



Changes in Hospital Quality after Conversion in Ownership Status

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This paper examines the effects of conversions between For-Profit and Not-For-Profit forms on quality of medical care in California hospitals. The sample includes elderly patients treated in California's private hospitals from 1990 to 1998 for Acute Myocardial Infarction and Congestive Heart Failure. The results suggest that converted hospitals have experienced quality changes before conversion and that ignoring these changes may bias the estimates of conversion effects. Both conversions are found to have some adverse consequences: Hospitals that converted to FP form show an increase in AMI mortality rates, while those converted to NFP status indicate an increase in CHF mortality outcomes.

Keywords: ownership conversions, hospital quality, mortality, medicare beneficiaries

JEL classification: L31, I18, I11

1. Introduction

Recent conversions of not-for-profit (NFP) hospitals¹ to for-profit (FP) status have raised public concerns about possible detrimental effects on quality of care (cf. Goddeeris and Weisbrod, 1998; Kuttner, 1996a, b; Ho and Hamilton, 2000). A common perception is that NFP institutions are committed to providing quality care regardless of costs. In fact, following Arrow (1963) theoretical models often assume that providers choose the NFP form of organization in order to signal this high commitment to quality (Frank and Sulkever, 1994; Glaeser and Schleifer, 1998).

There is a growing literature on the effects of ownership status on the quality of care.² However, only a limited number of papers have studied the effect of conversion from one form to the other. All these studies have assumed that the conversion effects on quality appear after the conversion. There is however, some evidence that conversions are usually preceded by financial difficulties (Sloan, 2002; Mark, 1999). Converted hospitals may therefore be subject to some gradual changes that potentially affect the quality of care prior to conversion. For instance, hospitals in financial distress may have started to deteriorate in quality long before conversion. In this case even if the conversion does improve the situation, failure to control for the pre-conversion changes may lead to the conclusion that conversion resulted in lower quality.

This paper examines the effects of conversions between FP and NFP forms in the California hospital market over the nine-year period between 1990 and 1998 using models with hospital fixed effects. It differs from the previous literature in several aspects. First, the time-variations of quality before conversion are taken into account by controlling for a linear trend before each type of conversion. Secondly, in contrast with Sloan (2002) and Shen (2002), there is no restrictive assumption on the conversion effects on quality.³ Finally, while all the above studies used a national sample of hospitals (Medicare data), this paper considers a relatively uniform sample including California's private short-term hospitals. The US states are quite different regarding FP sector's share in hospital markets, ranging from states with virtually no FP sector to markets dominated by FP hospitals. Since the presence of FP hospitals may affect the behavior of the NFP hospitals in the same area,⁴ the NFP hospitals in different states may be significantly different from each other. California hospital market is characterized by a relatively large FP sector that has remained more or less constant over the study period.

One of the important difficulties in studying the ownership effects on hospital quality is the selection bias. Patients with acute diseases are likely to choose the closest hospital. For instance, paramedics are instructed to take heart attack patients to the nearest hospital. In this paper the patient mix characteristics that are related to the hospital's location are taken into account through hospital fixed effects. Patient selection into a hospital may also be different before and after its conversion. For instance, an institution that changes from NFP to FP status may step up efforts to discourage the admission of unprofitable patients. Moreover, as suggested by Geweke, Gowrisankaran and Town (2003), patients with higher unobserved severity are more likely to choose higher-quality hospitals. Therefore, in the presence of unobserved severity factors, conversion effects may be biased (selection bias). In order to identify the direction and importance of such biases, I exploit the fact that patients admitted through the Emergency Room are less affected by systematic selection. Generally, these patients do not have time to plan their hospitalizations and are likely to go to the closest hospital. Moreover, California hospitals are required to treat patients in emergency situations regardless of their insurance coverage.⁵ These considerations suggest that the measured effects of conversion should be less biased among the ER patients.

The results of this paper generally indicate that conversions to both FP and NFP forms may have adverse effects on quality. While conversion to FP status is found to increase the in-hospital mortality of AMI patients, conversion to NFP form has increased the mortality probability in the CHF sample. These results suggest that health outcomes in different diagnoses may represent different dimensions of hospital quality. This paper's findings also suggest that hospitals that convert from one status to another may be subject to certain changes prior to conversion and neglecting such variations may lead to a considerable bias in the estimation of conversion effects.

The rest of the paper proceeds as follows: Section 2 reviews some of the previous literature. A description of the data and the adopted measures of quality is given in Section 3. Section 4 explains the econometric methodology and discusses potential sources of bias. Section 5 provides the results and Section 6 concludes the paper.

2. Background

Between 1970 and 1995, 330 of 5,000 NFP hospitals (about 7%) converted to FP type (Cutler and Horwitz, 2000). These conversions accelerated in the mid-90s. For example, 58 conversions occurred in 1995, up from 34 in 1994 (Kuttner, 1996a). These developments have spurred a large literature on the effects of FP and NFP status on quality of care, but the results are far from conclusive largely because of the difficulty of controlling adequately for patient selection. As Kessler and McClellan (2001) suggest, more productive hospitals may attract sicker patients. Geweke, Gowrisankaran and Town (2003) provide some evidence that patients with higher unobserved severity are more likely to be hospitalized in high quality institutions.

Studies such as Gowrisankaran and Town (1999), Ettner and Hermann (2001) and McClellan, McNeil and Newhouse (1994) suggest that many patients choose the closest hospital, but this does not mean that FP status can be treated as exogenous determinant of mortality because FP hospitals are more likely to locate in areas with better insured patients, for example in areas with high proportion of Medicare patients (Norton and Staiger, 1994). McClellan and Staiger (2000) found that NFP hospitals have slightly lower mortality rates in a sample of elderly AMI patients, but reported that the estimated effects fell by almost half when county fixed effects were included in the model. Sloan (2002) cites these results and concludes that FP hospitals tend to be located in areas with higher mortality rates.

The evidence in general points to the importance of hospital location in patient selection. Given that the hospital location does not change with conversion, the study of conversion effects can shed some light on the issue. Namely, using panel data models with fixed-effects one can account for the unobserved, location-related severity factors. The existing literature on the effects of conversions on quality of care is mainly limited to three papers: Sloan (2002), Picone, Chou and Sloan (2002) and Shen (2002).

All these papers used the Medicare data. Sloan examined the effects of conversions on patients admitted for stroke, hip fracture, coronary heart disease, congestive heart failure and pneumonia. He finds that conversions have no effect on the in-hospital mortality or on the proportion of uninsured patients. His results indicate however, that pneumonia patients treated in hospitals that converted to FP status experienced an increased rate of complications. Sloan argues that the failure to find a significant effect on the in-hospital mortality may reflect shorter hospitalizations after conversion to FP status. Using the same samples, Picone, Chou and Sloan (2002) found that one to two years after conversion to FP status, patients' mortality increases suggesting a decline in quality. Shen (2002) studied the effect of conversions on the health outcomes of Medicare heart attack patients. Her findings suggest that conversion to FP ownership has resulted in a significant increase in mortality probability.

All the three papers have concluded that conversion to FP status has caused a decline in quality, while conversion to NFP status has not shown any significant changes in quality. However, all these studies have assumed that the quality of a converting hospital has remained constant prior to conversion. Given that conversions, especially those hospitals that have been taken over by hospital chains,⁶ are usually caused by financial problems, the

assumption of constant quality of service does not appear to be realistic. It is important to note that financial difficulties are not always together with a decline in quality. It might as well be the case that in an increasingly competitive market, financial problems are due to a high quality of care such as a large nursing staff or expensive materials. It is also reasonable to assume that multi-hospital FP firms are more interested in hospitals that have maintained a high level of quality, which implies a good reputation, a large number of potential clients and better possibilities of savings by eventually lowering the quality.

3. Data

The data used in this paper consist of two main data sets prepared by the California's Office of Statewide Health Planning and Development (OSHPD). The first set is the Patient Discharge Data that includes all the discharge abstracts for all patients discharged from a Californian hospital from 1990 to 1998. Patients younger than 65 are excluded from the sample to obtain a relatively uniform sample of Medicare beneficiaries. The variables include patients' basic characteristics such as age, gender and race, length of stay, severity of the disease, the diagnosed conditions and procedures used for treatment. Severity of illness is defined in four levels (extreme, major, moderate, and minor) according to APR-DRG (All Patient Refined Diagnosis-Related Group) classification. This severity measure and its validity are discussed later in this section.

The second data set is the California's Hospitals Disclosure Data (CADD) from 1989 to 1998. This data set consists of the information obtained from the hospital financial reports submitted annually to the Department of Health Services. All non-federal hospitals are required to report. Hospital characteristics like ownership status, size (number of beds) and type of the hospital are extracted from this data set. Spetz, Seago and Mitchell (1999), Spetz, Mitchell and Seago (2000) and Mitchell et al. (2001) report that the ownership information reported in CADD has a lot of reporting errors. The main problems are non-standard reporting periods, multiple reports in a single year and late reporting or failure to report ownership changes. This data set is corrected using the information reported in the appendix of Spetz, Seago and Mitchell (1999) along with other corrections using Internet sources and a few direct contacts with hospitals.⁷ The status changes in private hospitals are completely checked and corrected. In order to avoid the potential errors related to the conversions of public hospitals, I excluded all hospitals that were public at least for one year within the sample period. In the analyses reported in this paper the unit of observation is a hospital-year with the year being the fiscal year beginning June 30th.⁸ The patient-level data are merged with hospital characteristics using the admission month and year for each patient.

Conversions

The changes in California's acute-care⁹ hospital market share in private FP, private NFP, and public sectors between 1989–90 and 1997–98 are given in Table 1. The changes in the number of hospitals in each sector and the average hospital size in terms of available beds are also given. These numbers suggest that during this period, public and FP

Table 1. Share of California acute-care hospitals by sector in 1990 and 1998.

	Year	FP	NFP	Public
Share of hospital beds (%)	1989–90	20.3	63.3	16.4
	1997–98	20.5	64.8	14.6
Number of hospitals	1989–90	134	238	90
	1997–98	107	233	70
Average size (number of beds)	1989–90	124	217	148
	1997–98	150	217	163

hospitals became fewer but larger. While the number of NFP hospitals increased, their size remained practically unchanged.¹⁰ The total number of acute-care hospitals decreased from 462 hospitals in 1989–90 to 410 hospitals in 1997–98. The NFP sector is however less affected by this consolidation trend. As we will see later, conversions are responsible for part of these asymmetrical changes across different sectors.

The data show three major types of conversion: FP to NFP, NFP to FP, and public to NFP. There are only a few conversions in other directions. Between 1990 and 1998, 11 hospitals converted from FP to NFP form, while 15 NFP hospitals became FP. At the same period 14 hospitals converted from public to NFP status. Among more than 500 acute-care hospitals that have operated in California, about 56 hospitals had at least one conversion during this period. These hospitals on average, account for about 13% of hospital beds in California. Table 2 gives the distribution of conversions between FP and NFP status over time. The number of hospitals and hospital beds are both given. As suggested by these numbers, the conversions are spread over the nine years and do not show any clear temporal pattern.

The variations in the size of the converted hospitals (given in Table 2) suggest that among both FP and NFP hospitals, the relatively large institutions have been more likely to convert in ownership status. However, given that hospital capacity is an endogenous parameter that can change with conversions, it is not included in the model.¹¹ Other hospital characteristics that do not change with conversion, are captured by hospital fixed effects.¹² Market-specific characteristics are not considered in the analysis. First, because the time-invariant and

Table 2. Conversions in California acute-care hospitals between FP and NFP forms.

	Total	Size	Fiscal year starting from the end of June							
			90–91	91–92	92–93	93–94	94–95	95–96	96–97	97–98
FP to NFP	11 (1672)	152	0	4 (533)	2 (218)	1 (162)	1 (274)	1 (118)	1 (230)	1 (137)
NFP to FP	15 (3480)	232	0	2 (262)	0	3 (191)	0	2 (279)	4 (1535)	4 (1213)

Total number of beds is given in brackets. Hospital size is considered as the average number of beds.

general time trends in market characteristics are respectively captured by the hospital fixed effects and year dummies, and the immediate effect of conversions on market shares does not seem to be significant.¹³ Secondly, the market share of FP hospitals in California remained almost constant over the study period.

Patient-Level Data

Hospitalizations of California's elderly patients for the following two diagnostic categories have been chosen: acute myocardial infarction (AMI), and congestive heart failure (CHF).¹⁴ In each case the sample contains all the patients of 65 years of age and older,¹⁵ hospitalized with the corresponding condition as principal diagnosis.¹⁶ Elderly patients provide relatively more homogeneous samples not only regarding age-related risk factors, but also because of a single insurance coverage by Medicare. Moreover, the relatively high risk among these patients helps avoid the small-sample problem caused by rare outcomes such as mortality.

The choice of diagnoses is also based on the variety of treatment methods available. One can expect a higher variation in hospital quality for cardiac diseases whose treatment is chosen from a relatively wide range of procedures. There has been a great amount of innovation in the treatment of cardiac diseases in general and CHF in particular (Braunwald and Bristow, 2000). Since the main measure of quality is based on the in-hospital mortality, the diagnoses are chosen from the most important causes of death. According to the California mortality data, AMI and CHF are ranked among the most deadly diseases in California and throughout the US.¹⁷

Table 3 gives the distribution of the patients and a descriptive summary of some of the features of hospitalizations by sector. The size of the samples varies from about 252,000 for the AMI group to 486,000 for CHF patients. NFP hospitals have the largest share (about 80 percent) of hospitalizations in private hospitals. FP hospitals have the highest mortality rate and the most severely ill cases (according to reported APR-DRG classification) in AMI sample and the lowest mortality and least severe case-mix in CHF group. These numbers also indicate that FP hospitals attract older patients. NFP hospitals have the highest rate of ER admissions and the longest hospitalizations.

The selection patterns observed in Table 3, suggest that an unbiased estimation of ownership effects requires controlling for severity variations across hospitals. The risk factors considered in this paper include demographic covariates like age, gender, race (black/non-black), and ethnicity (Asian and Hispanic groups). Age is considered as five age groups: 65 years to 69, 70 to 74, 75 to 79, 80 to 84, and 85 and older. I also control for the interaction terms of race and gender with age groups. Moreover, a severity index is constructed for every patient based on the APR-DRG classification.¹⁸ Finally, in the case of CHF sample where the diagnosis consists of four main categories, these categories are identified according to the first three digits of the principal diagnosis ICD-9-CM code and are taken into account using three binary indicators.

The APR-DRG measure of severity has been shown to be a powerful predictor of mortality.¹⁹ However, this measure is not directly used as a risk-adjustment factor. First, since it includes all the relevant diagnoses reported at discharge, regardless of whether they are

Table 3. Descriptive summary of hospitalizations in private acute-care hospitals.

Diagnostic group	AMI	CHF
Number of admissions	249,332	482,235
Distribution of admissions (%)		
For-Profit	17.8	21.0
Not-For-Profit	82.2	79.0
Average in-hospital death rate (%) by status and year		
For-Profit	14.5	5.5
Not-For-Profit	13.1	5.9
1990	15.9	7.34
1998	11.4	4.75
Overall	13.3	5.79
Average age (years)		
For-Profit	76.2	78.7
Not-For-Profit	76.0	78.4
Overall	76.0	78.5
Percent of patients with extreme or major severity categories		
For-Profit	46.7	37.3
Not-For-Profit	45.2	38.0
Overall	45.5	37.8
Percent of admissions through ER		
For-Profit	69.0	60.3
Not-For-Profit	70.5	67.9
Overall	70.2	66.3
Average length of stay (days)		
For-Profit	5.97	5.52
Not-For-Profit	6.39	5.62
Overall	6.31	5.60

developed before or after admission, it may include some “preventable” complications as well as “natural” comorbidities. Secondly, given that the Medicare reimbursement system is based on the patient’s diagnosis group, hospitals have an incentive to over-report complications.²⁰ This problem, known as upcoding or DRG creep, may occur differently among hospitals with different ownership status.²¹ In this paper, a severity index based on the APR-DRG classification is used. This index measures the difference between the APR-DRG severity measure of the patient and the average severity of patients within the same hospital-year-diagnosis group. Since this measure only represents the variation within hospital-year, differential upcoding cannot create any bias in the estimation of conversion effects.

Measures of Quality

One of the most commonly used outcome measures of quality is the risk-adjusted in-hospital mortality. There are several validation studies suggesting that adjusted mortality rates can be used as a measure of hospital quality. Thomas, Holloway and Guire (1993) studied the in-hospital mortality rates for ten diagnostic groups of patients separately. For many but not all of these groups, the results showed a significant relationship between risk-adjusted in-hospital mortality and the hospital's quality as evaluated by peer reviews based on explicit and implicit process criteria. The strongest evidence of validity was obtained for cardiac diseases, which may suggest less selection for this kind of patients. Kahn et al. (1990) found similar results using mortality rates 30 days after admission. Significant relationship of risk-adjusted 30-day mortality and several process measures of quality was found in four out of five examined conditions.

Based upon these studies, the risk-adjusted in-hospital mortality probability is adopted as the main measure of quality in this paper. Like most other health outcomes that potentially have some information about hospital quality, mortality is a rare outcome and sometimes takes a long time to manifest, making its measurement difficult. Especially since the hospitals have some discretion on discharging the patients, the differences in hospitals' discharge/transfer policies may distort the in-hospital mortality from the "real" mortality risk. However, this issue seems to be relatively insignificant for cardiac diseases, which generally show a high correlation between in-hospital and long-term mortality. For instance, Rosenthal et al. (2000) find a strong correlation between 30-day (post-admission) mortality rates and in-hospital death rates for a sample of 13,800 CHF patients. They also provide evidence that the small differences in hospitals ranking caused by replacing in-hospital death rates by 30-day mortality rates are not caused by the differences in hospital discharge practices.

As the numbers in Table 3 indicate, the selected diagnoses have relatively high in-hospital death rates. Moreover in both groups, a relatively large part of deaths occur in acute-care hospitals. For instance during 1998 in California, 29.1% of 17,422 deaths caused by AMI and more than half of deaths caused by CHF occurred in short-term hospitals. However, these arguments are not perfectly satisfying. I therefore study the robustness of the results to potential differences in discharge and transfer practices across hospitals. This issue is discussed in more detail later.

Another outcome measure used in this paper is the risk-adjusted probability of early re-admission of AMI patients following discharge from a hospital. Usually re-admission within a short period (typically one month) after an initial discharge is considered as an undesired outcome that could be avoided by the original provider (Thomas and Holloway, 1991; Carey and Burgess, 1999). In some cases re-admission within longer periods of time was used as an indicator of poor quality (Cutler, 1995). However, most of preventable readmissions occur within 10 days of a previous discharge (Frankl, Breeling and Goldman, 1991). Several authors have found that the variations in re-admission probability are related to patient's clinical conditions rather than hospital quality (cf. Thomas and Holloway, 1991; Thomas, 1996; Ludke, Booth and Lewis-Beck, 1993). However, a re-admission for an AMI patient may imply another heart attack, thus a significant increase in patient's mortality risk.

The re-admission measure used in this paper is based on unscheduled re-hospitalizations with AMI as the principal diagnosis within one, two and three months after an initial discharge.²²

4. Methods

The empirical model used in this paper can be formulated as follows:

$$m_{ijt} = \beta X_{ijt} + \gamma Z_{jt} + \tau Y_t + \lambda_j + \varepsilon_{ijt} \quad (1)$$

where m_{ijt} is the quality indicator of patient i hospitalized in hospital j in year t . The quality indicators are binary variables representing the patient's mortality outcome or whether the patient was readmitted after discharge.

X_{ijt} is the vector of patient's characteristics including five age groups, gender, race (black/non-black), two dummies for ethnicity (Asian, Hispanic) and the pair-wise interactions of age groups with gender and with race. This vector also includes a constructed severity index as defined in the previous section, as well as three additional dummies for CHF sample, which represent its main diagnostic sub-categories. Y_t is the vector of year dummies and λ_j is the hospital-specific fixed effect. Finally ε_{ijt} represents an *i.i.d.* random error that represents the unobserved heterogeneities among patients, hospitals, and years.

Z_{jt} is the vector of hospital status. This vector includes four conversion indicators that represent the state of hospital with respect to the conversion year. The coefficients of these variables measure the effect of conversions on quality. The first two of these variables are post-conversion dummy variables, NFP-to-FP and FP-to-NFP. Each of these dummies is set to one if the hospital has gone through the specified conversion in a previous year, and zero otherwise. The other two variables are linear trends ($t_{\text{NFP-to-FP}}$ and $t_{\text{FP-to-NFP}}$) that measure the number of years before the conversion. These variables are set to zero for the conversion year and all the following years and take negative values equal to the number of years before conversion. The trend variables are also set to zero for the hospitals whose ownership status was stable throughout the sample period (no conversion).

For instance if a hospital has converted from NFP to FP status in 1993, the NFP-to-FP dummy for that hospital is one in 1993 and all the following years and is zero for all the years prior to 1993 and the trend variable $t_{\text{NFP-to-FP}}$ for the same hospital takes 0, -1 , -2 and -3 respectively in 1993, 92, 91 and 90 and zero for all other years. The conversion year is the omitted year or the baseline. The negative values are chosen to ensure that the positive (negative) values of the trend coefficients represent the annual growth (decrease) in the dependent variable prior to conversion.

Since the effect of risk factors differs across different health conditions, equation (1) is estimated separately in the two diagnostic groups. The standard errors are corrected for the correlation of errors within hospital-year groups.²³ The least squares method is used to estimate the model.²⁴ This method may seem inconsistent with the dichotomous dependent variable. However, it should be noted that insofar as hospital-level effects are concerned, the model in equation (1) can be integrated to an equivalent aggregate model with

hospital-years as its observation units. The dependent variable can thus be considered as an aggregate mortality probability that is specific to hospital-year groups.²⁵

Patient Selection

Patient level data can be used to estimate hospital-specific measures of quality. However, these measures are affected by a variety of confounding factors such as caseload characteristics. Patients with different severity may favor hospitals in one sector over another. Hospitals may also have different incentives in targeting certain groups of patients or avoiding “costly” patients to make more profits. An unbiased estimation of ownership effects on hospital performance requires a sufficient adjustment for the unobserved risk factors that potentially vary across different sectors.

To the extent that patients go to the closest hospital and hospital location does not vary with ownership changes, hospital fixed effects (λ_j) can capture the selection effects. The emergency nature of heart diseases especially diagnoses like AMI can help in this regard. Similarly, patients admitted through ER are less affected by selection. Comparing the results between such patients and the whole sample can help identify the direction of selection biases.

There is a possibility that certain types of hospitals get rid of their sickest patients by premature discharges or transfers to other hospitals. In this case the mortality rates of such hospitals will be biased downward. But controlling for the length of hospital stays reduces this bias. Comparing specifications with and without controlling for the hospital stays allows to understand if the mortality differences are due to different lengths of hospitalization. For instance, suppose that high-quality hospitals, say NFP ones, have systematically longer hospitalizations for risky patients. In this case these hospitals’ mortality will be biased upward if the length of stay is not taken into account. On the other hand, since the length of stay is endogenous, controlling for it will result in an endogeneity bias resulting an underestimation of the mortality in NFP hospitals. The two specifications can therefore provide upper and lower bounds of the potential bias associated with differences in hospital stays.

Pre- and Post-Conversion Effects

The first hypothesis studied in this paper posits that NFP status is associated with a relatively high quality of service. In this case the quality rises after conversion from FP to NFP and deteriorates by a similar amount because of conversion from NFP to FP form. This hypothesis can be tested by comparing the coefficients of the two binary indicators representing post-conversion states (NFP-to-FP and FP-to-NFP). Under the symmetry hypothesis these coefficients must be opposite but similar in absolute value.

Another important question concerns the quality changes prior to conversion. Conversions are mostly a consequence of the sale of the hospital to a new owner. Such decisions are usually made a few years before the actual transactions occur. One can therefore expect that the converted hospitals have gone through some changes before the conversion. These pre-conversion changes may affect the hospital quality in different ways. For instance, a

hospital that is subject to financial problems and perhaps to a deteriorating quality is more likely to be taken over by other firms and eventually convert to another status. In this case if the pre-conversion effects are not taken into account, the estimations may suggest that the quality has actually fallen after the conversion even though the hospital may have actually improved.²⁶ Moreover, one may expect that NFP and FP hospitals differ in the way they cope with financial difficulties: While a FP hospital may lower the quality facing such problems, a NFP one may want to maintain a high quality of care. Financial problems may also arise if a NFP hospital decides to raise its quality of service. After conversion the new managers/owners may decide to lower the quality. In such a scenario, quality of the NFP hospital may have substantially increased before conversion, and conversion has a declining effect on quality. However, if the pre-conversion changes are neglected the estimations may show an improvement in quality because of conversion.

Potential quality changes prior to conversion are captured by the two linear trends ($t_{\text{NFP-10-FP}}$ and $t_{\text{FP-10-NFP}}$) as defined earlier. These trends approximate the pre-conversion change in quality with a constant annual growth rate starting long before conversion. However, one may argue that the pre-conversion changes may be limited to only a few years before conversion. It is however difficult to specify the outset of these changes. In order to avoid an arbitrary starting year, I used a linear approximation throughout. Given the relatively small number of conversions in the sample, the linear approximation is the best possible one.²⁷ Moreover, for the following reasons this approximation does not affect the main effects of conversions. First, as we go back to the starting year (1990) the number of observation points decreases quite rapidly, thus a relatively low weight in the estimations. For instance, only for a fifth of converted hospitals the sample covers eight years before conversion. Secondly, although a linear approximation might underestimate the potentially large effects occurring right before conversion, it can give an overall picture of the pre-conversion changes and does not bias the post-conversion effects represented by the two post-conversion indicators.

5. Results

Mortality Outcomes

The estimation results for AMI and CHF mortality outcomes are respectively given in Tables 4 and 5. In each group, the results are shown in two panels one for the entire sample (columns I, II and III) and one for the subsample of patients admitted through ER (columns IV, V and VI). In columns I and IV the changes before conversion are neglected and in columns III and VI the average length of hospital stay is included in the model. The first observation is that the symmetry hypothesis is strongly rejected in all specifications. That is, conversions in opposite directions do not have opposite effect on quality. Secondly, as expected the effect of severity indexes is positive and highly significant.²⁸

The first columns in both tables suggest that a conversion from NFP to FP does not have any significant effect on mortality whereas a FP to NFP conversion results in a significant increase in mortality incidence. These results may reflect at least partially, the pre-conversion changes. The results listed in column II (Table 4) show that after

Table 4. Mortality regressions (Acute Myocardial Infarction patients).

	Entire sample			Patients admitted through ER		
	I	II	III	IV	V	VI
Converted from NFP to FP	.0088 (.0074)	.019* (.010)	.018* (.010)	.0061 (.0081)	.018* (.010)	.018* (.011)
Converted from FP to NFP	.025** (.012)	.0074 (.011)	.0070 (.011)	.038** (.011)	.018 (.013)	.021* (.013)
Time trend before NFP to FP conversion	–	–.0028 (.0018)	–.0027 (.0018)	–	–.0034* (.0018)	–.0037* (.0020)
Time trend before FP to NFP conversion	–	.0064** (.0023)	.0083** (.0030)	–	.0072** (.0033)	.0089** (.0034)
Severity deviation	.13** (.0012)	.13** (.0012)	.15** (.0014)	.14** (.0013)	.14** (.0013)	.16** (.0014)
Length of stay (days)	–	–	–.012** (.0004)	–	–	–.015** (.0005)
R-square	.128	.128	.167	.132	.132	.183
Sample size	249,332 hospitalizations 1,522 hospital-years			175,550 hospitalizations 1,423 hospital-years		

Note: Standard errors are given in brackets.

Standard errors are clustered in hospital-year groups.

The time trends are compared to the conversion year for each hospital.

Hospital fixed effects, year dummies and patients demographics (5 age groups, gender, race and interaction of age groups with race and gender dummies) are included in the model but not shown in the table.

*Significant at 10% level.

**Significant at 5% level.

controlling for a linear trend in mortality before conversion, the results are reversed suggesting that conversion to FP status raises the mortality of AMI patients. This result is consistent with Shen (2002)'s findings that the conversions to FP status resulted in an increase in the mortality incidence of AMI patients.²⁹ The results in column II also suggest the hospitals that converted from FP to NFP form have experienced a gradual increase in AMI mortality before conversion. This result is consistent with the scenario that the FP hospitals lower the quality of service faced with financial difficulties, but the NFP hospitals tend to maintain the quality until they are taken over by a FP firm, which can lower the quality after the conversion. The results of CHF sample (Table 5) indicate however, that controlling for pre-conversion changes does not change the initial estimation results (compare columns I and II). These results suggest that the conversions from FP to NFP had a negative effect on quality.

The estimation results with control for the length of stay (LOS) are listed in column III (Tables 4 and 5). These results indicate that including the LOS does not change the results significantly, suggesting that the results are not driven by systematic differences in hospitals' discharge practices. Notice that if the estimated mortality differences were due

Table 5. Mortality regressions (Congestive Heart Failure patients).

	Entire sample			Patients admitted through ER		
	I	II	III	IV	V	VI
Converted from NFP to FP	-.0004 (.0040)	-.0005 (.0049)	-.0004 (.0049)	-.0043 (.0043)	-.0005 (.0050)	-.0004 (.0050)
Converted from FP to NFP	.015** (.0047)	.018** (.0055)	.018** (.0055)	.021** (.0058)	.023** (.0068)	.023** (.0055)
Time trend before NFP to FP conversion	-	-.000006 (.0008)	-.00002 (.0008)	-	-.0011 (.0009)	-.0011 (.0009)
Time trend before FP to NFP conversion	-	-.0012 (.0012)	-.0013 (.0012)	-	-.0009 (.0013)	-.0010 (.0013)
Severity deviation	.074** (.0009)	.074** (.0009)	.073** (.0009)	.075** (.0010)	.075** (.0010)	.074** (.0011)
Length of stay (days)	-	-	.00053** (.0001)	-	-	.00051** (.0002)
R-square	.0560	.0560	.0563	.0556	.0556	.0557
Sample size	482,235 hospitalizations 1,537 hospital-years			319,758 hospitalizations 1,434 hospital-years		

Notes: Standard errors are given in brackets.

Standard errors are clustered in hospital-year groups.

The time trends are compared to the conversion year for each hospital.

Hospital fixed effects, year dummies and patients demographics (5 age groups, gender, race and interaction of age groups with race and gender dummies) are included in the model but not shown in the table.

*Significant at 10% level.

**Significant at 5% level.

to differences in LOS, they should have decreased after controlling for hospital stays and this is not the case. The results show that the LOS has a negative effect on mortality among AMI patients (Table 4), but a positive effect on the CHF mortality (Table 5). It should be noted that there is obviously a negative correlation between LOS and the in-hospital death probability.³⁰ On the other hand, the hospital stays may represent part of the unobserved severity of cases, thus have a positive effect on mortality. This difference between AMI and CHF sample may be related to the fact that the in-hospital mortality in the AMI case is more than twice as that of CHF (see Table 3). The high frequency of death outcomes may cause a relatively high negative correlation with the LOS.

Comparing the results between the entire sample and the sub-sample of ER patients can help identify the direction of potential biases due to patient selection. The results in both Tables 4 and 5 (compare columns II and V) indicate that focusing on ER patients does not significantly change the estimation effects of conversion. If the higher (or lower) mortality rates were only because of the differences in case-mix severity, one can expect that the estimated differences are lower in cases that are less affected by selection (like ER patients). However, the results indicate that the estimated effects rather increase by

focusing on ER admissions, shown by the slightly higher absolute values in column V compared to column II, suggesting that the unobserved severity factors may lead to an underestimation of quality differences. This result is consistent with the suggestive evidence in the previous literature that more severe patients are more likely to choose higher-quality hospitals.

Table 4 also shows that if we focus on the ER sample, the NFP hospitals that converted to FP form shows a gradual decrease in AMI mortality rates before conversion (column V). This result may suggest that the FP firms are attracted in buying high-quality NFP hospitals in order to make profits by reducing the quality after the conversion.

Re-admission Rates

The probability of readmission among AMI patients is analyzed using re-hospitalization with AMI as a principal diagnosis within 1, 2, and 3 months after an initial discharge. The estimation results are given in Table 6. As expected the effect of severity measure is

Table 6. Readmission of AMI patients.

Readmission within	1 month		2 months		3 months	
	I	II	III	IV	V	VI
Converted from NFP to FP	.0046 (.0039)	.0035 (.0059)	.0066 (.0055)	.0044 (.0078)	.011* (.0066)	.012 (.0078)
Converted from FP to NFP	.014** (.0065)	.014* (.0076)	.014* (.0065)	.016** (.0081)	.013* (.0073)	.017* (.0088)
Time trend before NFP to FP conversion	–	.0003 (.0012)	–	.0007 (.0013)	–	–.00008 (.0015)
Time trend before FP to NFP conversion	–	–.00003 (.0009)	–	–.0007 (.0012)	–	–.0014 (.0013)
Severity deviation	.0013** (.0005)	.0012** (.0005)	.0026** (.0006)	.0026** (.0006)	.0024** (.0006)	.0024** (.0006)
<i>R</i> -square	.0100	.0100	.0097	.0097	.0096	.0096
Average re-admission rates						
FP hospitals		4.5%		5.7%		6.4%
NFP hospitals		3.4%		4.6%		5.4%
Overall		3.6%		4.8%		5.6%

Notes: The sample includes 202,864 observations (1,503 hospital-years) consisting of AMI elderly patients with valid ID who were discharged alive after an initial hospitalization.

Standard errors are given in brackets.

Standard errors are clustered in hospital-year groups.

The time trends are compared to the conversion year for each hospital.

Hospital fixed effects, year dummies and patients demographics (5 age groups, gender, race and interaction of age groups with race and gender dummies) are included in the model but not shown in the table.

*Significant at 10% level.

**Significant at 5% level.

positive. These results suggest that patients admitted to hospitals that converted to NFP status are more likely to be re-hospitalized after an initial treatment. Hospitals that converted to FP status show a similar change but the effects are statistically insignificant in most cases. However, the extremely low values of *R*-square in these regressions indicate that the re-admission probabilities are influenced by a relatively large number of unobserved factors. Due to the low explanatory power of this model, these results do not appear to be conclusive. This result is consistent with the evidence provided by Thomas (1996) and Ludke, Booth and Lewis-Beck (1993) who conclude that re-hospitalization probability is affected by individual patients' clinical conditions and cannot adequately represent the hospital quality.

6. Conclusions

Between 1990 and 1998 California has witnessed 11 conversions from FP to NFP status and 15 conversions from NFP to FP form. The quality changes before and after conversions have been analyzed. The estimations are based on models that control for possible selection biases by including hospital fixed effects and controlling for the relative severity of patients. The samples are restricted to elderly patients who are automatically eligible for Medicare benefits.

The first measure of quality is the in-hospital mortality of AMI patients. The results suggest that the converted hospitals have gone through a gradual change in quality before conversion. The NFP hospitals that converted to FP status show a slightly falling AMI mortality rate before conversion, followed by a significant increase after conversion. Conversely, the FP hospitals that have converted to NFP status show a gradual growth in AMI mortality outcomes before conversion, which slows down after conversion. The observed changes in AMI mortality before and after conversions are consistent with the contention that the NFP hospitals have a commitment to quality. Assuming that the conversions are driven by financial difficulties, these results indicate the FP and NFP hospitals react differently to such problems: While FP firms are willing to lower the quality the NFP hospitals are likely to maintain their high quality of service. These results also provide suggestive evidence that the FP firms are more interested in taking over NFP hospitals that have a more than average quality of service, thus more profitable through possible reduction of quality.

The above results are not confirmed by the other two measures of quality, that is the in-hospital mortality rate of CHF patients and the re-admission probability of patients treated for AMI. The CHF mortality has been found to increase after conversion from FP to NFP status. These results suggest that conversions may have different effects on various aspects of hospital quality. In the case of AMI re-admission rates, the model's explanatory power is too low for any conclusive statement.

The estimations are not sensitive to whether or not the average length of hospital stay is included in the model, which suggests that the estimated differences in mortality are not driven by potential differences between hospital types in hospital discharge/transfer policy. Comparing the results between the entire sample and the sample consisting of the ER admissions indicates that the mortality differences may be slightly underestimated

by patient selection. However, the relatively small differences suggest that as long as the hospital fixed effects are included, the selection bias does not considerably affect the results.

This study provides some evidence that the converted hospitals may be subject to quality changes before conversion. Controlling for these changes is crucial for an unbiased estimation of conversion effects. While the results suggest that some of the public concern over conversions to FP form may be warranted, this paper's general conclusion is that hospital quality is a complex multi-dimensional concept, and is unlikely to be uniformly affected by hospital ownership status.

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Notes

1. NFP hospitals are private hospitals that are owned by non-for-profit foundations, charity organizations or churches. Here, public hospitals are not considered as NFP.
2. Sloan et al. (2003) is a recent example. See Sloan (2000) and Baker et al. (2000) for extensive surveys of this literature.
3. Sloan (2002) assumes that conversion effects are symmetric. Shen (2002) on the other hand, assumes that the effect of conversion does not depend on the status prior to conversion. She assumes for instance that a conversion from public to NFP form has the same effect as a conversion from FP to NFP status.
4. See Kessler and McClellan (2001) for some evidence.
5. Although many hospitals violate these requirements, there is no significant difference in propensity to violate between FP and NFP hospitals in California (Blalock and Wolfe, 2001).
6. It is interesting to note that in California, a large part of conversions are the result of a takeover by a FP or NFP hospital chain. See Spetz, Mitchell and Seago (2000) for more details.
7. See Currie, Farsi and MacLeod (2002) for more details about the corrections in the data.
8. This is the OSHPD's fiscal year and the most frequent reporting period in the data. For the cases where the reporting period does not match with the fiscal year, the data are arranged such that every report is considered in the fiscal year that covered the largest part of the reporting period. In the hospital-years with multiple reports, a single observation is created using the weighted average over the reports (weights being the lengths of the reporting periods). In cases where conversion in status is in a multiple-report year, the new (old) status is considered if the conversion occurred in the first (second) half of the fiscal year.
9. By acute-care hospitals I mean all non-psychiatric hospitals that reported inpatient care. Rehabilitation centers are also excluded.
10. According to the data the average capacity of the NFP hospitals increased gradually from 217 beds in 1989–90 to 227 in 1993–94 and then decreased to 217 beds in 1997–98.
11. My regressions (not included in the paper) indicate that converted hospitals may change their capacity. However, including the number of beds in the regressions does not change the results of the paper.

12. For instance, Keeler et al. (1992) found that among all hospital characteristics, the involvement in teaching activities has the most significant effect on their quality measures. However, there is no association between conversions and teaching status in our sample. In fact there are only two FP hospitals that have teaching status, one of which is a non-converting hospital and the other has converted from NFP status, but kept its teaching affiliations after conversion.
13. My preliminary analyses (not included in the paper) show that an approximately constructed Herfindahl index based on county borders has no significant effect in mortality regressions as long as hospital fixed effects and year dummies are included in the model.
14. Four other diagnostic groups, malignant lung cancer, hypertensive heart disease, diabetes mellitus, and hospitalizations due to motor vehicle traffic accidents, were also studied using a similar methodology. However, these samples did not show any significant ownership effects, and are excluded from the paper to avoid unnecessary repetition.
15. I excluded a few patients older than 99 years.
16. The corresponding codes according to the International Classification of Diseases, 9th version, Clinical Modification (U.S. Department of Health and Human Services) are as follows: AMI: 410.xx, CHF: 428.0, 402.x1, 398.91, 404.x1, and 404.x3.
17. US Vital Statistics Mortality: multiple cause-of-death summary (1968–98), National Center for Health Statistics.
18. APR-DRG is a system of classification of diseases with severity categories, patented by 3M Health Information Systems. This severity measure is not available for most of the discharges that occurred in 1990 and 1991. APR-DRG system defines the severity as “the extent of physiologic decompensation or organ system loss of function.” Using information like principal diagnoses, procedures, multiple comorbidities, and age, it provides four *severity-of-illness and risk-of-mortality subclasses* within each DRG (Diagnosis-Related Group). See www.3Mhis.com and the 3M’s APR-DRG Software’s brochure.
19. See Romano and Chan (2000) for evidence regarding AMI patients.
20. For instance, Medicare reimbursements increase about 40% if an AMI patient has CHF complication (Psaty et al., 1999). Silverman and Skinner (2001) and Psaty et al. (1999) provide some evidence of over-reporting the severity of illness by hospitals. See also Foundation for Health Care Quality (1997), Section 2.
21. Studying Medicare inpatient claims between 1989 and 1997 for pneumonia patients, Silverman and Skinner (2001) provide evidence suggesting that upcoding is more common among FP hospitals and also those NFP hospitals that converted to FP type.
22. I also considered re-admissions within six months. The results were very similar and therefore not reported.
23. This correction is done by clustering the sample in hospital-year groups using cluster command in Stata. In this method the errors are only required to be independent across groups and can be correlated within groups. Consequently, the variations within groups contribute little to the estimation precision. The standard errors are therefore more realistic than those obtained with the independence assumption, which may be underestimated. See Moulton (1990) for an illustration of the downward bias in standard errors in grouped data and Rogers (1993) for more details on clustering technique. Our estimations show however that clustering does not change the estimated standard errors much. This result is consistent with Moulton’s contention that the problem does not arise in a fixed effects model (see Moulton, 1986).
24. The advantage of the least square method (compared to Logit or Probit) is in that no distribution assumption is imposed on the error term.
25. Note that the usual heteroscedasticity of OLS estimators with dichotomous dependent variables does not arise here because the errors across hospital-year groups do not have a dichotomous nature and the errors can be correlated within groups.
26. Note that if the pre-conversion effects are not taken into account, the estimated effect of conversion is based on the difference between average quality measures before and after conversion.
27. One can argue that these changes may have a non-linear form. I added the squares of these trends to the model. None of the second-order terms showed any significant effect. I also tried an alternative with 8 year dummies for any specific year before conversion. However, because of the large number of variables and relatively small number of observations in each group, virtually all the coefficients were statistically insignificant.
28. A further analysis (not reported here) shows that excluding the severity deviations does not affect the results but as expected decreases the model’s explanatory power, reflected in a significantly lower R^2 .

29. Shen (2002) used a national sample including 300 hospitals that changed ownership between 1985 and 1996.
 30. Patients who die do not stay in the hospital, resulting in a mechanical negative relation.

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