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# Changes in hospital quality after conversion in ownership status

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# Changes in Hospital Quality
# After Conversion in Ownership Status

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## Abstract

This paper examines the effects of hospital conversions between For-Profit and Not-For-Profit forms on quality of medical care. The sample includes Medicare 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, which may bias the estimated effects. Both conversions are found to have some adverse consequences regarding quality. 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 and re-admission rates of AMI patients.

*JEL classification:* L31; I18; I11

*Keywords:* Ownership conversions; Hospital quality; Mortality; Medicare beneficiaries

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## 1. Introduction

Recent conversions of not-for-profit (NFP) hospitals to for-profit (FP) status have raised public concerns about possible detrimental effects on quality of care (c.f. Goddeeris and Weisbrod (1998), Kuttner (1996a-b) and 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 (c.f. Frank and Sulkever (1994) and Glaeser and Schleifer (1998)).

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Sloan (2000, 2001) and Baker et al. (2000) provide extensive surveys of the growing literature on the effects of NFP and FP status on the quality of care. However, few studies actually examine conversions of hospitals from one form to the other. Sloan (2002) and Shen (2002) are two exceptions. Sloan examines the effects of conversions on elderly 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. Shen (2002) studies the effect of conversions on the health outcomes of heart attack patients. She finds that conversion to FP ownership has resulted in a significant increase in mortality probability. Both studies assume that the conversion effects on quality appear after conversion occurs. There is however, some evidence that conversions are usually preceded by financial difficulties (Sloan (2002) and 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 slightly improve the situation, failure to control for the pre-conversion changes may lead to the conclusion that conversions 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, there is no restrictive assumption on the conversion effects on quality.[1] Secondly, the time-variations of quality before conversion are taken into account by controlling for the number of years before each type of conversion. Finally, in contrast with Sloan (2002) and Shen (2002) who used a national sample of hospitals, I use a relatively uniform sample including California's private short-term hospitals. The US states are quite heterogeneous 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[2], 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.

[1] 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.

[2] See Kessler and McClellan (2001) for some evidence.

One of the important difficulties in studying the ownership effects on hospital quality is the selection bias. Patients may be selected differently into a hospital 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. In order to identify the direction and importance of the selection bias, I exploit the fact that different types of patients are selected in different ways. For example, heart attack patients are generally taken to the nearest hospital. Moreover, hospitals are required to treat patients in such an emergency situation regardless of their insurance coverage.[3] On the other hand, patients with chronic conditions generally have time to plan their hospitalizations and their decisions may be influenced by many factors within the control of hospitals. These considerations suggest that the measured effects of conversion should be least masked by selection effects in patients with heart attacks (Acute Myocardial Infarction or AMI) and most subject to selection bias in patients with chronic conditions such as Congestive Heart Failure (CHF).[4] A similar analysis is considered for patients admitted through the Emergency Room (ER), for whom the selection bias is attenuated because of time restrictions.

The results generally indicate a low variation in conversion effects across different samples with different selection intensities, suggesting that as long as hospital fixed effects are controlled for, the selection bias does not seriously affect the results. The analyses reported in this paper 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 probabilities of mortality for CHF sample and re-admission among AMI patients. Controlling for the hospital stay indicates that the estimated differences in mortality are not driven by changes in hospital discharge/transfer policy.

These results suggest that health outcomes in different diagnoses, even though similar in nature, may represent different dimensions of hospital quality. Moreover, the evidence is generally against the hypothesis that a particular ownership status represents a relatively high level of quality, suggesting that the observed changes after conversions are not directly resulted from institutional form. My findings also suggest that hospitals that convert from one status to another may be subject to certain changes prior to conversion.

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

[3] 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).

[4] Obviously noting that the two diagnoses are quite similar regarding the variety of treatment methods and other aspects of quality of care.

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-90's. 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 et al. (2001) 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 et al. (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.

Kessler and McClellan (2001) found that although the in-hospital mortality and the probability of readmission are on average lower in NFP hospitals, the presence of FP hospitals in the same area reduces expenditures at NFP hospitals without affecting health outcomes in these hospitals. These spillovers are suggestive of a market in which FP hospitals are more efficient than NFP hospitals. Using a national sample of hospitals Shen (2002) reports a significant increase in mortality of AMI Medicare patients after a conversion to FP status.

The literature generally points to the importance of the effects of patient selection. There is some evidence that patients are likely to choose the closest hospitals. In this paper the hospital location is taken into account by using hospital fixed effects. Another point is the selection of relatively sick patients into high-quality hospitals. This effect is studied by comparing the results between patients that are less subject to selection effects and other patients.

## 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 like 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 report. Hospital characteristics like ownership status, size (number of beds) and type of the hospital are extracted from this data set. Spetz et al (1999, 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 et al (1999) along with other corrections using Internet sources and a few direct contacts with hospitals.[5] 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 exclude 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.[6] 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-care[7] 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 hospitals became fewer but larger. While the number of

[5] See Currie et al. (2002) for more details about the corrections in the data.
[6] 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 reporting period). 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.
[7] By acute-care hospitals I mean all non-psychiatric hospitals that reported inpatient care. Rehabilitation centers are also excluded.

NFP hospitals increased, their size remained practically unchanged.[8] 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 much 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 are 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.[9] Other hospital characteristics that do not change with conversion, are captured by hospital fixed effects.[10] Market-specific characteristics are not considered in the analysis. First, because the time-invariant and 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.[11] 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

[8] 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.

[9] My regressions (not shown in the paper) suggest that converted hospitals may change their capacity. However, including the number of beds in the regressions does not change the results of the paper.

[10] 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.

[11] My preliminary analyses (not reported here) 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 controlled for.

congestive heart failure (CHF).[12] In each case the sample contains all the patients of 65 years of age and older[13], hospitalized with the corresponding condition as principal diagnosis.[14] Elderly patients provide relatively more homogeneous samples not only regarding age-related risk factors, but also because of a single insurance coverage by Medicare.

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.[15]

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.[16] Finally, in the case of CHF sample

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[12] 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.

[13] I exclude a few patients older than 99 years.

[14] The corresponding codes according to the International Classification of Diseases, 9th version, Clinical Modification (U.S. Departmnet of Health and Human Services) are as follows: AMI: 410.xx, CHF: 428.0, 402.x1, 398.91, 404.x1, and 404.x3.

[15] US Vital Statistics Mortality: multiple cause-of-death summary (1968-98), National Center for Health Statistics.

[16] 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

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.[17] 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 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.[18] This problem, known as upcoding or DRG creep, may occur differently among hospitals with different ownership status.[19] 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 ownership 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 et al. (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

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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.

[17] See Romano and Chan (2000) for evidence regarding AMI patients.

[18] 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.

[19] 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.

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 resulted from 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 readmission of AMI patients following discharge from a hospital. Usually readmission 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) and Carey and Burgess (1999)). In some cases readmission 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 et al, 1991). Several authors have found that the variations in readmission probability are related to patient's clinical conditions rather than hospital quality (Thomas and Holloway (1991), Thomas (1996), and Ludke et al. (1993)). However, a readmission 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.[20]

## 4. Methods

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

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

[20] I also considered re-admissions within six month. The results with were very similar and therefore not reported.

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, whether the patient was readmitted after discharge, or whether certain procedures were used during the hospitalization.

$X_{ijt}$ is the vector of patient's characteristics including age groups, gender, race and their pair-wise interactions. 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. $Z_{jt}$ is the vector of hospital status. This vector includes a series of conversion indicators that represent the state of hospital with respect to the conversion year. These variables will be explained in each case. $Y_t$ is the vector of year dummies and $\lambda_j$ is the hospital-specific fixed effect. Finally $\varepsilon_{ijt}$ represents an *i.i.d.* random error that represents the unobserved heterogeneities among patients, hospitals, and years.

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.[21] The least squares method is used to estimate the model.[22] 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 hospital-level model. The dependent variable can thus be considered as an aggregate hospital-specific mortality probability.[23]

*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.

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[21] This correction is done by clustering the sample in hospital-year groups. In this method the errors can be correlated within clusters. Consequently, the variations within clusters contribute little to the estimation precision. The standard errors are therefore more realistic than those obtained with the independence assumption, which may be under-estimated. 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)).

[22] The advantage of the least square method (compared to Logit or Probit) is in that no distribution assumption is imposed on the error term.

[23] Note that the usual heteroscedasticity of OLS estimators with dichotomous dependent variables does not arise here because the errors are clustered within hospital-year groups and the errors across groups do not have a dichotomous nature.

To the extent that patients go to the closest hospital and hospital location does not change with ownership, hospital fixed effects ($\lambda_j$) can help to avoid selection effects. The emergency nature of diagnoses like AMI can help in this regard. Similarly, patients admitted through ER may be less affected by selection. Comparing the results between such patients and the whole sample and also across the two diagnostic groups can help identify the direction of such 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 stay allows to understand if the mortality differences are resulted from 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 stay.

*Pre- and post-conversion effects*

The first hypothesis studied in this paper posits that NFP status is inherently associated with a relatively high quality of service. In this case the quality rises after conversion from FP to NFP and deteriorates at a similar amount because of conversion from NFP to FP form. This symmetry assumption can be tested by comparing conversions in opposite directions. In order to study this issue two binary indicators representing post-conversion states for the two types of conversion are introduced in the model in equation (1). Under the symmetry hypothesis the coefficients of these indicators 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 taken a few years before the actual transactions occur. One can therefore expect that the converted hospitals go through some changes before conversion, which may affect the hospital quality. 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. In order to control for potential changes in quality prior to conversion, two linear trends are introduced in the model: one for FP to NFP conversion and one for NFP to FP conversions. These variables represent the number of years before the corresponding conversion for each hospital. They are set to zero for the conversion year and all the following years and also for the hospitals that did not convert, and they take negative values for the years before conversion. Therefore, these trends capture the annual change in mortality before conversion.[24] The changes after conversion are represented by the two post-conversion indicators.

## 5. Results

*Mortality and patient selection*

Table 4 gives the estimated effects of ownership status on the in-hospital mortality. The first column gives the regression results without control for severity. These results suggest that FP status is associated with lower mortality rates for CHF patients. The difference is however insignificant for AMI patients. The results in column *II* show that controlling for severity deviation within hospital-year groups does not change the results. However as expected, the constructed measure of relative severity has a positive effect on mortality and the model's explanatory power increases (reflected in a significant increase in the R-square). The estimation results with control for the length-of-stay are listed in column *III*. These results indicate that including the length-of-stay does not change the results significantly, suggesting that the results are not driven by systematic differences in hospitals' discharge practices. The results show that the length-of-stay has a negative effect on mortality among AMI patients but a positive effect on the CHF mortality. The negative effect is consistent with our contention that hospitals may affect the apparent mortality rates by early discharges. The results suggest however, that the length-of-stay may represent at least for CHF patients, part of the unobserved severity of illness.

Columns *IV* to *VI* list the estimation results for the patients admitted through ER. These numbers indicate that restricting both samples to ER admissions results in an increase in the estimated mortality of NFP hospitals. This pattern can be explained by weaker selection effects for ER patients, suggesting that unobserved severity differences are more likely to create a downward bias for the NFP hospitals' mortality. According to this interpretation, the CHF sample should give a lower mortality for NFP hospitals because, compared to AMI patients, this group is more affected by election bias. This prediction is only partially confirmed by the results of the ER samples. However, the results of table 4 generally show that the estimated effect of ownership status is more or less

[24] One can argue however that these changes may be of an arbitrary 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 are statistically insignificant.

similar across different samples, suggesting that after controlling for hospital fixed effects the selection bias is relatively limited.

The results generally reject the hypothesis that NFP hospitals have a higher quality with respect to the mortality outcomes of the studied diagnoses. Rather, they provide suggestive evidence that FP status may be associated with lower in-hospital mortality rates for converted hospitals. However, it should be noted that these estimations are based on the implicit assumption that different institutional forms have inherent quality characteristics. As it will be clear later this assumption may be unrealistic.

*Changes before and after conversion*

Table 5 lists the estimation results of mortality regressions controlling for the potential pre- and post-conversion effects. As it can be seen in columns *I* and *IV*, the symmetry hypothesis is strongly rejected. Interestingly, both AMI and CHF samples 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* show that after 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.[25] 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.

The results of CHF sample (column *V*) suggest however, that controlling for pre-conversion changes does not change the initial estimation results (column *IV*). The results in columns *III* and *VI* indicate that controlling for the length-of-stay does not change the estimation results, suggesting that the estimated changes are not driven by different discharge/transfer practices. The results in table 5 point to two important general shortcomings in the analysis of hospital quality and conversions. First, the changes in hospital quality before conversion are crucial. The results may be completely misleading if these changes are not taken into account. Secondly, the quality measures depend on the adopted diagnosis. Hospital quality has therefore several dimensions that may vary independently.

*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. These results suggest that patients admitted to hospitals that converted to NFP status are more

[25] Shen (2002) used a national sample including 300 hospitals that changed ownership between 1985 and 1996.

likely to be re-hospitalized after an initial treatment. The very low values of R-square indicate however, that the re-admission probabilities are influenced by a relatively large number of unobserved factors. Hospitals that converted to FP status show a similar change but the effects are statistically insignificant in most cases. The effect of severity measure is as expected positive.

## 6. Conclusions

Between 1990 and 1998 California has witnessed 11 conversions from FP to NFP status and 15 conversions from NFP to FP form. Both types of conversions are found to have adverse effects on the quality of care in converted hospitals. Hospitals converted to FP status show a significant increase in the in-hospital mortality of their elderly AMI patients. On the other hand, hospitals converted to NFP form have experienced an increase in the mortality incidence of their CHF patients and in the re-admission probability of patients treated for AMI. These estimates are obtained from models that control for possible selection biases by including hospital fixed effects and controlling for the relative severity of patients' illnesses. The results appear to be robust to potential differences between hospital types regarding discharge and transfer practices and also to the possible quality changes prior to conversions.

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, which is unlikely to be uniformly affected by hospital ownership status. The observed changes after conversions are not consistent with the contention that a particular institutional form is equivalent to a high commitment to quality.


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## 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 |

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

| | | | Fiscal year starting from the end of June | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Size | 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.

## 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** |

**Table 4- Mortality regressions**

| | | Entire Sample | | | Patients Admitted through ER | | |
|---|---|---|---|---|---|---|---|
| | | *I* | *II* | *III* | *IV* | *V* | *VI* |
| Acute Myocardial Infarction | Not-for-profit | .0054 (.0071) | .0063 (.0072) | .0085 (.0074) | .011 (.0074) | .013* (.007) | .016** (.008) |
| | Severity deviation | – | .130** (.001) | .153** (.001) | – | .139** (.001) | .164** (.0015) |
| | Length-of-stay (days) | – | – | -.012** (.0004) | – | – | -.015** (.0005) |
| | $R^2$ | .031 | .128 | .167 | .031 | .132 | .183 |
| | Sample size | 249,332 hospitalizations 1,522 hospital-years | | | 175,550 hospitalizations 1,423 hospital years | | |
| Congestive Heart Failure | Not-for-profit | .0064** (.0032) | .0064** (.0031) | .0063** (.0032) | .011** (.004) | .011** (.004) | .0105** (.004) |
| | Severity deviation | – | .074** (.001) | .073** (.0009) | – | .075** (.001) | .074** (.001) |
| | Length-of-stay (days) | – | – | .00053** (.0001) | – | – | .00051** (.0001) |
| | $R^2$ | .013 | .056 | .056 | .010 | .056 | .056 |
| | Sample size | 482,235 hospitalizations 1,537 hospital-years | | | 319,758 hospitalizations 1,434 hospital-years | | |

- For-Profit status is considered as base line (coefficient zero).
- Standard errors are given in brackets.
- ** indicates significant at 5% level.
- * indicates significant at 10% level.
- Standard errors are clustered in hospital-year groups.
- 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.

**Table 5- Mortality regressions with pre- and post-conversion indicators**

| | Acute Myocardial Infarction | | | Congestive Heart Failure | | |
|---|---|---|---|---|---|---|
| | *I* | *II* | *III* | *IV* | *V* | *VI* |
| Converted from NFP to FP | .0088<br>(.0074) | .019*<br>(.010) | .018*<br>(.010) | -.0004<br>(.0040) | -.0005<br>(.0049) | -.0004<br>(.0049) |
| Converted from FP to NFP | .025**<br>(.012) | .0074<br>(.011) | .0070<br>(.011) | .015**<br>(.0047) | .018**<br>(.0055) | .018**<br>(.0055) |
| Time trend before NFP to FP conversion | – | -.0028<br>(.0018) | -.0027<br>(.0018) | – | -.000006<br>(.0008) | -.00002<br>(.0008) |
| Time trend before FP to NFP conversion | – | .0064**<br>(.0023) | .0083**<br>(.0030) | – | -.0012<br>(.0012) | -.0013<br>(.0012) |
| Severity deviation | .13**<br>(.0012) | .13**<br>(.0012) | .15**<br>(.0014) | .074**<br>(.0009) | .0074**<br>(.0009) | .0073**<br>(.0009) |
| Length-of-stay (days) | – | – | -.012**<br>(.0004) | – | – | .00053**<br>(.0001) |
| R-square | .128 | .128 | .167 | .0560 | .0560 | .0563 |
| Sample size | 249,332 hospitalizations<br>1,522 hospital-years | | | 482,235 hospitalizations<br>1,537 hospital-years | | |

- Standard errors are given in brackets.
- ** indicates significant at 5% level.
- * indicates significant at 10% level.
- 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.

**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<br>(.0039) | .0035<br>(.0059) | .0066<br>(.0055) | .0044<br>(.0078) | .011*<br>(.0066) | .012<br>(.0078) |
| Converted from FP to NFP | .014**<br>(.0065) | .014*<br>(.0076) | .014*<br>(.0065) | .016**<br>(.0081) | .013*<br>(.0073) | .017*<br>(.0088) |
| Time trend before NFP to FP conversion | – | .0003<br>(.0012) | – | .0007<br>(.0013) | – | -.00008<br>(.0015) |
| Time trend before FP to NFP conversion | – | -.00003<br>(.0009) | – | -.0007<br>(.0012) | – | -.0014<br>(.0013) |
| Severity deviation | .0013**<br>(.0005) | .0012**<br>(.0005) | .0026**<br>(.0006) | .0026**<br>(.0006) | .0024**<br>(.0006) | .0024**<br>(.0006) |
| R-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% | |

- 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.
- ** indicates significant at 5% level.
- * indicates significant at 10% level.
- 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.

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