-for-profit status (NFP) (Ko, et al., 2014).

There are some benefits and drawbacks of public hospitals' privatization. Given the major role of public hospitals as safety net providers, there are concerns that privatization may reduce access to care for the indigent as privatized hospitals may become less committed to serving the underserved (Bovbjerg, Marsteller and Ullman, 2000; Thorpe, Florence and Sieber, 2000; Thorpe, Florence and Sieber, 2000; Desai, Lucas and Young, 2000). On the other hand, literature suggests that privatization eases and expands access to capital that may result in the acquisition of modern technology, recruitment of talented managerial and clinical workforce, as well as infrastructure renovation (Desai, Lucas and Young, 2000; Wessel, 2011), improved health care quality (Bovbjerg, Marsteller and Ullman, 2000), enhanced financial performance (Shen, 2003; Picone, Chou and Sloan, 2002), and efficiency (Villa and Kane, 2013; Tiemann and Schreyögg, 2012).

Prior studies have shown privatization among US public hospitals to be associated to similar or better efficiency. For instance, Villa and Kane studied the impact of public hospitals 'privatization, to private not-for-profit status, on financial performance and efficiency using a sample of 22 public hospitals located in California, Florida, and Massachusetts. Based on six-year longitudinal data and a nonequivalent group design, they found that privatization resulted in improved operating margins and length of stay. However, they found no significant change in inpatient expenses per admission after privatization (Villa and Kane, 2013). The study of Villa and Kane has some limitations based on the use of nonequivalent group design which does not take into consideration the organizational and market factors that may impact efficiency. In addition, this study did not explore the impact of privatization to for-profit status on efficiency.

The purpose of this study is to build on Villa and Kane's study (Villa and Kane, 2013) by investigating whether privatization enhances efficiency and productivity using longitudinal data (1997-2013) of a national sample of public hospitals in the United States while controlling for organizational and market factors that may impact efficiency and productivity. This study further examines whether privatization to for-profit status results in higher efficiency and productivity compared with privatization to not-for-profit status.

Identifying ways to improve efficiency in health care is of increasing importance in the US. Health care spending currently accounts for 18 percent of GDP (Health, United States, 2015) and a review reported that waste costs the US between $476 billion and $992 billion in 2011, of which one third was attributed to waste from Medicare and Medicaid (Health Policy Brief, 2012). To address this

issue, the Institute of Medicine has included efficiency as one of the six aims for improving the health care system (Institute of Medicine, 2012).

In health care, efficiency refers to waste elimination with respect to the use of tangible and intangible resources needed for the provision of health care services (Institute of Medicine, 2012; Hussey, et al., 2009). More precisely, there are two types of efficiency: technical efficiency and allocative efficiency. Technical efficiency is defined as "producing the maximum amount of output from a given quantity of input, or producing a given amount output from a minimum quantity of input" and allocative efficiency is defined as "the amount of input mix which minimizes cost, given input prices or the amount of output mix that maximizes revenue, given output prices" (Hollingsworth, 2008). On the other hand, productivity is defined as "the ratio of an index of output to an index of input usage" (Hollingsworth, 2008). Productivity and efficiency are associated; a change in productivity may be attributed to a change in efficiency (Hollingsworth, 2008).

Conceptual Framework and Hypotheses

This study uses agency theory and property rights theory to explore the relationships between privatization and efficiency and productivity. Both theories have been used to examine the impact of privatization on efficiency (Tiemann and Schreyögg, 2010; Tiemann and Schreyögg, 2012. Agency theory describes the problem associated with the relationship between the principal (the owner) and the agent (the person/group of people acting on behalf of the owner/principal). Agency theory suggests there can be a misalignment of goals between the principal and the agent, who often acts in his or her own best interest (Tiemann & Schreyögg, 2010; Tiemann & Schreyögg, 2012; Cuervo & Villalonga, 2000). Aligning the agent's goals to that of the principal comes at a cost to the principal (Eisenhardt, 1989; Clarkson, 1972) and misalignment of goals has the potential to negatively impact organizational efficiency. While this issue is relevant to all three ownership types (public, private not-profit, and private for-profit), it is more prevalent and more difficult to solve among public hospitals due to dual principal-agent relationship, that is the relationship between the public, as owners, and politicians on one hand, and the relationship between politicians and the managers, as agents on the other hand (Cuervo and Villalonga, 2000). Politicians may interfere in management decision making and may push agendas that do not always aim to enhance hospitals' efficiency (Tiemann and Schreyögg, 2010; Cuervo and Villalonga, 2000). However, politicians' involvement in decision making is less likely to be experienced by privately owned organizations. Therefore, private organizations may be better able to align the principal's goals to those of the agent. Based on these premises, we expect privatization of public hospitals to enhance efficiency and productivity.

Hypothesis 1a. *Public hospitals that privatize are more efficient after privatization.*

Hypothesis 1b. *Public hospitals that privatize have higher productivity after privatization.*

Property rights is defined as an individual's or an organization's right of ownership to a resource; the right to have control over the resource; the right to consume, use, and exploit the resource to achieve one's goals and objectives; the right to earn income from the resource; and the right to sell the resource to other individuals or entities (Furubotn and Pejovich, 1972; Eggertsson, 1990; Hart,

1995). Clarkson (1972) and Tiemann and Schreyögg (2010) suggest that FP status has the most effective tools to resolve conflicting intentions between the agent and the principal. Since shareholders have the right to own and distribute residual income, they can control managers' behavior and align their intentions with shareholders' by positively correlating managers' compensations with the hospital's financial performance. In addition, given shareholders' right to sell stocks to other people and the fear that shareholders might sell their assets and invest them in other organizations that can maximize their wealth, managers of FP hospitals will do their best to maximize shareholders' wealth. One way to do so is to increase efficiency and productivity.

Since the trustees of NFP hospitals do not have the right to own residual income nor to distribute it to managers, they may be less effective at aligning their intentions with those of the managers. Managers may also be less motivated to take actions to improve efficiency and productivity of the hospital since profit maximization is not the major objective of NFP hospitals (Clarkson, 1972; Weech-Maldonado, et al., 2012).

Tiemann and Schreyögg (2010, 2012) studied the impact of public hospitals' privatization to either private for-profit or private not-for profit status, using a national sample of public hospitals in Germany, based on longitudinal data from 1996 to 2007 and from 1996 to 2008, respectively. Using efficiency scores from data envelopment analysis and after controlling for organizational and market characteristics, they found that privatization to for-profit status resulted in a significant and greater increase in efficiency compared with privatization to not-for profit status. Thus, we expect public hospitals that convert to for-profit status to be more efficient than public hospitals that convert to not-for-profit status.

Hypothesis 2a: *Public hospitals that privatize to for-profit status are more efficient than public hospitals that privatize to not-for-profit status.*

Hypothesis 2b: *Public hospitals that privatize to for-profit status have higher productivity than public hospitals that privatize to not-for-profit status.*

Methods

Data

This study used data from: (1) the American Hospital Association (AHA) Annual Survey, (2) the Area Health Resources File (AHRF), (3) the Centers for Medicare and Medicaid Services (CMS) Cost Report (MCR), (4) CMS Impact Files, and (5) the Local Area Unemployment Statistics (LAUS) from the Bureau of Labor Statistics. The AHA data file consists of hospital profile variables such as ownership status, number of hospital beds, teaching status, multihospital system affiliation, and the number of clinical and non-clinical staff. The AHRF data file contains demographic and economic information on counties. The MCR data file contains financial data; it is the most validated and widely accepted data file for hospital financial analysis (Pink, Holmes and D'Alpe, 2005). The Impact Files contain Case Mix Index (CMI) of each individual hospital. The LAUS data file contains estimates of monthly and annual averages of employment measures for metropolitan areas, cities, and counties.

This study used a national sample of non-federal, government-owned, acute care, general and surgical hospitals operating in the US as of 1997. These hospitals were tracked each year through 2013. Our original sample consisted of 1,225 public hospitals. To derive the analytic sample, several exclusion criteria were applied. First, hospitals that converted to a skilled nursing facility (n= 6) or an ambulatory care facility (n=2) were excluded. Second, critical access hospitals (n=557) were also excluded because they have a different reimbursement environment. Third, we excluded hospitals that were acquired or merged (n= 16) during the study period. Fourth, hospitals without complete financial reports across the study period were excluded from the analytic sample (n= 139). Fifth, hospitals that experienced multiple ownership conversions (n= 34) during the study period were excluded from the analytic sample. Finally, 35 hospitals that closed during the study period were deleted from the data file. As a result, our final analytic sample consisted of a cohort of 436 public hospitals (7,386 hospital-year observations).

Variables

Dependent variables

We used financial and non-financial measures of efficiency and productivity. Prior studies have suggested that using both financial and non-financial measures of hospital performance is beneficial given that financial measures focus on short-term performance and lack the information needed to comprehensively evaluate a hospital's performance (Watkins, 2000). Following Watkins (2000), our financial measures of efficiency consisted of Fixed Asset Turnover (FATO) and Current Asset Turnover (CATO). Fixed assets are among the least liquid assets; those that are difficult to convert into cash in a short term. Land, buildings, and equipment constitute such assets (Gapenski and Reiter, 2015). Current assets consist the most liquid assets such as cash and other assets that can be converted into cash within one accounting period such as net patient accounts receivable (Gapenski and Reiter, 2015). FATO refers to the ratio of Total Revenue to Net Fixed Assets. It measures fixed asset efficiency calculated as the total revenue generated for each dollar worth of fixed assets (Watkins, 2000; Gapenski and Reiter, 2015). CATO measures working capital efficiency and is defined as the ratio of Total Operating Revenue to Current Assets (Watkins, 2000). It measures the amount of patient revenue generated per one dollar worth of current assets (Gapenski and Reiter, 2015). Higher FATO and CATO indicate higher efficiency.

Our non-financial measures of efficiency consisted of occupancy rate, total full-time equivalent (FTE) employees per occupied bed, and work hours per adjusted patient day. These measures have been used in prior studies of efficiency (Watkins, 2000; Velez-Gonzalez, Pradhan and Weech-Maldonado, 2011; Sear, 1991). Occupancy rate consisted of the ratio of total inpatient days to the product of total number of beds and 365 days. FTE employees per occupied bed estimated the number of total employees needed to provide inpatient services per patient. Work hours per adjusted patient day measured labor intensity; it estimated the total number of hours needed to provide services to the patient. Adjusted patient day takes into account outpatient visits and in-hospital stays. Higher occupancy rate represents higher efficiency, but higher FTE employees per occupied bed as well as higher work hours per adjusted patient day indicate lower efficiency. To measure productivity, we used case-mix adjusted admissions per FTE; it indicates manpower productivity. The total number of admissions for each hospital was adjusted by multiplying total

admissions by case mix index (CMI). CMI measures the intensity of hospital services according to the severity of disease.

Independent variable

Our independent variable was privatization. To test Hypotheses 1a and 1b, privatization was a dichotomous variable coded as "1" if the hospital privatized (the year of privatization and subsequent years were coded as 1) and "0" if the hospital remained public.[26] To test Hypotheses 2a and 2b, we created two dichotomous variables to represent conversion to NFP status and conversion to FP status.

Control variables

This study controlled for organizational and market characteristics that may influence efficiency and productivity (Rosko, 1999; McKay, Deily and Dorner, 2002). Organizational characteristics included hospital size, teaching status, outpatient mix, payer mix**,** multihospital system membership, contract management, and participation in health networks. In addition, occupancy rate was included as a control variable when it was not the dependent variable. CMI was also included as a control variable except when case mix adjusted admissions per FTE was used as the dependent variable.

Market characteristics included the following variables: per capita income, unemployment rate, percentage of people who were 65 years of age and older, number of active physicians per 1,000 persons, yearly change in unemployment rate, Medicare managed care penetration, market competition measured by Herfindahl Hirschman Index (HHI), and excess capacity. The operational definitions of the variables are summarized in Table 1.

Table 1. List of Variables and Operational Definitions

Variable	Operational Definition	Data Source
Dependent Variables - Efficiency		
Fixed asset turnover (FATO)	Total Revenue / Net Fixed Assets	MCR[a]
Current asset turnover (CATO)	Total Operating Revenue / Current Assets	MCR
Occupancy rate	Total Inpatient Days / (# beds*365 days)	AHA[b]
FTE employees per occupied bed[g]	Total FTE employees / # occupied beds	AHA
Work hours per adjusted patient day[g]	Total work hours / (inpatient days + (inpatient days *(Outpatient revenue/Inpatient revenue))	AHA
Dependent Variable- Productivity		
Case mix adjusted admissions per FTE	(Total admissions *Case Mix index) / Total FTEs	AHA CMS IF[c]

Table 1. Continued

Variable	Operational Definition	Data Source
Independent Variables		
Privatization from public to private status	**Hypotheses 1a and 1b** Dichotomous: Privatization= 1 No privatization =0	AHA
Privatization from public to either private for-profit of private not-for-profit status	**Hypotheses 2a and 2b** Dichotomous: Privatization to FP=1 No privatization to FP= 0 Dichotomous: Privatization to NFP = 1 No privatization to NFP =0	
Control Variables-Organizational Factors		
System Membership	Dichotomous: System member hospital =1 Stand-alone hospital = 0	AHA
Contract management	Dichotomous: Under contract management = 1 Not under contract management =0	AHA
Health network	Dichotomous: Health network participant = 1 Not health network participant =0	AHA
Hospital beds	Total number of beds in the hospital	AHA
Teaching status	Dichotomous: Having teaching activities = 1 No teaching activities =0	AHA
Occupancy rate	Total Inpatient Days /(# beds*365 days)	AHA
Outpatient mix	Total outpatient visits (equivalent inpatient days) = total outpatient visits/3 Total equivalent inpatient days = (total outpatient patient visits / 3) + total inpatient days Outpatient mix = (total outpatient visit /3) / Total equivalent inpatient days	AHA
Percent Medicare inpatient days	Medicare inpatient days/total inpatient days	AHA
Percent Medicaid inpatient days	Medicaid inpatient days /total inpatient days	AHA
Case Mix index	Measures intensity of hospital services according to disease severity	CMS IF
Control Variables- Market Factors[f]		
Per capita income	Total income in county/total number of residents	AHRF[d]
Unemployment rate	Total number of unemployed labor force/total labor force	LAUS
Percentage of population ≥ 65 years old	Total number of people ≥ 65 years old /total population	AHRF
Active physicians/ 1000 pop	(Number of active physicians/total population)*1000	AHRF
Herfindahl Hirschman Index (HHI)	Herfindahl Index=Σ squared market share of all the hospitals in the Health Service Area. Market share for each hospital is measured in term of total acute-care patient days for individual hospitals /the total acute-care patient days in the Health Service Area	AHRF AHA
Excess capacity	Total number of unoccupied beds in the county/total number of hospitals in the county	AHRF

Table 1. Continued

Variable	Operational Definition	Data Source
Medicare managed care penetration	Medicare managed care enrollees/Total Medicare eligibles	AHRF
Yearly change in unemployment rate	Fluctuation of unemployment rate from year to year	LAUS[e]

Notes:
a. Centers for Medicare and Medicaid Services Cost Reports
b. American Hospital Association Annual Survey
c. Centers for Medicare and Medicaid Services Impact Files
d. Area Health Resources Files
e. Local Area Unemployment Statistics
f. All market factors control variables were measured at county level except for HHI, which was measured at the Health Service Area level
g. Lower value means higher efficiency

Analysis

To meet the normality assumption for each of our dependent variables, observations with values five standard deviations above or below the mean were deleted (Weech-Maldonado, et al., 2012). In addition, the dependent variable FATO was log transformed to account for skewness and kurtosis.

We conducted descriptive statistics and calculated Pearson's correlations of all independent variables. There were no pairwise correlations above 0.80 for any of the control variables, a typical threshold used to assess potential multicollinearity. We also used cross-tabulations and ANOVAs as well as linear regressions with hospital-level and year fixed-effects. The fixed-effects (FE) model is the appropriate model to examine the impact of privatization on efficiency and productivity, since it controls for time-invariant, unobservable variables that may explain between-hospital differences; therefore, focusing on within-hospital variations in efficiency and productivity as a result of privatization. Failing to do so can lead to biased results due to omitted variables (Woolridge, 2013). The FE linear regressions were modeled as follow:

$Y_{it}=\alpha + \beta_{1*} Pr_{it} + \beta_{2*}C_{it} + \beta_{3*}Year + \mu_{it}$ (Hypotheses 1a and 1b)
$Y_{it}=\alpha + \beta_{1*} Prfp_{it} + \beta_{2*} Prnp_{it} + \beta_{3*}C_{it} + \beta_{4*}Year + \mu_{it}$ (Hypotheses 2a and 2b)

Where:
Y: Dependent variable (efficiency, productivity)
Pr: Privatization from public to private status
Prfp: Privatization from public to for-profit status
Prnp: Privatization from public to not-for-profit status
C: Control variables (organizational and market characteristics)
Year: Year dummy variables
i: Individual hospital; t: Each individual year; μ: Error term

Joint tests were also used, following the regression models, for Hypotheses 2a and 2b, to test the null hypothesis that the beta coefficients of privatization to FP and privatization to NFP were statistically the same. The analyses were conducted using STATA version 14.

Results

A total of 104 hospitals (24 percent) privatized during the study period. Among privatized hospitals, 75 hospitals (17 percent) privatized to not-for-profit status and 29 hospitals (7 percent) privatized to for-profit status. Table 2 presents the results of the cross-tabulations and ANOVAs. A larger percentage of hospitals that privatized to FP were members of multihospital systems (75 percent) compared with hospitals that privatized to NFP (53 percent). Compared to hospitals that privatized to FP, a larger percentage of hospitals that privatized to NFP were under contract management (11 percent), participants in health networks (36 percent), and teaching hospitals (24 percent). Furthermore, hospitals that privatized to NFP were the largest, with an average size of 220 beds, compared with hospitals that privatized to FP (104 beds) and hospitals that remained public (196 beds). Hospitals that privatized to FP had the lowest CMI (1.18) and the lowest percent Medicaid inpatient days (18 percent), but the highest percent Medicare inpatient days (56 percent).

Figure 2. Cross-Tabulations and Analysis of Variance[a]

Mean/Frequency (%)	Remained Public	Public=> FP	Public=>NFP	P-value[b]
Dependent Variables				
Current Asset Turnover	2.81	4.91	3.06	<0.001
Fixed Asset Turnover	1.58	2.08	1.80	<0.001
Occupancy Rate	0.57	0.48	0.57	<0.001
FTE Employee per occupied bed	10.35	8.99	10.35	<0.001
Work Hours per Adjusted Patient Days	27.46	26.67	26.66	0.11
Case Mix Adjusted Admissions per FTE	9.98	12.61	10.99	<0.001
Independent Variable – Privatization	6,484 (88.79)	246 (3.33)	656 (8.88)	
Control Variables – Organizational Factors				
System Membership				
Yes	1,769 (27.28)	185 (75.20)	348 (53.05)	<0.001
No	4,715 (72.72)	61 (24.80)	308 (46.96)	
Contract Management				
Yes	944 (14.56)	14 (5.69)	75 (11.43)	<0.001
No	5,540 (85.44)	232 (94.31)	581 (88.57)	

Figure 2. Continued

Mean/Frequency (%)	Remained Public	Public=> FP	Public=>NFP	P-value[b]
Health Network				
Yes	1,530 (23.60)	35 (14.23)	236 (35.98)	<0.001
No	4,954 (76.40)	211(85.77)	420 (64.02)	
Teaching Status				
Yes	1,609 (24.81)	31 (12.60)	160 (24.39)	<0.001
No	4,875 (75.19)	215 (87.40)	496 (75.61)	
Hospital beds	196	104	220	<0.001
Percent Medicare inpatient days	45	56	49	<0.001
Percent Medicaid inpatient days	24	18	21	<0.001
Outpatient mix	0.53	0.50	0.53	<0.05
Case Mix Index	1.28	1.18	1.36	<0.001
Control Variables – Market Factors				
Per capita income	29,400	31,736	34,202	<0.001
Unemployment rate	6.34	7.60	6.65	<0.001
Percentage of population ≥ 65	0.14	0.15	0.14	<0.001
Physicians per 1000 population	2.00	2.00	2.00	<0.01
Excess capacity	60	53	61	<0.05
Herfindahl Hirschman Index	0.87	0.86	0.87	=0.55
Medicare managed care penetration	0.12	0.13	0.18	<0.001
Change in unemployment rate	0.04	0.05	0.05	=0.19

Notes:
a. Frequencies are expressed in hospital-year observations
b. Statistically significant at $p \leq .05$

With respect to environmental factors, hospitals that privatized to NFP tended to be located in counties with higher per capita income and hospitals that remained public were located in counties with lower per capita income. Furthermore, hospitals that privatized to NFP were more likely to be located in more competitive markets, in terms of excess capacity and Medicare managed care penetration, compared with hospitals that privatized to FP status.

Table 3 presents the results of the fixed-effects linear regressions related to Hypotheses 1a and 1b. Hypothesis 1a was partially supported. Privatization was associated with increased efficiency in terms of CATO (β=0.63; $p \leq 0.001$) and FATO (β=0.23; $p \leq 0.001$). Furthermore, privatization was associated with a decrease in FTE employees per occupied bed (β= -0.93; $p \leq 0.001$) and a marginally significant decrease in work hours per adjusted patient day (β= - 0.68; $p \leq 0.10$). Privatization was also associated with increased productivity in terms of case mix adjusted admissions per FTE (β=0.83; $p \leq 0.001$); thus, Hypothesis 1b was supported.

Table 3. Fixed Effects Linear Regression Models to Test Hypotheses 1a and 1b (n = 7,386)[a]

	Current Asset Turnover	Log_Fixed Asset Turnover	Occupancy Rate	FTE Employees per Occupied Bed	Work Hours per Adjusted Patient Day	Case Mix Adjusted Admissions per FTE
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Independent Variable						
Privatization from Public to Private	0.63**** (0.08)	0.23**** (0.03)	-0.001 (0.001)	-0.93**** (0.17)	-0.68* (0.40)	0.83**** (0.13)
Control Variables Organizational Factors						
System membership	0.20*** (0.06)	-0.24 (0.02)	-0.001 (0.005)	0.29** (0.14)	0.14 (0.33)	0.14 (0.11)
Contract management	-0.13** (0.06)	0.01 (0.02)	0.01 (0.04)	0.07 (0.14)	0.21 (0.33)	0.07 (0.11)
Health Network	-0.09** (0.05)	-0.04 (0.02)	-0.0002 (0.004)	-0.02 (0.11)	-0.39 (0.24)	0.04 (0.08)
Hospital beds	0.001*** (0.0004)	0.0001 (0.0001)	-0.0003**** (0.00003)	-0.01**** (0.001)	-0.03**** (0.002)	0.002**** (0.001)
Teaching status	-0.12 (0.07)	0.11**** (0.03)	-0.001 (0.01)	0.30* (0.16)	1.22**** (0.009)	0.05 (0.12)
Occupancy rate	0.19 (0.17)	0.01 (0.06)	-	-0.13**** (0.004)	-0.23**** (0.01)	0.03**** (0.003)
Outpatient mix	-0.07 (0.18)	0.07 (0.07)	-0.43**** (0.01)	10.06**** (0.40)	0.12**** (0.01)	-0.02**** (0.003)
Percent Medicare inpatient days	0.01 (0.16)	-0.17*** (0.06)	-0.10**** (0.01)	0.42 (0.36)	0.04**** (0.01)	0.01**** (0.003)
Percent Medicaid inpatient days	0.18 (0.17)	-0.03 (0.07)	0.04*** (0.01)	-0.72* (0.39)	-0.03*** 0.01)	-0.001 (0.003)
Case mix index	0.63**** (0.18)	0.16** (0.07)	0.04*** (0.01)	-1.25**** (0.36)	0.03**** (0.01)	-
Control Variables – Market Factors						
Per capita income	-0.0002 (0.0003)	-0.0001 (0.0001)	-0.000001 (0.00003)	-0.004**** 0.001	-0.0003 (0.002)	0.003**** (0.001)
Unemployment rate	0.02** (0.01)	0.01**** (0.004)	0.001 (0.001)	0.03 (0.02)	0.28**** (0.05)	0.01 (0.02)
Percentage of population ≥ 65	-0.02 (0.01)	0.70 (0.54)	-0.11 (0.10)	-0.03 (0.03)	-0.01 (0.10)	0.02 (0.02)
Physicians /1000 pop	0.07 (0.04)	-0.03* (0.02)	0.01*** (0.003)	0.23** (0.09)	0.59*** (0.22)	-0.18** (0.07)

Table 3. Fixed Effects Linear Regression Models to Test Hypotheses 1a and 1b (n = 7,386)[a]

	Current Asset Turnover	Log_Fixed Asset Turnover	Occupancy Rate	FTE Employees per Occupied Bed	Work Hours per Adjusted Patient Day	Case Mix Adjusted Admissions per FTE
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Control Variables – Market Factors						
Excess capacity	0.001 (0.001)	0.001** (0.0003)	-0.002**** (0.00001)	-0.01**** (0.002)	-0.01*** (0.004)	0.0004 (0.001)
Herfindahl-Hirschman Index	-0.07 (0.08)	-0.08** (0.03)	0.02*** (0.006)	-0.37** (0.18)	-0.90** (0.42)	0.58**** (0.14)
Medicare Managed care penetration	1.17**** (0.28)	-0.08 (0.11)	-0.01 (0.02)	0.43 (0.62)	-0.02* (0.01)	0.02**** (0.005)
Change in unemployment rate	-0.02 (0.09)	0.03 (0.04)	0.01 (0.01)	-0.09 (0.21)	-0.90* (0.49)	-0.10 (0.16)
Overall F-test	7.03****	4.54****	81.04****	193.45****	62.18****	43.40****

Notes: *p ≤ 0.10 **p ≤ 0.05 ***p ≤0.01 ****p ≤ 0.001

[a] Sample sizes are expressed in hospital-year observations

Table 4 presents the results of the analyses associated with Hypotheses 2a and 2b. Hypothesis 2a was partially supported. Privatization to FP status was associated with a greater increase in efficiency in terms of CATO (β=1.47; p ≤ 0.001) and FTE employees per occupied bed (β=-2.11; p ≤ 0.001) compared with a smaller increase in efficiency for hospitals that privatized to NFP with CATO (β=0.24; p ≤ 0.01) and FTE employees per occupied bed (β = -0.40; p ≤ 0.001). However, contrary to our expectation, privatization to NFP was associated with a greater increase in efficiency in terms of FATO (β = 0.24; p ≤ 0.001), work hours per adjusted patient day (β = -1.65; p ≤ 0.001), and occupancy rate (marginally significant; β = 0.01; p ≤ 0.10), compared with privatization to FP status. Hypothesis 2b was supported. Privatization to FP status was associated with an increase of 2.4 points in case-mix adjusted admissions per FTE (p ≤ 0.001), on average, compared with privatization to NFP status. The joint tests were statistically significant at p ≤ 0.01, indicating that the beta coefficients were statistically different between privatization to FP and NFP.

Several organizational and environmental factors were associated with the dependent variables. We found relatively similar results with respect to the relationships between the dependent variables and the control variables for Hypotheses 1a and 2a as well as Hypotheses 1b and 2b. The following section summarizes the control variables significantly associated with the dependent variables at p ≤ 0.05 or less, based on the results of Hypotheses 2a and 2b (Table 4).

Table 4. Fixed Effects Linear Regression Models to Test Hypotheses 2a and 2b. (n =7,386)[a]

	Current Asset Turnover	Log_Fixed Asset Turnover	Occupancy Rate	FTE Employees per Occupied Bed	Work Hours per Adjusted Patient Day	Case Mix Adjusted Admissions per FTE
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Independent Variable						
Privatization from Public to for-profit	1.47**** (0.13)	0.19**** (0.05)	-0.03*** (0.01)	-2.11**** (0.29)	1.41** (0.66)	2.38**** (0.21)
Privatization from Public to Not-for-profit	0.24*** (0.09)	0.24**** (0.04)	0.01* (0.01)	-0.40* (0.20)	-1.65**** (0.47)	0.11 (0.15)
Control Variables Organizational Factors						
System membership	0.19*** (0.07)	-0.02 (0.02)	-0.001 (0.005)	0.31** (0.14)	0.13 (0.33)	0.12 (0.11)
Contract management	-0.08 (0.06)	0.01 (0.02)	0.004 (0.005)	0.002 (0.14)	0.33 (0.33)	0.16 (0.11)
Health Network	-0.10** (0.05)	-0.04** (0.02)	-0.0002 (0.004)	-0.02 (0.11)	-0.40 (0.24)	0.04 (0.08)
Hospital beds	0.001** (0.0004)	0.0001 (0.0001)	-0.0003**** (0.00003)	-0.01**** (0.001)	-0.03**** (0.002)	0.002**** (0.001)
Teaching status	-0.10 (0.07)	0.11**** 0.03	-0.001 (0.01)	0.27* (0.16)	1.27**** (0.38)	0.10 (0.12)
Occupancy rate	0.25 (0.16)	0.07 (0.06)	-	-0.13**** (0.004)	-0.23**** (0.01)	0.03**** (0.003)
Outpatient mix	-0.01 (0.17)	0.07 (0.07)	-0.43**** (0.01	9.96**** (0.40)	0.12**** (00.1)	-0.02**** (0.003)
Percent Medicare inpatient days	-0.08 (0.16)	-0.16** (0.06)	-0.09**** (0.01)	0.55 (0.36)	0.04**** (0.01)	0.01**** (0.003)
Percent Medicaid inpatient days	0.18 (0.17)	-0.03 (0.07)	0.04*** (0.01)	-0.72* (0.30)	-0.03*** (0.01)	-0.001 0.003
Case mix index	0.64**** (0.18)	0.16** (0.07)	0.04*** (0.01)	-1.26**** (0.36)	0.03**** (0.01)	-
Control Variables – Market Factors						
Per capita income	-0.0001 (0.003)	-0.0001 0.0001	-0.000006 (0.00003)	-0.004**** (0.001)	-0.00002 (0.002)	0.003**** (0.001)
Unemployment rate	0.02** (0.10)	0.01**** (0.004)	0.001 (0.001)	-0.08 (0.21)	0.29**** (0.05)	0.02 (0.02)
Percentage of population ≥ 65	-0.02 (0.01)	0.71 (0.54)	-0.11 (0.10)	-0.03 (0.30)	-0.01 (0.07)	0.02 (0.02)
Physicians /1000 pop	0.08** (0.04)	-0.03* (0.02)	0.01*** (0.003)	0.21** (0.09)	0.63*** (0.22)	-0.15** (0.07)

Table 4. Continued

	Current Asset Turnover	Log_Fixed Asset Turnover	Occupancy Rate	FTE Employees per Occupied Bed	Work Hours per Adjusted Patient Day	Case Mix Adjusted Admissions per FTE
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Control Variables – Market Factors						
Excess capacity	0.001 (0.001)	0.001** (0.0003)	-0.002**** (0.0001)	-0.01**** (0.002)	-0.01*** (0.004)	0.0002 (0.001)
Herfindahl-Hirschman Index	-0.06 (0.08)	-0.08** (0.03)	0.02*** (0.01)	-0.38** (0.18)	-0.89** (0.42)	0.59**** (0.13)
Medicare Managed care penetration	1.31**** (0.28)	-0.10 (0.11)	-0.02 (0.02)	0.22 (0.62)	-0.20 (0.01)	0.02**** (0.005)
Change in unemployment rate	-0.03 (0.09)	0.03 (0.04)	0.01 (0.01)	-0.08 (0.21)	-0.92* (0.48)	-0.10 (0.15)
Overall F-test	8.78****	4.44****	79.24****	189.57****	61.04****	45.13****

Notes: *p ≤ 0.10 **p ≤ 0.05 ***p ≤0.01 ****p ≤ 0.001
a. Sample sizes are expressed in hospital-year observations

We found several associations between the organizational and environmental factors and the measures of efficiency. Hospital size was positively associated with CATO (β =0.001); it was negatively associated with occupancy rate (β = -0.0003), FTE employees per occupied bed (β= -0.13) and work hours per adjusted patient day (β = -0.23). Occupancy rate was negatively associated with FTE employee per occupied bed (β=-0.13) and work hours per adjusted patient day (β=-0.23). Higher outpatient mix was associated with lower occupancy rate (β =-0.43) as well as higher FTE employees per occupied bed (β =9.96) and work hours per adjusted patient day (β=0.12). Percent Medicare inpatient days had a negative association with FATO (β =-0.16) and occupancy rate (β=-0.09) but a positive association with work hours per adjusted patient day (β=0.04). However, percent Medicaid inpatient days had a positive association with occupancy rate (β=0.04) but a negative association with work hours per adjusted patient day (β= -0.03). CMI was positively associated with CATO (β=0.64), FATO (β =0.16), occupancy rate (β=0.04) and work hours per adjusted patient day (β=0.03); it was negatively associated with FTE employees per occupied bed (β=-1.26).

With respect to market factors, we found per capita income to be negatively associated with FTE employees per occupied bed (β=-0.004). Unemployment rate was positively associated with CATO (β =0.02), FATO (β =0.01), and work hours per adjusted patient day (β=0.29). The number of physicians per 1000 population was positively associated with CATO (β =0.08), occupancy rate (β =0.01), FTE employees per occupied bed (β =0.21), and work hours per adjusted patient day (β =0.63). Higher HHI was associated with decreased FATO (β = -0.08), FTE employees per occupied bed (β = -0.38), and work hours per adjusted patient day (β = -0.89), but it was associated with increased occupancy rate (β =0.02). Higher excess capacity was associated with increased

FATO (β =0.001), but it was associated with decreased occupancy rate (β =-0.002), FTE employees per occupied bed (β=-0.01), and work hours per adjusted patient day (β =-0.01).

Our measure of productivity - case mix adjusted admissions per FTE - was also significantly associated with several control variables at $p \leq 0.05$ or less. The organizational factors positively associated with case mix adjusted admissions included hospital beds (β =0.002), occupancy rate (β=0.03,) and percent Medicare inpatient days (β=0.01). Outpatient mix was negatively associated with case mix adjusted admissions per FTE (β =-0.02). In addition, environmental factors per capita income (β=0.003), HHI (β =0.59), and Medicare managed care penetration (β=0.02) were positively associated with case mix adjusted admissions per FTE. The number of physicians per 1000 population was associated with a decrease in case mix adjusted admissions per FTE (β= -0.15)

Discussion

This study examined the impact of public hospitals' privatization on efficiency and productivity. We further explored whether privatization to for-profit status results in higher efficiency and productivity compared with privatization to not-for-profit status. Our major finding indicates that privatization enhances efficiency and productivity. Privatized hospitals tend to experience improved efficiency in terms of working capital efficiency (CATO), long-term assets utilization (FATO), and manpower employment (FTE employees per occupied beds and work hours per adjusted patient day). In addition, privatized hospitals tend to experience greater productivity in terms of case mix adjusted admissions per FTE. Unlike public hospitals, privatized hospitals are not subject to the same levels of heavy bureaucracy, burdensome social responsibilities, and politics. Therefore, they may be able to more efficiently use their assets and be more productive.

Additional major findings suggest that, compared with hospitals that are privatized to NFP, hospitals that are privatized to FP experience higher efficiency in working capital utilizations as well as manpower utilization (FTE employees per occupied bed). The greater increase in working capital utilization in FP privatization, compared with NFP privatization, may be a result of better inventory and accounts receivable management. In addition, given that FP hospitals have to maximize shareholder wealth, they may tend to prioritize short-term financial performance by focusing more on working capital utilization instead of long-term asset utilization. It may also be the result of FP hospitals enhancing their payer mix, which results in increased operating revenue and consequently, enhanced working capital utilization. Our data show that hospitals that privatized to FP tend to have a higher proportion Medicare patients and lower proportion of Medicaid patients compared with hospitals that privatized to NFP. With respect to employee utilization, since employee salary and compensation account for the largest portion of a hospital's budget, on average; hospitals privatized to FP may aggressively reduce the number of employees to contain costs (Tiemann and Schreyögg, 2012).

Furthermore, hospitals privatized to FP experience higher productivity in terms of increased admissions per FTE. Since FP hospitals have an obligation to maximize shareholders' wealth, they likely seek the highest possible profit through efficient use of resources. There are two potential mechanisms that may explain the observed impact of FP privatization on productivity. On the one

hand, because FP hospitals are more market driven than NFP hospitals (Sear, 1991), they may use aggressive marketing strategies to attract more patients, resulting in increased admissions. On the other hand, increased case mix adjusted admissions per FTE may be explained by the observed reduction in FTEs in for-profit privatization.

Some findings, however, were contrary to our expectations. First, our results suggest that hospitals that privatized to NFP experienced a greater increase in efficiency, compared with hospitals that privatized to FP, with respect to long-term assets utilization and manpower utilization (work hours per adjusted patient day). Since profit maximization is not the main objective of NFPs, they may focus more on the use of long-term assets instead of short-term working capital. Furthermore, given their not-for-profit status, hospitals that privatize to NFP may hire more educated nurses, resulting in decreased amount of time taking care for the patients. Second, we found that hospitals that privatized to NFPs were more efficient than hospitals privatized to FPs with respect to capacity utilization. Higher occupancy rate may result in economies of scale as resources are shared across a larger number of patients. This may explain the greater efficiency of NFP in terms of work hours per patient day.

Our study has some limitations with respect to the variables needed for this study. For instance, a hospital's efficiency may depend on payer mix, but we could not control for the proportions of privately insured, underinsured and uninsured patients due to lack of data. These variables could have provided insights on whether serving non-Medicare and non-Medicaid patients has an impact on efficiency. However, the data for this study have been widely used in health care research streams and this study provides insights into the impact of public hospitals' privatization on efficiency and productivity. Additional empirical studies on public hospitals' privatization are needed in terms of the impact of privatization on patient satisfaction, employee satisfaction, physician satisfaction, competitive landscape, pricing of health care services, access to health care services, and quality of care.

Managerial and Policy Implications

The findings from this study provide a number of insights for health care management. The major findings indicate that privatization enhances efficiency and productivity. Therefore, public constituencies could consider privatization as an alternative strategy if a public hospital experiences low efficiency and productivity. However, administrators and other stakeholders considering privatization should consider other factors. For instance, while privatization to FP results in a significant improvement in productivity, it does not consistently result in a significant and superior efficiency compared with privatization to NFP. Hospitals that privatize to NFP tend to focus more on work hour reduction while hospitals that privatize to FP tend to focus more on reducing the number of employees as well as increasing working capital efficiency. This implies that privatization is not a panacea that can solve all aspects of public hospitals' inefficiency. It is a strategy that can improve some areas but not others.

Likewise, our study findings and those of Tiemann and Schreyögg (2010, 2012), suggest that privatization enhances efficiency. However, efficiency, particularly in terms of manpower, may come at the expense of other dimensions of health care delivery such as health care access and quality. Evidence suggests that privatization has been linked to a decline in health care quality

such as increased mortality rate for patients with acute myocardial infarction (Shen, 2002), increased crude mortality rate (Picone, Chou and Sloan, 2002), and increased pneumonia complications (Sloan, 2002). Therefore, hospital administrators and other stakeholders considering privatization must also consider the balance between efficiency and quality. Other research suggests that privatized hospitals may shed their role as safety net hospitals, resulting in decreased uncompensated care (Thorpe, Florence and Sieber, 2000; Desai, Lucas and Young, 2000; Needleman, Laphere and Chollet, 1999), and increased probability of closures of specialized services (Villa and Kane, 2013; Shen, 2003).

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