Private Equity in the Hospital Industry

Janet Gao *Indiana University*
Yongseok Kim *Indiana University*
Merih Sevilir *Indiana University*

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Abstract

This paper studies the growing presence of private equity (PE) acquirers in the hospital industry. We examine employment, operational efficiency and patient outcomes at hospitals acquired by PE firms. While the total employment at target hospitals significantly declines, the proportion of physicians and nurses in the total workforce (skilled worker ratio) increases for hospitals acquired by a publicly traded PE backed hospital. Employment cuts also occur in hospitals acquired by non-PE acquirers, but skilled worker ratio does not increase in those hospitals. PE-backed acquirers, especially publicly traded ones, are also uniquely associated with reductions in overhead costs. Consistent with PE acquirers increasing skilled worker ratio, patient satisfaction scores do not decline at PE-acquired hospitals and even improve along some dimensions. In contrast, patient satisfaction significantly worsens at hospitals acquired by non-PE acquirers. Examining real patient outcomes, we find that PE acquirers are not associated with higher mortality and readmission rates at target hospitals than non-PE acquirers. Overall, our paper provides a comprehensive look at the role of PE acquirers in the hospital industry, and documents nuanced differences between PE and non-PE acquirers, as well as between PE backed acquirers with and without access to public capital markets.

Key words: Private Equity, Hospital Acquisitions, Employment, Operational Efficiency, Real Patient Outcomes and Satisfaction

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1 Introduction

It is estimated that private equity (PE) investors invested around $200 billion into the U.S. healthcare industry over the last decade, including sizeable amounts into hospitals.[1] There are opposing views on their growing presence in the hospital industry. Proponents of PE investors claim that they provide hospitals with much needed capital to invest in new technologies that improve patient care and outcomes, and their managerial and operating experience can improve a struggling hospital, benefiting the local community. Opponents, on the other hand, voice concerns that PE investors load hospitals with debt, sell assets, and implement layoffs to generate profits, and sometimes close hospitals, with a negative impact on access to health care and jobs.

To shed light on this important and current debate, in this paper we examine employment, efficiency and patient outcomes at hospitals acquired by PE acquirers, relative to a matched control group of non-acquired hospitals. In addition to studying post-acquisition outcomes at PE acquired hospitals, we also examine those outcomes at hospitals acquired by non-PE acquirers. This allows us to make more nuanced inferences regarding the potential role of PE acquirers relative to other acquirer types.

Hospitals are economically very important. They are among the largest providers of jobs in their community. Not only the hospital industry ranks among the top ten largest employers in all U.S. states, hospitals also employ a large number of female workers. Healthcare spending in the United States makes up 18% of the gross domestic product (GDP), well above the spending level in any other country. Prior studies estimate that approximately 30% of health care spending is considered wasteful, with estimated waste due to administrative burden and complexity exceeding $250 billion (Shrank et al. 2019). Given their core competency of reducing inefficiency and wasteful spending, PE firms could provide an intervention mechanism targeting administrative overhead and complexity at acquired hospitals. In addition, management and operational expertise they possess may equip a hospital with better resources in terms of financing human capital, and improving accounting services, such as bill and claims processing. Increased

[1] Source: A city's only hospital cut services. How locals fought back. *Wall Street Journal*, Aug. 2020.

efficiency, in turn, may benefit patients and communities through improved viability of acquired hospitals.

One natural source of efficiency improvement for PE acquirers could be through employment reduction at acquired hospitals. On the other hand, given that patient experience and outcomes depend critically on the availability of skilled employees such as nurses and physicians, one may also expect to see an increase in the proportion of skilled employees if PE investors provide acquired hospitals with capital to hire and retain skilled nurses and physicians. PE investors could also be instrumental in facilitating hospitals' access to public capital markets through an initial public offering (IPO) given their knowledge and expertise related to public capital markets and the going public process. By taking a target hospital public, PE investors can help that target hospital access cheaper capital and better attract skilled employees. Ultimately, to understand the potential role of PE firms on labor outcomes, on the operating efficiency of acquired hospitals as well as on patient outcomes, one needs a detailed examination of how acquired hospitals perform based on whether they are acquired by PE firms or PE-backed hospitals.

The hospital industry provides a rich and interesting setting to examine the role of PE firms as acquirers. PE firms can participate in a hospital acquisition in two different ways. First, a PE firm directly can acquire a hospital or a system of hospitals. Second, PE firms conduct roll-up acquisitions where a PE-acquired hospital makes subsequent hospital acquisitions to form a large system of hospitals.

We compile a comprehensive sample of 1,218 M&A deals in the hospital industry over the time period from 2001 to 2018. Our initial focus is on 414 deals where the acquirer is a for-profit organization. We first examine employment outcomes at acquired hospitals, relative to a control group of hospitals that have not been acquired. The treatment and control hospitals are matched by Census region, metropolitan area status, year, and pre-acquisition hospital characteristics. Our most stringent specification imposes a multitude of controls, including hospital and local county characteristics, hospital fixed effects, and event-by-year interactive fixed effects. Hospital fixed effects help us track the conditions of the same hospital over time. Event-by-year interactive fixed effects allow us to compare

a pair of treated and control hospitals closely over the event horizon.

We find that employment declines significantly at acquired hospitals, compared to the matched control group. Importantly, we observe significant employment cuts at target hospitals of both PE and non-PE acquirers. While overall employment declines, the proportion of skilled employees involving nurses, pharmacists, and physicians increases at hospitals acquired by publicly traded PE-backed hospitals. The proportion of skilled employees does not change at hospitals acquired by non-PE acquirers. On the other hand, we do observe a reduction in skilled employee ratio when the acquirer is a PE-backed private hospital, that is, a hospital with no listing on public capital markets.

To see if the increase in the skilled employee ratio for publicly traded PE-backed acquirers could be explained alone by such acquirers' access to public capital markets, we compare the skilled employee ratio at targets of publicly traded PE backed acquirers versus other publicly traded acquirers. Although we observe an increase in the skilled employee ratio associated with both types of acquirers, the magnitude of the increase is much larger at hospitals acquired by PE backed publicly traded hospitals. These findings suggest that labor outcomes at acquired hospitals depend critically on whether the acquirer hospital has access to public capital markets as well as whether it is PE-backed.

Our examination of wages of nurses, pharmacists, physicians, and other employees yields consistent inferences with the finding that PE acquirers increase skilled employee ratio. We find that the ratio of wages paid to skilled workers relative to total wages (i.e., skilled worker wage ratio) increases when the acquirer is a publicly traded PE-backed hospital. There is no change in the skilled worker wage ratio in hospitals acquired by non-PE investors nor in hospitals acquired by PE-backed hospitals with no public listing.

We next examine a key indicator of operating efficiency measured by overhead costs. We find that target hospitals of PE-backed acquirers experience a significant decline in overhead costs, while targets of non-PE backed acquirers do not exhibit such a change. The reduction in overhead costs is most prominent among targets of PE-backed, publicly traded acquirers. This result is consistent with the view that such acquirers benefit from

the efficiency focus of PE investors as well as from accountability to other public investors.

What type of hospitals benefit more from PE acquirers? Answering this question can potentially shed light on the mechanisms through which PE firms or PE-backed acquirers improve efficiency at target hospitals. We first examine the roll-up strategy that PE firms utilize where they achieve economies of scale by forming a large system of hospitals through multiple acquisitions. We classify target hospitals by the extent to which they become a part of a larger system after being acquired by PE acquirers. We find a greater increase in skilled labor ratio and larger reduction in overhead costs when a PE acquirer forms larger combined hospital system compared to the size of the target's previous system. This result is consistent with the argument that PE acquirers achieve economies of scale at target hospitals. Second, we consider the potential for geographical synergies. Partitioning targets based on whether they have geographical overlap with the existing hospitals in the acquirers' system, we show that skilled labor growth and overhead cost reduction are stronger in cases where the target is located in the same state as at least one of the hospitals of the PE-backed acquirer. This finding suggests that PE acquirers generate synergies from managing geographically close hospitals. Finally, we look into the for-profit status of target hospitals prior to the acquisition. We conjecture that, hospitals previously organized as non-profit entities should experience the largest improvement in efficiency when taken over by PE investors or PE-backed hospitals. Our evidence supports this prediction, suggesting that PE investors can significantly improve target hospitals by transitioning them from a non-profit to a for-profit system and keeping the acquired hospitals accountable to PE investors.

After studying employment and operating efficiency outcomes, we examine patient outcomes at acquired hospitals across several dimensions. First, we focus on mortality rates, the most commonly used metric for health care quality. We next turn to readmission rates, which is a proxy for the effectiveness of hospital treatment. Finally, we examine survey evidence on patient satisfaction.

Patients at PE-acquired hospitals do not experience an increase in mortality rates due to heart attack and heart failure, while those at non-PE-acquired hospitals do ex-

hibit marginally higher mortality rates due to heart failure. Patients at all target hospitals experience higher death rates related to pneumonia, but the increase is larger in magnitude for patients at hospitals acquired by non-PE investors. Compared to the control group, readmission rates do not increase for PE acquired hospitals. Readmission rates associated with heart failure even decline at PE acquired hospitals. Finally, while we document a robust decline in patient satisfaction at an average target hospital subsequent to being acquired, consistent with the results in Beaulieu et al. (2020), we observe that patient satisfaction declines more at targets of non-PE acquirers. In fact, we observe no significant decline in any patient satisfaction scores at hospitals acquired by publicly traded PE-backed hospitals. This result is in line with our prior observation that these acquirers are associated with an increase in the proportion of skilled employees which are critical in providing quality health care. Overall, results from real patient outcomes and patient satisfaction surveys do not suggest deteriorating patient outcomes at PE acquired hospitals, with the exception of increased rate of deaths due to pneumonia.

Although existing work has analyzed important aspects of mergers in the hospital industry, with the exception of Bruch et al. (2020), no study has paid attention to the for-profit status of acquirers. Since there are major concerns for regulators regarding mergers between two competing hospitals, extensive research has examined the price impact of mergers and found sizeable price increases at both acquirer and target hospitals (Dafny 2009, Lewis and Pflum 2016, Dafny et al. 2019). Cooper et al. (2019) also find that prices increase significantly when the merging hospitals are geographically close, but not when they are geographically distant. Consistent with cost cutting and efficiency improvements motives of mergers, Schmitt (2017) and Craig et al. (2019) find that acquired hospitals experience significant cost savings, and multi-hospital system acquirers are more successful in reducing costs at acquired hospitals. A recent study examines the quality of healthcare at acquired hospitals and finds that patient experiences worsen modestly subsequent to acquisitions, with no meaningful changes in outcomes such as mortality rates or readmission rates (Beaulieu et al. 2020).

Recent work by Bruch et al. (2020) examines hospitals acquired by PE investors

from 2005 to 2017, and finds that hospitals acquired by PE investors are associated with increases in net income, charges, charge to cost ratios, and case mix index as well as improvements in some quality measures. Bruch et al. (2021) examine hospital data from 2018 and finds that PE investors are more likely to buy hospitals in rural and low-income areas. While our findings are consistent with the profitability and efficiency results they document, our focus on how PE investors restructure the labor force and human capital profile of target hospitals provides a specific channel through which they improve efficiency. In addition, our results suggest that their role is not limited to targeting inefficiency and reducing it. An important novel finding emerging from our paper is that the skilled employment profile of a target hospital depends critically on whether the acquirer has public listing and PE backing and hence, access to public capital markets. Finally, our paper studies differences in post-acquisition outcomes between PE and non-PE acquirers, and documents meaningful differences across different acquirer types. Even within PE acquirers, there are key differences in post-acquisition outcomes based on whether acquirers have access to public capital markets, suggesting that combining all acquirers into a single group may mask important variation in acquisition outcomes.

Our results regarding the impact of PE acquirers on the human capital profile of the target hospital are related to the findings in Davis et al. (2014). This paper shows that while PE buyouts lead to modest net job losses they also result in large increases in gross job creation and destruction. Our analysis finds that PE acquirers lead to large job losses overall. However, job losses seem to concentrate in low skilled occupations. We do observe an increase in the ratio of skilled employees when the acquirer is a publicly traded hospital with PE ownership. Hence, our paper adds a nuanced finding to the role of PE in promoting investment in skilled human capital. Consistent with Davis et al. (2014), we also observe that PE acquirers are associated with operational efficiency in the hospitals they acquire. In addition, during our sample period the vast majority of hospitals accessing public capital markets in an IPO were PE owned, suggesting that PEs play a role in facilitating hospitals' access to public capital through an IPO.

More recent studies in the healthcare industry examine the role of PE investors in

the management of nursing home industry (Gandhi et al. 2020, and Gupta et al. 2020). Gandhi et al. (2020) document positive effects of private equity on nursing homes in highly competitive markets in terms of increased staffing care. In less competitive markets, PE reduces staffing by a significant amount. Gupta et al. (2020), on the other hand, find that PE owners reduce the quality of care at nursing homes they manage. Our analysis complements these recent studies by studying PE acquirers in the hospital industry. Similar to these papers, we also find that hospitals acquired by PE-backed private hospitals experience a reduction in the proportion of skilled employees including nurses. However, publicly traded PE-backed acquirers are associated with an increase in the ratio of skilled employees and no decline in patient satisfaction outcomes. These findings suggest that the short term effects of private equity may be different from its long term effects — those observed after PE acquired hospitals access public capital markets through an IPO. They are also consistent with "permanent substantial component" and "long lasting effects of PEs" proposed in Kaplan and Stromberg (2009) and Biesinger et al. (2020). In more recent work, Liu (2021) examines the pricing implications of PE investors in the hospital industry. He finds a significant price increase at PE-acquired hospitals and their local rivals. The paper attributes increased prices at PE acquired hospitals to PEs' superior bargaining power with respect to private insurers. Our paper primarily focuses on labor outcomes at PE-acquired general acute care hospitals while Liu (2021) examines pricing implications of PE acquirers in a wider range of acquired hospitals including specialized behavioral hospitals. Finally, our paper is related to Adelino et al. (2015), who examine investment cash-flow sensitivity of non-profit hospitals, and find that such hospitals exhibit a similar investment behavior to public firms.

2 Background: Private Equity Acquisitions in the Hospital Industry

There are several types of hospital acquisitions where the acquiring hospital is associated with a PE firm. The first type is that a PE firm directly acquires a hospital or a

system of hospitals. Second, a target hospital previously acquired by a PE firm makes acquisitions itself, forming a system of hospitals, referred to as "roll-up acquisitions." In such acquisitions, the acquirer hospital could have public or private status. In our analysis, for direct acquisitions by PE investors and acquisitions made by PE-backed private hospitals, we refer to the acquirers as *PE-Backed Private Acquirers*. For acquisitions performed by PE-backed, publicly traded hospitals, we refer to the acquirers as *PE-Backed Public Acquirers*.

We note that, while publicly listed PE-backed hospitals are subject to monitoring by a broader set of public shareholders, their governance and operations are often influenced by PE investors. In some cases, PE investors continue to hold a stake in the hospital or stay on the board of directors long time after taking the hospital public in an IPO. In other cases, even if PE investors fully exit the hospital, it is possible that their "imprint" remains, influencing the decision-making inside the hospital (Biesinger et al. 2020).[2]

Acquirers that have had no PE investors are classified as *Non-PE Backed Acquirers*. Such acquirers could be private hospitals as well as publicly traded hospitals. Initially we combine both private and public hospitals into a single category. Later in our tests, to obtain a more detailed understanding of the role of PE acquirers, we split this category into *Non-PE Backed Private Acquirers* and *Non-PE Backed Public Acquirers*.

3 Data and Sample

We collect data from several sources. Information regarding hospital characteristics and performance comes from Centers for Medicare & Medicaid Services (CMS). We extend the list of hospital mergers and acquisitions compiled by Cooper et al. (2019) to 2018 from various sources, including SDC, Factset, and Becker's Hospital Review. Finally, we extract patient satisfaction data from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.

[2]Our classification of PE-backed public hospitals is consistent with Davis et al. (2014), who refer to a PE-acquired firm to be a PE-backed firm even after the firm's IPO.

3.1 Hospital Characteristics Data

We obtain hospital characteristics data from Centers for Medicare & Medicaid Services' (CMS) Healthcare Cost Report Information System (HCRIS). Medicare-certified institutional providers are required to submit their annual cost report to a Medicare Administrative Contractor (MAC) and CMS maintains the cost report data in HCRIS.

We collect from the cost reports information regarding hospitals employment and operational characteristics. To start, we collect data on overall employment and wages per hour for employees in various occupations. The unit of employment is a full-time equivalent employee (FTE), which is given by total employee-hours worked divided by 2,080 (40 hours a week multiplied by 52 weeks). This employment count is then converted into log terms (*Log(Employment)*).

Following Prager and Schmitt (2021), we categorize employees into skilled and unskilled, with skilled workers referring to nurses, pharmacist, and physicians, and unskilled workers including all other employees. We compute three metrics for the skilled labor composition inside a hospital. First, we define *Skilled Worker Ratio* as the percentage of the number of skilled workers relative to all employees. In addition, we calculate *Skilled Worker Wage Ratio*, the ratio of wages paid to skilled workers to the total amount of wages. Finally, we scale the count of skilled workers by all treated patients (*Skilled Workers/Patients*). We measure the number of treated patients using adjusted discharge measure (Schmitt 2017), defined as the number of inpatient discharges multiplied by $(1 + outpatient\ charges/inpatient\ charges)$. This adjustment is necessary for two reasons. One is that the number of patients treated outside the hospital, that is, outpatient discharges is not available. To obtain a measure of outpatient discharges we calculate adjusted discharge defined as the number of discharged inpatients multiplied by $(1+outpatient\ charges/inpatient\ charges)$. Second, since outpatient treatment generally takes up less hospital resources and requires less time from nurses and physicians than inpatient treatment, the adjusted discharge measure discounts the number of outpatients proportionately, taking into account the possibility that target hospitals may strategically change the outpatient-to-inpatient ratio as a part of their operational adjustment.

In addition, we obtain an operating efficiency measure of a hospital using the log of overhead costs scaled by the number of patients. We follow HCRIS' definition of overhead salaries and make some adjustments. HCRIS defines overhead salaries as "general service cost centers," i.e., salary expenses that are associated with the whole facility but not directly related to furnishing patient care. This includes administrative salaries, utilities, housekeeping, etc. We exclude nurses and pharmacy worker salaries from overhead costs because those are categorized as skilled worker salary.

3.2 Hospital Mergers and Acquisitions Data

Data on hospital M&A activity come from multiple sources. First, we rely on the merger roster during the period of 2001 through 2014 provided by Cooper et al. (2019). Following the strategy of Cooper et al. (2019), we extend the sample of M&As to 2018.

We start from the AHA's Annual Survey of Hospitals and identify the changes in system identifiers of individual hospitals. These changes in system classification likely suggest the change in hospital ownership. We verify whether a change in system identifier is indeed associated with an acquisition by manually validating these events across several mergers and acquisitions databases, including SDC Platinum, FactSet, and most importantly, Becker's Hospital Review. In this process, we match the list of AHA system changes with acquisitions recorded in those databases according to the names and locations of target and acquirer hospitals, as well as the completion date of the deals. We also supplement the acquisition list based on information from SDC, FactSet, and Becker's and record deals that are not correctly captured by the changes in AHA system IDs. When the matching between Becker's and AHA is ambiguous, we manually search internet resources including local newspaper articles and American Hospital Directory (AHD) to further verify the matches.

The above process gives us a sample of 1,218 MAs that occurred during the period of 2001 through 2018. The deals involve 478 unique acquirers and 1,684 unique target hospitals. The HCRIS data allow us to track a target hospital over time, even after it is acquired by another hospital. This presents an advantage over papers studying MA

outcomes in other industries.

3.3 Classification of Acquirers

We group M&A deals based on acquirer types. Among the 1,218 deals in our sample, 804 are acquisitions conducted by nonprofit acquirers and 414 are acquisitions by for-profit organizations. We focus on acquisitions conducted by for-profit institutions and classify acquirers into private equity (PE) backed acquirers and non-PE-backed acquirers. We obtain information regarding PE investment and the holding duration of PE firms from CapitalIQ and manually verify this information. We also collect data regarding the presence of PE investors for a hospital from news articles. Finally, we corroborate our classification of PE presence using the exit timing of PE investors from Pitchbook.

As discussed in Section 2, we refer to acquisitions where the acquirer is a PE firm as well as a PE-backed privately owned hospital as deals conducted by PE-backed private acquirers. The former group, where a PE firm directly acquires a hospital, can be inferred based on the name of the acquirers from our MA sample. The latter case is defined as acquisitions conducted by hospitals that are previously acquired by PE firms where PE firms have not exited by the time of the current deal of interest.

It is more challenging to identify PE-backed, publicly traded acquirers. We start with all the publicly traded acquirers that have been backed by PE firms, and search for PE exit information and PE ownership duration for those acquirers in Pitchbook and CapitalIQ. We define PE-backed public acquirers as public acquirers backed by PEs as of their IPO dates.

In our sample of acquisitions where the acquirer is a for-profit organization, 198 are acquisitions by PE-backed acquirers and 216 are acquisitions by non PE-backed acquirers. out of the 216 acquisitions by non PE backed hospitals, 164 acquiring hospitals are private and 52 are publicly traded. Among the 198 acquisitions where the acquirer is PE-backed, 117 deals involve a PE-backed private acquirer, and 81 involve a PE-backed publicly traded acquirer. Among the 117 deals, the acquirer is a PE firm in 99 deals, and a PE-backed private hospital system in the remaining 18 deals.

3.4 Patient-level Outcomes and Patient Satisfaction

We obtain information on patient outcomes from Hospital Compare Outcome Measures, which is publicly disclosed by the Centers for Medicare & Medicaid Services (CMS) and Hospital Quality Alliance (HQA). These databases provide rich information including health treatment, patient recovery, complications during treatment, readmission rates, and mortality rates. We follow the prior literature and focus primarily on mortality and readmission rates as proxies for the quality of care (e.g., Ho and Hamilton 2000; Propper et al. 2004; Cooper et al. 2011; Gaynor and Town 2011). Mortality rate is the most commonly used proxy for hospitals' quality of care. Readmission rate is also used as a measure of the effectiveness of treatment.

Our main measures include 30-day mortality rates from heart attack (AMI), heart failure (HF), and pneumonia (PN), as well as 30-day readmission rates following treatment for the same conditions. All measures of healthcare quality outcomes have been adjusted for patient risk using statistical models. Patient risk includes clinical (e.g., types of treatments, severity of conditions), demographic (e.g., age and sex), and socioeconomic (e.g., race, income, ethnicity) factors.[3] In untabulated analyses, we examine other outcomes including mortality and readmission rates regarding other diseases as well as infection rate and complication during treatment.

Patient satisfaction scores come from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, which is a standardized survey of patients' view of hospital care conducted nationally at the annual frequency. The survey contains questions about patients' experience and satisfaction levels with each hospital. The questions relate to many aspects of patient experience. We narrow down to the following set of questions that are most representative of the quality of care provided by a hospital: quality of communication with nurses and doctors, whether patients get timely help, the overall rating that patients assign to a hospital, and whether patients would recommend the hospital to someone else. For each survey question, the database classifies the responses into three categories (top box, middle box, and bottom box) and discloses the

[3]See more detailed explanation regarding risk adjustment in CMS MMS Blueprint.

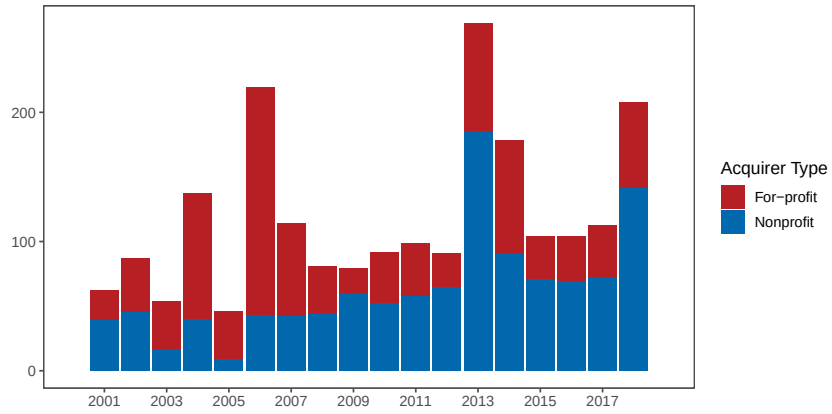
percentage of respondents in each category. We compute the average response by assigning scores of 1–3 to the categories, with 3 corresponding to top box and 1 to bottom box. We then take the weighted average of these scores, with the weight being the percentage of respondents in a given category. Appendix B provides more detailed explanation and examples for this classification scheme.

3.5 Initial Sample Construction

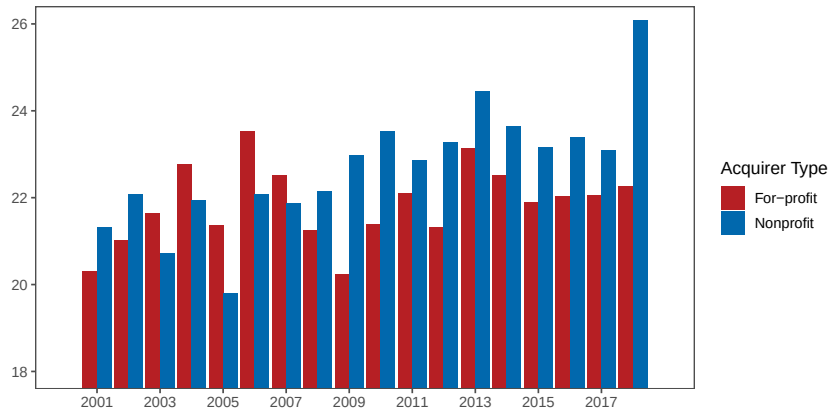
With data gathered from the above sources and procedures, we compile a hospital unit-year panel. Each standalone hospital and each hospital that belongs to a system has its own, separate observation. This allows us to follow and track an individual hospital after it is acquired. Following Cooper et al. (2019), we restrict our sample to general medical and surgical hospitals. Military and Veteran Health (VA) hospitals are excluded from the sample. Following Schmitt (2017), if a hospital is acquired multiple times within the sample period, we exclude the target hospital in our analysis since it is unclear how to define pre- and post-acquisition periods for such hospitals. We also require hospitals not to have any gaps in their observations and to appear in the data for at least five years in the sample. Target hospitals are required to have at least two years of observations before and after the acquisition year in order to compare pre-acquisition observations and post-acquisition observations within target hospitals.

3.6 Univariate Analysis

The hospital industry has experienced persistent growth in MA activity over the past two decades. Figure 1 illustrates this time trend. In Panel A, we report the total number of hospitals acquired each year. In Panel B, we compute the natural logarithm of total asset values of hospitals acquired each year. Over our sample period, 46.5% of the target hospitals were acquired by for-profit organizations. There is a peak in the number of deals in 2013, with around 240 hospitals being acquired. Deal activity peaked again in 2018. In that year, hospitals with a total value of about $175 billion are acquired, reaching a record-high deal value in recent history. The total value of assets acquired by for-profit



(A) The total number of hospitals acquired



(B) The log total asset value of acquired hospitals

Figure 1. Hospital Mergers and Acquisitions Activity. This figure shows the time series patterns of hospital mergers in our sample. We classify targets into two groups based on whether the acquirer is a for-profit or a nonprofit institution. Panel A reports the number of hospitals being acquired by each acquirer type in a given year. Panel B reports the log of total asset values of target hospitals by each acquirer type.

acquirers over our sample period is $79 billion out of total acquisition volume of $460 billion. These statistics suggest for-profit acquirers play an economically meaningful role in the M&A activity in the hospital industry.

Figure 2 reports the number of deals involving different types of for-profit acquirers. The pattern suggests that the majority of the deals by for-profit acquirers are conducted by PE-backed acquirers (74%). Moreover, the majority of target hospitals have for-profit status (70%).

Table 1 presents summary statistics for our analysis. In Panel A, we report and compare the characteristics of target hospitals during the four years prior to their acquisition and the characteristics of hospitals that are never acquired in our sample. Target

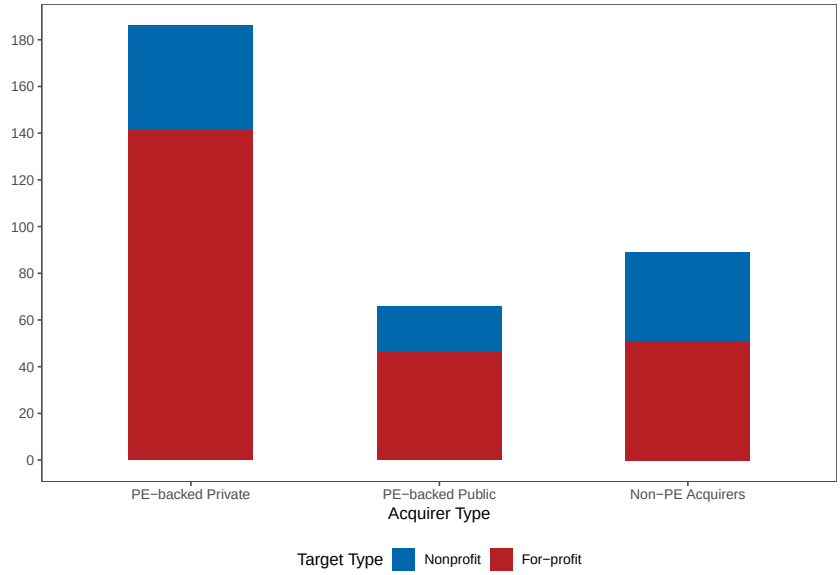


Figure 2. Distribution of Deals by Target and Acquirer Types. This figure reports the breakdown of our sample of deals conducted by for-profit acquirers. We classify targets into two groups based on whether they are for-profit or nonprofit. Acquirers are classified into three types: PE-backed private acquirers, PE-backed publicly traded acquirers, and Non-PE acquirers. The height of the columns represents the number of deals with each classification in our sample. The height of the blue bars represents the number of deals involving nonprofit targets, while the height of the red bars represents the number of deals involving for-profit targets.

hospitals have similar employment size as non-targets, but are larger in terms of the total number of beds than non-target hospitals. Target hospitals also have lower skilled worker-patient ratio as well as lower overhead salary-patient ratio than non-targets. Interestingly, target hospitals have lower patient satisfaction outcomes across all dimensions than non-acquired hospitals. In terms of operating characteristics, target hospitals have a higher case mix index, which implies that they provide more complicated medical services than that of non-acquired hospitals. Finally, target hospitals have a lower proportion of outpatient discharges than other hospitals.

Table 1 About Here

4 Empirical Methodology

Given that target and control hospitals differ significantly in many important dimensions, we follow the existing work on hospital mergers such as Schmitt (2017) and Prager and Schmitt (2021) and conduct a matched sample analysis. In this analysis, we com-

pare each target hospital to a matched control hospital that is similar across various dimensions, including size, operational features, and patient characteristics.

The matched control group is constructed as follows. We start with an initial pool of hospitals that includes (a) all hospitals that have not been acquired by and have not acquired any other hospital in our sample period and (b) "future target" hospitals which will not be acquired within the next 5 years. For each target hospital, we find one "nearest neighbor" hospital in the control pool based on a Mahalanobis matching method with replacement. The matched control hospital needs to locate in the same Census Region and have the same Metropolitan area status as the treated hospital. More importantly, the group of matched control units needs to have the closest Mahalanobis distance to the treated units based on their average hospital characteristics during the four years prior to the acquisition and total employment during $t-1$ and $t-2$ year prior to the deal. The hospital characteristics that we use in the matching process include the log number of beds, the case mix index (a measure of clinical complexity of a hospital's service), the fraction of Medicare discharges, the fraction of Medicaid discharges, and the fraction of outpatient charges defined as outpatient charges divided by the sum of outpatient and inpatient charges. We follow the prior work by Schmitt (2017), and Prager and Schmitt (2021) in choosing these matching variables. Matching based on employment during during $t-1$ and $t-2$ helps us control for pre-existing trend in employment growth prior to the acquisition.[4]

Figure 3 summarizes the covariate balance before and after matching. Similarity between target and control hospitals is measured by standardized difference, which is the average difference between matched pairs (target − control) divided by the standard deviation computed over all observations. After matching, we observe increased similarity between target and control hospitals, although the similarity is lower in the employment dimension than in other dimensions we match on. While target hospitals have lower employment ex ante compared to control hospitals, target and control groups exhibit

[4]The idea of matching on an outcome variable is also found in other matching methodologies such as entropy balancing or synthetic control methods, whereby the researcher identifies the control group by minimizing the difference in the sample moments of the outcome variable between the treatment and control groups (Abadie et al. 2010 and Hainmueller 2012).

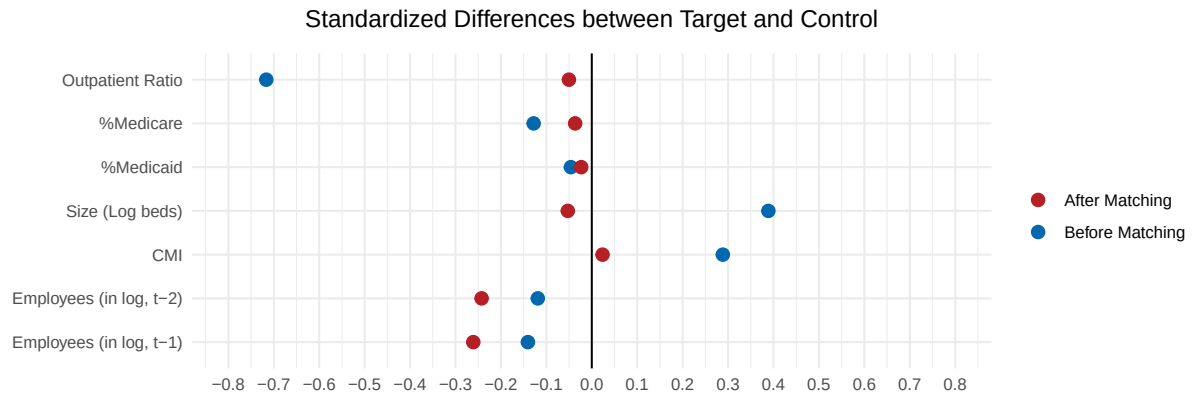


Figure 3. Covariate Balance This figure shows the values of standardized differences between target and matched control hospitals. The difference is computed by values in target hospitals minus values in control hospitals. Detailed variable definitions are provided by Appendix A.

parallel pre-trend in employment as can be observed in Figure 4.

Our testing sample is an event-hospital unit-year panel, whereby an event refers to an acquisition of a hospital. With each event, we track the target hospital and its matched control over the $[-4, +4]$ years around the event. This panel has 4,904 observations spanning the period of 2001 through 2018. In Panel B of Table 1, we report the summary statistics for the key variables in the matched sample.

We examine post-acquisition outcomes at target hospitals, relative to their matched control hospitals, in a multivariate setting. We adopt a difference-in-difference framework to examine how target hospitals change after being acquired. The analysis controls for a variety of target characteristics, location characteristics of the target hospital and a set of stringent fixed effects. Specifically, we estimate the following regression:

$$Y_{e,i,t} = \beta Target_{e,i,t} + \gamma \cdot X_{i,t} + \alpha_i + \mu_{e,t} + \epsilon_{e,i,t} \tag{1}$$

where e indicates an acquisition event, i indicates a hospital, and t indicates a year around the event. $Y_{e,i,t}$ represents a variety of hospital outcomes that we examine, including employment, the ratio of skilled employees, the ratio of skilled worker wages to total wages, overhead costs, and real patient outcomes and patient satisfaction scores. *Target* is an indicator variable that turns to one for a target hospital in deal e from the acquisition year onward. X_{it} represents a vector of hospital and county-level controls, including all

variables in the matching process, and county population size, one-bedroom rent, and population demographics (e.g., the percentage of residents that are Asian and African American).

Our approach controls for hospital fixed effects (α_i) and event-by-year interactive fixed effects ($\tau_{e,t}$), which allows us to compare within a pair of treated and control hospitals over each year in the event window. In this framework, we are interested in β, which measures how a target hospital changes subsequent to being acquired, compared to the concurrent changes in the conditions of matched control hospitals that are located in the same Census region.

In our main analyses, we separately estimate the effects of different types of acquirers on target hospitals and estimate the following model:

$$Y_{e,i,t} = \beta_1 PE\ Public\ Acquirer_{e,i,t} + \beta_2 PE\ Private\ Acquirer_{e,i,t} + \beta_3 NonPE\ Acquirer_{e,i,t} + \gamma \cdot X_{i,t} + \alpha_i + \mu_{e,t} + \epsilon_{e,i,t}, \quad (2)$$

where *PE Public Acquirer* equals one for targets of PE-backed, publicly traded hospitals, and zero otherwise. *PE Private Acquirer* turns to one for targets of PE firms and PE-backed private acquirers. *NonPE Acquirer* is an indicator for targets of non-PE-backed acquirers.

5 Main Results

5.1 Employment Outcomes

5.1.1 Total Number of Employees

We start our analysis by examining changes in the number and composition of employees at acquired hospitals, relative to those at matched control hospitals. Ex ante, there are reasons to believe that PE acquirers may cut jobs and also expand certain types of employment at target hospitals. On one hand, PE firms may cut excess employment to

reduce overhead costs and improve efficiency at target hospitals. On the other hand, PE acquirers could provide capital and management expertise to target hospitals, ultimately increasing their capacity to hire skilled workers, especially nurses and physicians who are crucial to providing quality health care.

Table 2 presents employment outcomes at acquired hospitals following the specification of Equation 1 and Equation 2. In Column (1), we use a relatively sparse fixed effects structure, including only hospital fixed effects and year fixed effects, effectively comparing target hospitals to all control hospitals. In Column (2), we have event fixed effects and event time fixed effects separately. The event time fixed effect helps remove a general time trend for an average event, and event-time fixed effects absorb common time trends between treated and control hospitals around the acquisition year. In the third column, we further impose event-by-time interactive fixed effects. This helps purge out unobservable dynamics affecting a specific acquisition event, that is, any changes that jointly affect the pair of target and control hospitals. Given that this is the most stringent fixed effect, we carry this specification throughout the rest of our analyses.

Panel A of Table 2 shows a robust decline in employment at acquired hospitals both at the year of the acquisition and in the first four years after the acquisition. Subsequent to being acquired, the average target hospital reduces 6% of its labor force in the year of the acquisition, and over 10% during the following four years. Panel B shows that employment at target declines for all types of acquirers, with the magnitude of the decline being greater for PE acquirers than non-PE acquirers.

TABLE 2 ABOUT HERE

The reduction in employment potentially suggests a cost-cutting motive by acquirers. An important question is whether by cutting employment, PE acquirers compromise the quality of health care and patient welfare at the hospitals they acquire. We attempt to address this important point in two ways. We start by looking at changes in the fraction of "core" employees such as nurses, pharmacists, and physicians, who are skilled in providing medical care. Later in our analysis, we examine patient outcomes (i.e., mortality

and readmission rates, and patient satisfaction scores) to see if changes in the skilled labor profile of target hospitals are reflected in patient outcomes and experiences.

5.1.2 Employee Composition

To examine the changes in the workforce composition at a target hospital, we partition employees into skilled and unskilled types. Skilled employees include nurses, pharmacists, and physicians. Unskilled employees include others, which include housekeeping, cafeteria workers, etc. Our main measure of worker composition is *Skilled Worker Ratio*, the percentage of skilled employees in a hospital relative to all employees. To further shed light on a hospital's allocation of financial resources to hiring skilled workers, we also compute *Skilled Worker Wage Ratio*, the percent of salary expenses for skilled employees. Results from this analysis are reported in Table 3. Panel A presents results regarding *Skilled Worker Ratio*, i.e., the number of skilled workers as a percentage of total employees in a hospital. In Columns (1) and (2), we examine the average effect of PE-backed acquirers and non-PE-backed acquirers. We observe that the proportion of skilled employees increases at targets of PE acquirers while staying unchanged at targets of non-PE acquirers. In Columns (3) and (4) we find that the increase in the ratio of skilled employees occurs exclusively at hospitals acquired by publicly traded hospitals with PE backing. The estimates suggest that PE-backed public acquirers lead to about a 2-percentage-point increase in the skilled worker ratio at target hospitals. This magnitude accounts for a 50% increase relative to the average skilled worker ratio in target hospitals prior to the acquisition.

Table 3 About Here

In Panel B, we analyze *Skilled Worker Wage Ratio*, the wages paid to nurses and physicians as a fraction of the total wage expenditure at a target hospital. In Columns (1) and (2), we find that hospitals acquired by PE acquirers pay a greater fraction of total wages to skilled workers while hospitals acquired by non-PE acquirers do not seem to change this ratio. Results in Columns (3) and (4) show that the increase in skilled wage ratio occurs predominantly at targets acquired by publicly traded PE-backed hospitals. These results

suggest that PE acquirers' role is not limited to cost cutting by reducing employment and wage bills of the target hospital. They appear to be active in reducing unskilled employment and at the same time preserving or increasing the number of critical employees such as nurses and physicians, who end up receiving a greater share of total wages.

One potential explanation of the previous finding is that hospitals may be outsourcing routine tasks to contractors and account for such spending as non-wage expenditures. Under that explanation, hospitals may not change the employee composition, or allocate more resources towards skilled employees, but are simply changing their accounting method. To address this concern, we examine two additional measures of skilled workers. The first measure is the number of skilled employees per patient (*Skilled Workers/Patients*). This ratio is informative of the quality of care received by patients in a hospital. The second measure is the log number of skilled workers, without a scalar. These measures should not be affected by outsourcing activities.

Table 4 provides results from these auxiliary analysis. Results from Panel A suggests little change in per-patient skilled labor in the average target hospitals of PE-backed or non-PE-backed acquirers. However, interesting effects emerge as we separately consider publicly traded and private acquirers. Publicly traded hospitals with PE backing are associated with significant improvement in the number of skilled healthcare providers per patient. In contrast, private acquirers, including those backed by PE firms, are associated with a declining number of skilled employees per patient. We find a similar pattern from total skilled employees, as shown in Panel B. These findings are consistent with private acquirers having less financial resources to increase skilled human capital, relative to acquirers with access to public capital markets. It is unlikely that access to public capital markets alone could explain the increase in skilled employee ratio given that the magnitude of the increase in skilled worker ratio for publicly traded acquirers with no PE-backing is much smaller.

TABLE 4 ABOUT HERE

Our results on the relation between PE acquirers and employment are consistent with

the findings from earlier studies on productivity and employment implications of PE investment. Many earlier studies document a decline in employment associated with PE investment (Kaplan and Stromberg 2009). Kaplan (1989) studies the economic outcomes at firms acquired by private equity in leveraged buyout transactions, and shows that a median firm loses 12% of employment on an industry adjusted basis immediately after the buyout. Muscarella and Vetsuypens (1990) examine 72 firms that complete an initial public offering (IPO) after an LBO between 1983 and 1987, and for the 26 firms they can track, employment declines by an average of 0.6 percent between the LBO and the IPO. Using U.S. Census Bureau data covering manufacturing plants of 131 firms going through private equity buyout from 1981 to 1986, Lichtenberg and Siegel (1990) find that on an industry-adjusted basis, employment falls by 1.2% per year after buyout compared to 1.9% rate of decline per year before the buyout. Wright, Thompson, and Robbie (1992) and Amess and Wright (2007) also find that buyouts in the UK lead to modest employment declines.

Recent papers find more nuanced effects of PE investment on human capital and productivity, often suggesting a positive role of PE involvement in improving worker skill and technology adoption. This implication is similar to our observation that publicly traded PE-backed acquirers are associated with increased skilled labor at target hospitals. Using data on buyouts in France, Boucly, Sraer, and Thesmar (2011) find that employment grows at private equity-acquired firms than at controls. They interpret this result as private equity relaxing the financial constraints of target firms. Agrawal and Tambe (2016) use an individual-level data set obtained from an online job-search platform in the US, and find that buyouts increase IT-related investments, which enhance employees' human capital and increase the survival likelihood of target firms. Olsson and Tåg (2017) analyze individual-level employment data for private equity buyouts in Sweden, and present strong evidence for labor market polarization. Antoni et al. (2019) use establishment and worker-level data from private equity buyouts in Germany, and document a reduction in overall employment but an increase in hiring involving IT jobs. Our findings add a new nuance to these earlier observations on the role of PE firms in the hospital industry.

5.1.3 Skilled Employee Turnover

We further investigate whether hospitals acquired by PE-backed acquirers attract skilled employees by examining skilled employee flows including physicians and nurses at target hospitals. To do this, we obtain granular data on the career paths of individual clinicians from the Doctors and Clinicians National Downloadable File. Doctors and Clinicians National Downloadable File is a database compiled by the Centers for Medicare and Medicaid Services (CMS) under Medicare Provider Enrollment, Chain, and Ownership System (PECOS).[5] It covers all clinicians working with medicare patients that are enrolled in PECOS. Clinicians mostly refer to physicians and nurses, but also include other non physician practitioners (NPPs). We refer to clinicians in this database as skilled employees. It provides information regarding skilled employees' affiliations during the period of 2014–2018, thus allowing us to track the precise timing when a skilled employee joins or leaves a hospital. With this database, we are able to study how M&A deals affect skilled employee flows at a hospital.

We compile a career path sample, for which the unit of observation is a skilled employee-hospital-year. The variables of interest are *Leave Hospital* and *Join Hospital*. *Leave Hospital* is an indicator for whether the current year is the last year a given skilled employee works at a hospital; while *Join Hospital* equals one for the first year a skilled employee joins a hospital, and zero otherwise.[6] We estimate the following regressions:

$$Career\ Outcomes_{p,i,t} = \beta Target_{i,t} + \gamma \cdot X_{i,t} + \alpha_i + \phi_p + \tau_t + \epsilon_{p,i,t}, \tag{3}$$

where p represents a skilled employee, i a hospital, and t a year. *Career Outcomes*$\in\{$*Join Hospital*, *Leave Hospital*$\}$. Our regression controls for skilled employee fixed effects (ϕ_p), hospital fixed effects (α_i), and year fixed effects (τ_t). Physician fixed effects allow us to track the same physician's career trajectory over time, and hospital fixed effects help us compare the same hospital's ability to attract skilled employee before and after the

[5]Description of the database can be found at https://data.cms.gov/provider-data/sites/default/files/data_dictionaries/physician/DOC_Data_Dictionary.pdf.

[6]We do not set *Join Hospital* to one for year 2014, nor *Leave Hospital* to be one for 2018.

acquisition. Year fixed effects remove macroeconomic conditions. We also control for hospital and local characteristics as in the baseline analysis.

Similar to our baseline analysis, we also separate *Target* into several groups based on the acquirer type, i.e., *Non-PE Backed Acquirers*, *PE-Backed Acquirers*, *PE-Backed Public Acquirers*, and *PE-Backed Private Acquirers*.

In addition, we examine whether PEs' target hospitals are particularly capable of attracting and retaining high-quality skilled employees. We measure skilled employee quality using years of work experience, i.e., the number of years they have graduated from medical school. *Experienced* is an indicator that equals one when a skilled employee has accumulated an above-sample-median years of work experience, and zero otherwise. We then examine the interactive effect of hospital acquisition and experience on skilled employee turnover outcomes.

Table 5 reports the results. In Panel A, we examine the likelihood of a skilled employee to leave and join a target hospital. In Panel B, we separately estimate such likelihood for target hospitals of PE-backed and non-PE-backed acquirers. In Panel C, we further separate PE-backed acquirers into private and publicly traded ones. Finally, in Panel D, we consider whether target hospitals attract and retain more experienced skilled employee. In each panel and outcome variable, we present results with and without individual fixed effects.

TABLE 5 ABOUT HERE

Results from Panel A suggest that target hospitals experience significantly higher skilled employee turnover compared to other hospitals. Skilled employee are 5% more likely to leave a target hospital and 4% more likely to join one. Results from Panel B further demonstrate that the heightened turnover occurs in target hospitals of PE-backed acquirers. Those acquired by non-PE related acquirers do not seem to experience changes in skilled employee turnover.

As we further separate PE-backed acquirers into publicly traded and private ones, we find that skilled employees are equally more likely to join targets of private and publicly traded acquirers. However, targets of public acquirers appear to be better able to retain

skilled employees. As shown by the coefficients of Columns (1) and (2) in Panel C, skilled employees are more likely to leave hospitals acquired by private acquirers but not those acquired by public ones.

In Panel D, we drill down further on the mechanisms of the differential retention effect, and examine whether public acquirers are better able to attract and retain experienced skilled employees. Our evidence is consistent with this conjecture. First, we note that the coefficients of *Experienced* and indicators for target hospitals are positive for *Join Hospital* and negative for *Leave Hospital*. In other words, experienced skilled employees are more likely to be hired and retained by target hospitals than inexperienced skilled employees. Second, comparing this interactive coefficient across acquirer types, we find that the incremental likelihood of joining hospitals by experienced physicians does not differ across acquirer types, while their job separation rates do differ. The likelihood of an experienced skilled employee joining a hospital is around 4.5% for targets of PE-backed public acquirers ($= 0.038 + 0.007$, Column (4)), and 4.9% for targets of private PE acquirers ($= 0.058 - 0.009$). When a hospital is taken over by PE-backed public acquirers, experienced skilled employees are only 1% more likely to leave and this likelihood is not statistically significant from zero. When PE-backed private acquirers purchase a hospital, experienced skilled employees are 2.5% more likely to separate from the hospital.

5.2 Overhead Salaries

Shrank et al. (2019) estimate that overhead costs account for a major source of wasteful spending at hospitals. PE acquirers potentially have the expertise to reduce such wasteful expenditures and improve the efficiency of target hospitals. We test this conjecture by directly examining the changes in overhead salaries in HCRIS. We define overhead salaries as total wages paid to all employees excluding the wages paid to skilled employees involving nurses, physicians and pharmacists. We compute the total overhead salaries at a hospital and scale it by patient counts (adjusted discharge), and take the log of the per-patient overhead salaries. We then estimate the changes in overhead salaries at target hospitals following Equation 1 and 2.

Table 6 reports the results. In Panel A, we show that overhead salaries decline significantly in an average target hospital. In Panel B, we look at the changes in overhead salaries associated with different types of acquirers, and find that the decline in overhead salaries is concentrated in PE-backed acquirers. This effect is particularly strong in PE-backed public acquirers. The economic magnitudes are substantial. In our most stringent specification, overhead salaries decline by around 9.5% for hospitals acquired PE-backed private entities and 12.7% for those acquired by PE-backed public entities. In Panel C, we consider an alternative measure, which is the ratio of overhead salaries over total operating costs. We find that this ratio declines only for targets of PE-backed public acquirers.

TABLE 6 ABOUT HERE

Overall, these results are consistent with the argument that PE acquirers help improve the operating efficiency of target hospitals by reducing overhead salaries.

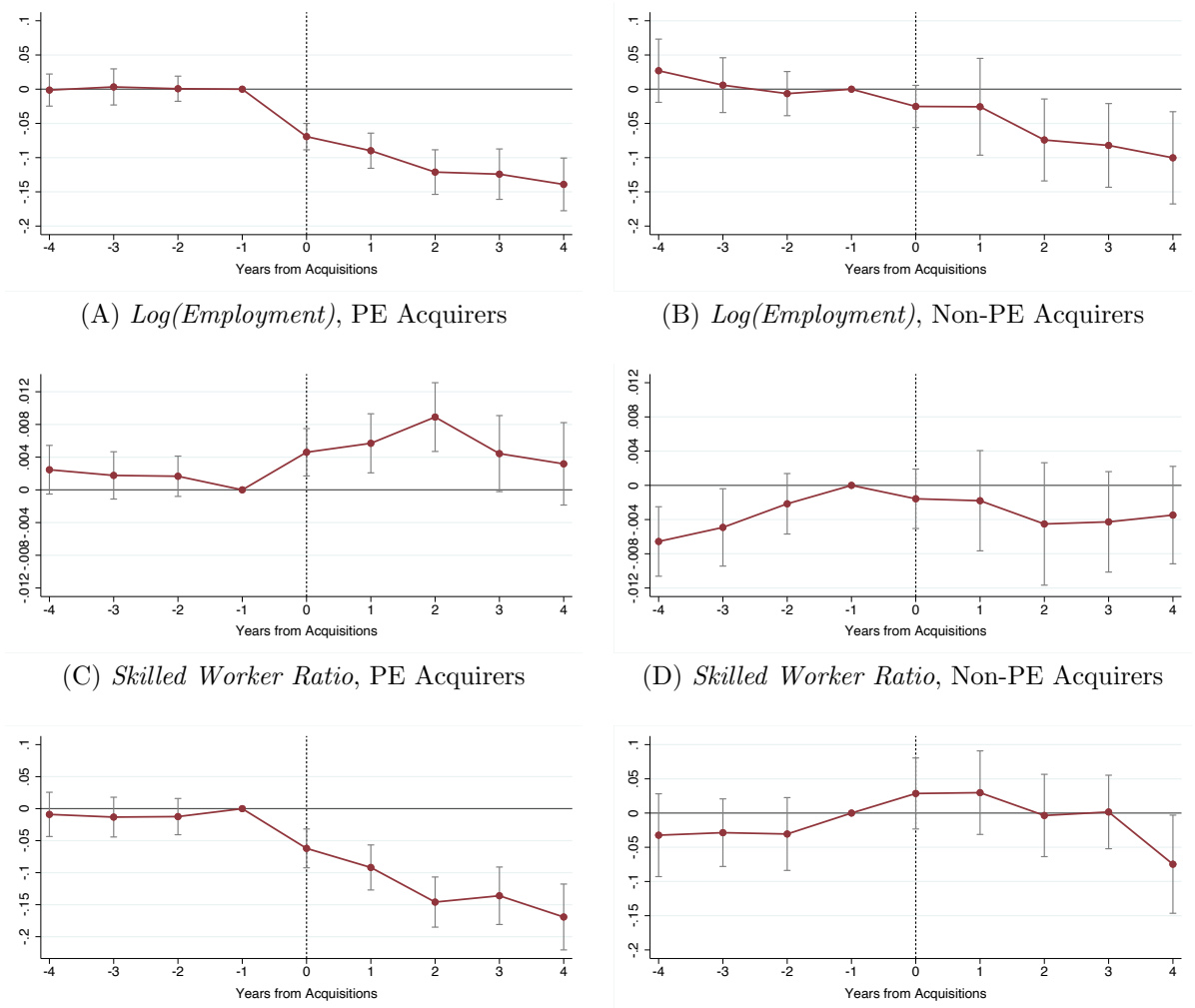
5.3 Dynamic Effects of PE Acquisitions

In this section, we track the changes in employment and costs at target hospitals during every year around the event window. This examination serves two purposes. First, it helps reveal the extent to which the changes we document have occurred in target hospitals prior to the acquisition, and that the PE investors may have selected improving hospitals based on observable characteristics. Second, it allows us to trace the timeline of changes implemented by PE and non-PE acquirers.

We estimate the dynamic effect of hospital acquisitions using the model below:

$$Y_{e,i,t} = \Sigma_{\tau=-4}^{4} \beta_{1,\tau} PE\ Acquirer_{e,i,t=\tau} + \Sigma_{\tau=-4}^{4} \beta_{2,\tau} NonPE\ Acquirer_{e,i,t=\tau} + \gamma \cdot X_{i,t} + \alpha_i + \mu_{e,t} + \epsilon_{e,i,t}, \quad (4)$$

where τ indicates years during the event window. $PE\ Acquirer_{e,i,t=\tau}$ is an indicator for whether hospital i is acquired by a PE or PE-backed firm τ years prior to the observation



(A) *Log(Employment)*, PE Acquirers

(B) *Log(Employment)*, Non-PE Acquirers

(C) *Skilled Worker Ratio*, PE Acquirers

(D) *Skilled Worker Ratio*, Non-PE Acquirers

(E) *Log(Overhead/Patients)*, PE Acquirers

(F) *Log(Overhead/Patients)*, Non-PE Acquirers

Figure 4. Dynamic Effect of PE and Non-PE Acquirers. This figure shows the changes in total employment, skilled worker ratio, and per-patient overhead costs at target hospitals over the acquisition event window. The left-side panels represent effects from PE acquirers (β_1) and the right-side panels report effects from non-PE acquirers (β_2). In each panel, the dots and intervals represent the coefficient and the 95-percentile confidence intervals around it, respectively. Year -1 is absorbed as the base year.

point. $NonPE\ Acquirer_{e,i,t=\tau}$ is defined analogously. In this estimation, the year prior to the event $\tau = -1$ is omitted as the benchmark year.

Figure 4 depicts the results. Panels A and B report coefficients for *Log(Employment)*, Panels C and D report results for *Skilled Worker Ratio*, and Panels E and F report results for *Log(Overhead/Patients)*. We present the coefficients for PE acquirers ($\beta_{1,\tau}$) on the left-side panels and the coefficients for non-PE acquirers ($\beta_{2,\tau}$) on the right panels, so that the effects of PE and non-PE investors can be compared directly. We do not observe any significant pre-event changes for PE targets prior to the acquisitions. Targets

of non-PE hospitals also do not exhibit clear pre-event trends, although skilled labor ratio seems to be lower in Year −4 compared to Year −1 in these hospitals. Following the acquisitions, targets of PEs or PE-backed hospitals exhibit strong and persistent employment and cost cuts, as well as large increases in skilled worker ratio. While targets of non-PE acquirers also experience reduction in employment, there is no increase in the ratio of skilled employees in any year following the acquisition in these hospitals. The reduction in overhead costs is also statistically weak and economically small. Overall, these observations are consistent with our findings from the multivariate analysis that PE acquirers are associated with an increase in skilled worker ratio and reduction in overhead costs while all types of acquirers are associated with a reduction in overall employment at the target hospital.

5.4 Publicly Traded Acquirers and PE Backing

Our results so far suggest that PE-backed, publicly traded acquirers are associated with larger layoffs at their target hospitals, but also an increase in the hiring of skilled labor (nurses, pharmacists and physicians). To understand the drivers of outcomes between PE backed publicly traded acquirers and private acquirers, we compare the changes at hospitals acquired by publicly traded hospitals with PE-backing at the time of their IPOs and those without PE-backing.

Table 7 reports the results from this analysis. We focus on total employment, skilled labor ratio, and overhead cost per patient. Acquirers are first decomposed into PE-backed and non-PE-backed, and within each category, further decomposed into publicly traded and private acquirers. We compare the coefficients between the two types of acquirers and report the difference in coefficients at the bottom of the table ("Difference in Coeff"), together with the statistical significance of the difference. For the ease of display, coefficients of private acquirers are suppressed.

Table 7 About Here

Results suggest that within publicly traded acquirers, those with PE-backing at the

time of their IPO are cut employment and increase skilled workers to a greater extent than those without PE-backing. While public acquirers without PE-backing also increase skilled labor ratio, the magnitude of the change is significantly smaller (0.004 compared to 0.024). Finally, we observe significant differences in the two types of acquirers' ability to cut overhead costs: PE-backed public acquirers are associated with large reductions in overhead costs but non-PE-backed public acquirers are not.

Overall, these findings provide support for our argument that PE investors shape the the governance and business strategy of publicly traded hospitals. It also suggests that the increases in skilled labor ratio cannot be fully explained by the public status of the acquirer. Overall, publicly traded PE-backed hospitals seem to enjoy the benefits of being PE-backed as well as having access to public capital markets and being accountable to public investors.

5.5 Cross-sectional Analyses

Our results so far suggest that PE acquirers increase the fraction of core, skilled employees at target hospitals while still achieving overhead cost reduction. We look into which types of target hospitals benefit most from these effects. This investigation helps reveal the potential channels through which PE acquirers are able to improve the efficiency of target hospitals. In this regard, we focus on three mechanisms, economies of scale, geographical expertise, and changes in for-profit status of the target hospital.

We conjecture that PE acquirers can organize larger hospital systems, thus better consolidating resources and generating synergies through economies of scale. If a hospital is transferred from a relatively small system to a larger system through a PE-led acquisition, it might experience a greater increase in the number of skilled workers and a greater reduction in overhead costs. To test this conjecture, we compute the change in the size of the hospital system owning the target hospital before and after the acquisition. Specifically, we compute the relative size of the previous target system compared to the newly *combined* system after the acquisition. The size of a hospital system is measured by the number of hospitals in the system. This relative size ratio reveals whether the target unit

operates in a larger system after the deal compared to before. We define "small" ("large") PE targets as ones whose relative size ratio is below (above) the sample median across all PE-led acquisitions, and separately examine the effect for small and large PE targets.

Panel A of Table 8 reports results from this analysis. Consistent with our expectation, small targets are associated with a significant increase in skill employee ratio, while large targets are not. Total employment cut and overhead cost reduction induced by PE-backed acquirers are also much stronger for small targets. These results are consistent with PE acquirers being able to achieve economies of scale, consolidating and more efficiently allocating resources across their hospital units. Corroborating with this argument, PE firms in our sample indeed organize larger hospital systems through acquisitions than non-PE firms.

TABLE 8 ABOUT HERE

In Panel B, we test whether PE acquirers generate better outcomes at target hospitals that are in a more proximate location to the PE acquirer's existing hospitals. If geographical proximity allows PE acquirers to manage a newly acquired hospital more efficiently, we would expect target hospitals located in the same state as hospitals in the acquirers' system to benefit more from the acquisition. Accordingly, we partition PE targets into "in-state" and "out-of-state." In-state targets are ones that are located in the same state as at least one of the hospitals owned by the acquirer. Out-of-state targets are those that do not overlap with any hospital in the acquirer's system. Our results suggest that skilled worker ratio increases substantially for in-state PE targets, but declines for out-of-state ones. Cost reduction is also more pronounced for in-state targets. These results align with the argument of geographical expertise. It is at odds with the "acquire to kill" motive in some narrative accounts.[7]

Finally, we test the differential post-acquisition changes between for-profit and non-profit target hospitals. Compared to for-profit targets, hospitals previously organized as

[7]See, for example, a May 2021 report from the Wall Street Journal "PE-Backed Chain Threatens to Shut Two Hospitals Over Financial Dispute With Rhode Island." In unreported results, we do not find evidence that targets of PE-backed hospitals have a statistically higher closure rate than targets of non-PE acquirers.

nonprofit should undergo bigger changes in management incentives, operating policies, and financial capacity given that they become accountable to investors after being acquired. We thus expect to see nonprofit targets to be able to expand their hiring of core healthcare workers and reduce wasteful expenditure to a greater extent. Results in Panel C lend support to this argument. Nonprofit targets of PE acquirers exhibit significantly larger increase in skilled worker ratio, and larger reductions in total employment as well as overhead costs, compared to for-profit targets.

Taken together, our cross-sectional analyses shed light on potential channels through which PE firms or PE-backed acquirers could implement changes at their portfolio hospitals. They create economies of scale within their hospital systems, generate greater synergies for newly acquired hospitals that are in closer proximity to their existing hospitals, and transform nonprofit hospitals by making them accountable to public and private investors. Hence, our paper identifies a novel role for PE firms in transforming non-profit organizations into profit organizations, and improving their performance.

6 Real Patient Outcomes

We next examine whether PE acquirers' profit maximization motives conflict with patient interest and well-being. To do so, we investigate the "real patient outcomes" at target hospitals. We do so by tracking the changes in patient outcomes at acquired hospitals across various dimensions, including mortality rates, readmission rates of discharged patients, and survey evidence regarding patient satisfaction.

6.1 Patient Mortality and Readmission Rates

Mortality is an ultimate measure of patient welfare, and has been used frequently in prior studies as a metric of the effectiveness of healthcare quality (see Gaynor and Town (2011) for a review). The most widely used mortality metric is 30-day acute myocardial infarction (AMI) mortality rate, that is, the death rate of heart-attack patients during the 30-day period following hospitalization. We construct two supplementary mortality

measures related to heart failure and pneumonia, defined analogously. Each aspect of mortality rate is based on the 30-day risk standardized rates.

In the CMS Hospital Compare database, mortality rates are reported with 3-year rolling windows. In other words, for year 2007, we only observe the cumulative mortality rates calculated based on data from 2005–2007. To gauge the effect of an acquisition, we adopt a first-difference approach. We collect mortality rates reported over several time intervals, including a pre-event window $[t-3, t-1]$ and four post-event windows reported in year 3 through 6: $[t+1, t+3]$, $[t+2, t+4]$, $[t+3, t+5]$, and $[t+4, t+6]$. For each post-event window, we compute the change in mortality rate for a given hospital from the pre-event window to the post-event window. This gives us four observations for each hospital-acquisition event. This first-difference approach allows us to directly measure the changes in mortality rate following a hospitalization from pre-acquisition years to post-acquisition years. Note that we exclude the window that includes the year of the acquisition because mortality rates in those windows are only partially affected by the treatment.

In the multivariate regression, we regress the changes in mortality rates on acquirer types, while transforming all the other control variables in a similar fashion. We also remove hospital fixed effects, which are absorbed by the first-difference approach. Our specification is as follows:

$$\Delta Y_{e,i,\tau} = \beta_1 PE\ Acquirer_{e,i,\tau} + \beta_2 NonPE\ Acquirer_{e,i,\tau} + \gamma \cdot \Delta X_{i,t} + \mu_e + \nu_{e,i,\tau}, \quad (5)$$

where $\Delta Y_{e,i,\tau}$ represents the changes in mortality rate from the pre-event window to a post-event window, indexed by τ. $\Delta X_{i,t}$ represents the first-difference in control variables, and μ_e stands for event fixed effects.

Panel A of Table 9 reports the results from estimating Equation 5. We present coefficients from regressions with and without event fixed effects. For this analysis, we do not partition PE-backed acquirers based on their public trading status due to data limitations related to mortality and readmission rates.

TABLE 9 ABOUT HERE

We do not find that PE or PE-backed acquirers are associated with larger increases in heart attack mortality or heart failure mortality. They are associated with a small increase in the mortality rate related to pneumonia (about 0.8 percentage points). In comparison, non-PE acquirers are associated with higher mortality rates related to both heart failure and pneumonia, and those increases in mortality rates are more substantial than those related to PE acquirers (about 1.6 percentage points for pneumonia-related mortality).

We next turn to readmission rates after discharge. Readmission rate is an important indicator of the effectiveness of medical treatment (Ho and Hamilton 2000). Similar to mortality rates, we also consider readmission using a 30-day window after discharge, and we focus on the same illnesses as before - heart attack, heart failure, and pneumonia. The sample construction and regression setup follow the same structure as the mortality analysis.

Panel B reports the results for readmission rates. We find that hospitals acquired by PE-backed acquirers experience a strong decrease in readmission rates among discharged patients diagnosed with heart failure conditions, a weak (insignificant) decrease in the readmission rates among pneumonia patients, and no change in the readmission rate related to heart attack patients. Similar effects are observed for non-PE backed acquirers, although those acquirers are associated with a stronger decline in the readmission rates regarding pneumonia patients.

Overall, our investigation yields mixed observations regarding the effectiveness of treatment from hospitals acquired by PE and non-PE institutions. PE-backed acquirers seem to lead to a smaller increase in mortality rates, but also a weaker decline in readmission rates. In untabulated analyses, we also look into other patient outcomes, including complications and infection during hospitalization. We do not find clear evidence that target hospitals of PE-backed acquirers differ from targets of non-PE acquirers in those dimensions. In other words, PE-backed acquirers do not seem to reduce the quality of medical treatment at target hospitals compared to non-PE acquirers. Our finding complements the results from the nursing home industry where PE acquirers of nursing homes do not necessarily lead to deterioration of health outcomes (Gandhi et al. 2020),

especially for nursing homes subject to greater product market competition.

6.2 Patient Satisfaction

In this section, we investigate patient satisfaction at acquired hospitals, relative to patient satisfaction at the matched control group. As mentioned in Section 3.4, we use data measuring patient satisfaction from the HCAHPS survey. This dataset provides survey results on how patients evaluate their experience and the quality of the service at their hospital by giving an overall rating to the hospital as well as by ranking the quality of communication with doctors, the quality of communication with nurses, whether they receive help as soon as they need it and whether they would recommend the hospital to others. We present the survey questions in Appendix B.

Table 10 reports the results. Results in Panel A suggest that patient satisfaction scores across all dimensions decline significantly at hospitals acquired by non-PE acquirers, which is consistent with the findings in Beaulieu et al (2020). Yet, patient satisfaction at hospitals acquired by PE acquirers experience little change, declining only in "communication with nurses." Panel B shows that while hospitals acquired by non-PE acquirers and PE backed private acquirers exhibit a decline in patient satisfaction, PE backed public acquirers are associated with no decline, and even an improvement in whether patients received help and the overall rating patients assign to a hospital.

TABLE 10 ABOUT HERE

These observations are particularly interesting in light of our earlier results on the ratio of skilled workers, the wages of skilled workers and overhead salary reduction at acquired hospitals. PE backed publicly traded acquirers are associated with a significant increase in the skilled employees ratio, and in the wages of skilled employees. In addition, they are the ones associated with smaller cost cutting than the other types of acquirers. Given that they have access to public capital markets and accountability to public shareholders, they might have stronger incentives and greater access to capital to operate a hospital more efficiently from the perspective of both shareholders and patients than other types of acquir-

ers. On the downside, PE backed publicly traded acquirers are associated with the greatest cut in overall employment, with a potential negative impact on the job prospects of the communities where they are located. However, employment cuts, especially those involving non-core employees could be one way of turning hospitals into more efficient and viable entities with an improved ability to maintain quality health care for their community.

7 Changes in Patient and Operation Characteristics subsequent to Acquisitions

In this section, we discuss the possibility that changes in patient satisfaction around PE-backed acquisitions could be driven by changes in the type of patients admitted by the acquired hospitals and the type of medical procedures performed. We address this concern by directly examining the changes in hospitals' operating characteristics subsequent to being acquired.

In Table 11 we examine the changes in various operating characteristics of target hospitals, including the log number of beds, case-mix index, outpatient ratio, the percent of medicare patients , and the percent of medicaid patients relative to all patients. Changes in these characteristics are then compared across acquirer types. Panel A presents the effects for PE-backed acquirers and non-PE-backed acquirers. Panel B further looks into the effects of PE-backed private and public acquirers, respectively.

Table 11 About Here

We do not find any change in target hospital size, as measured by the log number of beds. PE-backed and non-PE-backed acquirers exhibit differential effects on the complexity of operations for target hospitals. Based on the case mix index, hospitals acquired by non-PE backed institutions reduce the complexity of their procedures by about 3 percentage points while PE-backed acquirers, especially private ones lead to an increase in the complexity. In Column (3), we investigate the changes in outpatient/inpatient ratios, and find a significant decrease in outpatient ratio by PE-backed acquirers. Despite the claim

that outpatient procedures are becoming increasingly important and cost efficient sources of revenue for hospitals, this result does not suggest that PE acquirers increase outpatient procedures and services in relation to inpatient services. Finally, we look at patient composition using the percentage of patients enrolled in medicare and medicaid programs. Hospitals acquired by PE-backed institutions display a 1 percentage point decline in the percentage of medicare patients, but such a decline is concentrated in targets of private acquirers and do not show up among publicly traded PE-backed acquirers. There is no change in medicaid patients for any type of target hospitals, alleviating the concerns that PE acquired hospitals start serving younger and richer patients after they are acquired. In addition, given that our sample hospitals involve only acute-care hospitals providing a large array of basic services ranging from cardiology to neurology, there are limited concerns for the possibility that our results are driven by PE investors changing patient profile by switching to, for example, providing more profitable dermatology or cosmetic procedures at the hospitals they acquire.

Overall, our investigation suggests little changes in patient composition and operating characteristics for hospitals acquired by PE- acquirers. While we cannot observe the changes in the patient population of a target hospital after being acquired, our results regarding improvement in patient satisfaction and mortality rates are unlikely to be driven by changes in the patient portfolio at target hospitals. Finally, in unreported analysis, we find that our results on real patient outcomes remain robust for rural target hospitals which do not have any neighbor hospital that patients can easily switch to after the hospital is acquired. In other words, for such rural hospitals, there is little concern that patient population can change after a hospital gets acquired by PE investors.

8 Conclusion

Hospitals are important not only as providers of access to health care, but also as the largest providers of jobs in the US. As such, the M&A activity in the hospital industry deserves attention to understand how it affects jobs, efficiency and patient outcomes at

acquired hospitals. The need for conducting research to address these outcomes becomes even more pressing when one recognizes the increasing pace of activity in the industry by for-profit acquirers such as private equity firms and publicly traded hospitals. While we find that PE acquirers are associated with significant employment cuts at acquired hospitals, they also are associated with an increase in the ratio of skilled employees. Importantly, although non-PE acquirers are associated with a decline in employment at target hospitals, the ratio of skilled employees does not change at the hospitals they acquire. Consistent with these findings, patient satisfaction outcomes do not worsen for PE acquirers whereas patient satisfaction at target hospitals acquired by non-PE acquirers significantly worsen. In addition, we do not observe a deterioration in real patient outcomes such as mortality rates or readmission rates in PE-acquired hospitals, alleviating the concerns that PE firms improve efficiency at the expense of patients.

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Table 1
Summary Statistics
This table reports the summary statistics for the main variables used in our study. Panel A reports summary statistics for target and non-target hospitals in the initial (unmatched) sample. For target hospitals, we only consider observations from four years prior to their acquisition. Panel B reports summmary statistics for the matched sample of targets and controls. Detailed variable definitions are provided by Appendix A.

Panel A: Unmatched Sample

	Non-Targets		Targets		Diff.	t-Statistics
	Obs.	Mean	Obs.	Mean	Targets − Non Targets	
Log(Employment)	18,382	6.44	1,247	6.44	0.00	(0.07)
Skilled Worker Ratio	13,121	0.04	1,036	0.04	0.00***	(5.46)
Skilled Worker Wage Ratio	13,125	0.07	1,046	0.06	−0.01***	(−6.30)
Skilled Workers/Patients (×100)	13,119	0.31	1,036	0.24	−0.06***	(−10.59)
Log(Overhead/Patients)	19,305	6.75	1,260	6.36	−0.39***	(−24.81)
Mortality for Heart Attack (AMI)	7,008	15.00	296	15.73	0.73***	(7.13)
Mortality for Heart Failure	11,383	11.65	356	11.30	−0.35***	(−4.25)
Mortality for Pneumonia)	13,132	13.16	362	12.17	−1.00***	(−6.98)
Nurse Comm.	13,709	2.74	429	2.68	−0.07***	(−15.72)
Doctor Comm.	13,709	2.78	429	2.75	−0.03***	(−8.66)
Receive Help	13,706	2.59	429	2.48	−0.11***	(−16.27)
Hospital Rating	13,708	2.62	429	2.51	−0.11***	(−17.28)
Recommendation	13,708	2.66	429	2.57	−0.09***	(−14.90)
Beds	26,614	116.75	1,295	180.08	63.34***	(15.36)
CMI	18,294	1.31	1,239	1.38	0.06***	(7.61)
%Medicare	26,614	0.46	1,295	0.40	−0.06***	(−13.42)
%Medicaid	26,595	0.13	1,295	0.14	0.01***	(4.99)
Outpatient Ratio	26,613	0.57	1,295	0.41	−0.17***	(−34.98)

Panel B: Matched Sample

	Obs.	Mean	Std	Median	P25	P75
Employment and Costs						
Employment	2,174	905.23	698.90	728.65	446.58	1137.38
Log(Employment)	2,174	6.57	0.69	6.59	6.10	7.04
Skilled Worker Ratio	1,689	0.04	0.02	0.04	0.03	0.05
Skilled Worker Wage Ratio	1,690	0.06	0.02	0.06	0.05	0.07
Skilled Workers/Patients (×100)	1,688	0.25	0.12	0.23	0.17	0.30
Overhead/Patients	2,173	657.76	299.95	582.19	454.97	778.71
Log(Overhead/Patients)	2,173	6.41	0.40	6.37	6.12	6.66
Patient Outcomes						
Mortality for Heart Attack (AMI)	488	15.45	1.71	15.40	14.30	16.50
Mortality for Heart Failure	546	11.41	1.66	11.30	10.20	12.50
Mortality for Pneumonia	550	12.16	2.27	11.90	10.50	13.60
Readmission for Heart Attack (AMI)	414	19.15	1.66	19.30	17.90	20.40
Readmission for Heart Failure	507	24.27	2.09	24.10	22.80	25.70
Readmission for Pneumonia	511	18.25	1.59	18.20	17.00	19.20
Patient Satisfaction						
Nurse Comm.	699	2.69	0.08	2.70	2.64	2.74
Doctor Comm.	699	2.75	0.07	2.75	2.71	2.79
Receive Help	699	2.49	0.12	2.49	2.42	2.56
Hospital Rating	699	2.54	0.12	2.55	2.46	2.62
Recommendation	699	2.60	0.12	2.61	2.52	2.68
Hospital Characteristics						
Beds	2,174	194.63	123.70	162.00	109.00	258.00
CMI	2,170	1.38	0.20	1.37	1.23	1.52
%Medicare	2,174	0.39	0.12	0.39	0.30	0.47
%Medicaid	2,174	0.15	0.10	0.13	0.07	0.20
Outpatient Ratio	2,173	0.40	0.13	0.38	0.30	0.48

Table 2
Employment at Target Hospitals
This table examines changes in employment of the target hospital around mergers. The dependent variable is the log of total employees (measured in full-time equivalent employees based on employed hours). Panel A reports results for all target hospitals. Panel B reports results for different acquirers separately. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Employment at All Targets

Dep. Var.: *Log(Employment)*	(1)	(2)	(3)
Target $(t = 0)$	−0.0645***	−0.0561***	−0.0586***
	(−7.76)	(−6.40)	(−6.75)
Target $(t > 0)$	−0.0937***	−0.1011***	−0.1048***
	(−7.18)	(−7.11)	(−7.19)
Hospital Controls	Yes	Yes	Yes
County Controls	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes
Year FEs	Yes	No	No
Event FEs	No	Yes	No
Event Time FEs	No	Yes	No
Event-by-Year FEs	No	No	Yes
Adjusted R^2	0.98	0.98	0.98
Observation	4,831	4,831	4,716

Panel B: Employment at Targets by Acquirer Type

Dep. Var.: *Log(Employment)*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	−0.0975***	−0.1019***		
	(−7.70)	(−7.59)		
PE-Backed Private Acquirers			−0.0812***	−0.0857***
			(−6.01)	(−5.76)
PE-Backed Public Acquirers			−0.1411***	−0.1450***
			(−6.61)	(−5.54)
Non-PE Backed Acquirers	−0.0690***	−0.0677**	−0.0692***	−0.0679**
	(−2.88)	(−2.50)	(−2.89)	(−2.51)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Adjusted R^2	0.98	0.98	0.98	0.98
Observations	4,831	4,716	4,831	4,716

Table 3
Skilled Employees at Target Hospitals

This table examines changes in nurse and physician employment of the target hospital around mergers. Panel A reports the results for *Skilled Worker Ratio*, the ratio of nurses and physicians relative to all employees. Panel B reports results for *Skilled Wages/Total Wages*, the ratio of salary payment to nurses and physicians relative to the wage payment to all workers. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Ratio of Nurses and Physicians to Total Employment

Dep. Var.: *Skilled Worker Ratio*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	0.0034**	0.0034*		
	(2.29)	(1.96)		
PE-Backed Private Acquirers			−0.0018	−0.0038***
			(−1.41)	(−2.86)
PE-Backed Public Acquirers			0.0191***	0.0245***
			(8.29)	(7.49)
Non-PE Backed Acquirers	−0.0014	0.0019	−0.0014	0.0017
	(−0.69)	(0.84)	(−0.70)	(0.79)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Observations	3,849	3,044	3,849	3,044
Adjusted R^2	0.72	0.70	0.75	0.75

Panel B: Ratio of Nurse and Physician Wages to Total Wages

Dep. Var.: *Skilled Worker Wage Ratio*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	0.0065***	0.0069***		
	(2.94)	(2.73)		
PE-Backed Private Acquirers			−0.0006	−0.0030
			(−0.25)	(−1.33)
PE-Backed Public Acquirers			0.0272***	0.0337***
			(9.71)	(8.01)
Non-PE Backed Acquirers	0.0003	0.0016	0.0002	0.0013
	(0.10)	(0.44)	(0.07)	(0.39)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Observations	3,858	3,060	3,858	3,060
Adjusted R^2	0.75	0.70	0.77	0.73

Table 4
Skilled Employees at Target Hospitals, Alternative Definition
This table examines alternative definitions of labor force composition and examines the changes in skill labor in acquired hospitals. These alternative metrics help address the concern that changes in skill worker ratio may reflect hospitals' effort to outsource routine work. Panel A reports results for *Log(Skilled Workers/Patients)*, the log of nurses and physicians per patients. The number of patients is estimated by adjusted discharges, defined as the number of discharged inpatients multiplied by (1+outpatient charges/inpatient charges). Panel B presents results for the log of total number of skilled workers, i.e., *Log(Skilled workers)*. See Appendix A for variable definitions. *t*-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Nurses and Physicians per Patient

Dep. Var.: *Skilled Workers/Patients*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	−0.0000	−0.0001		
	(−0.13)	(−0.64)		
PE-Backed Private Acquirers			−0.0003***	−0.0005***
			(−3.20)	(−4.31)
PE-Backed Public Acquirers			0.0008***	0.0011***
			(6.64)	(6.43)
Non-PE Backed Acquirers	−0.0003*	−0.0001	−0.0003*	−0.0001
	(−1.77)	(−0.35)	(−1.79)	(−0.40)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Observations	3,849	3,044	3,849	3,044
Adjusted R^2	0.75	0.72	0.77	0.75

Panel B: The Log Number of Skilled Employees

Dep. Var.: *Log(Skilled Employees)*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	−0.0219	−0.0229		
	(−0.61)	(−0.50)		
PE-Backed Private Acquirers			−0.1266***	−0.1882***
			(−3.59)	(−4.53)
PE-Backed Public Acquirers			0.2962***	0.4569***
			(5.89)	(5.98)
Non-PE Backed Acquirers	−0.0863*	−0.0288	−0.0863*	−0.0324
	(−1.66)	(−0.44)	(−1.68)	(−0.51)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Observations	3,849	3,044	3,849	3,044
Adjusted R^2	0.90	0.89	0.90	0.90

Table 5
Skilled employees Turnover at Target Hospitals
In this table, we track the career paths of individual skilled employees and examine whether they are more or less likely to leave or join a target hospital. Data on skilled employees' career paths come from Doctors and Clinicians National Downloadable File. The unit of observation is a skilled employee-hospital-year. Our sample spans the period of 2014–2018. *Leave Hospital* is an indicator for the current year being the last year that a skilled employee works at a given hospital. *Join Hospital* is an indicator for the current year being the first year that a skilled employee starts working at a hospital. See Appendix A for variable definitions. Panel A reports results for all target hospitals. Panel B and C reports results for different acquirers separately. Panel D reports results regarding the turnover of experienced and inexperienced skilled employees. *Experienced* is an indicator that equals one if a skilled employee has above-median work experience. Work experience is defined as the number of years after graduation from a medical school. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Skilled Employee Turnover at All Targets

Dep. Var.:	*Leave Hospital*		*Join Hospital*	
	(1)	(2)	(3)	(4)
Target $(t = 0)$	0.0036	0.0300*	0.0022	0.0009
	(0.41)	(1.94)	(0.27)	(0.08)
Target $(t > 0)$	0.0173*	0.0553**	0.0418***	0.0359**
	(1.83)	(2.58)	(3.86)	(2.53)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Individual FEs	No	Yes	No	Yes
Observations	230,089	201,605	230,089	201,605
Adjusted R^2	0.08	0.37	0.09	0.41

Panel B: Skilled Employee Turnover at Targets of PE-backed and Non-PE Acquirers

Dep. Var.:	*Leave Hospital*		*Join Hospital*	
	(1)	(2)	(3)	(4)
PE-Backed Acquirers	0.0122*	0.0380**	0.0149*	0.0246**
	(1.86)	(2.19)	(1.69)	(2.56)
Non-PE Backed Acquirers	0.0087	0.0497	0.0261	−0.0232
	(0.86)	(0.85)	(0.87)	(−0.99)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Individual FEs	No	Yes	No	Yes
Observations	230,739	202,245	230,739	202,245
Adjusted R^2	0.08	0.37	0.09	0.41

Panel C: Skilled Employee Turnover for All Acquirer Types

Dep. Var.:	*Leave Hospital*		*Join Hospital*	
	(1)	(2)	(3)	(4)
PE-Backed Private Acquirers	0.0154**	0.0407**	0.0134	0.0241**
	(2.33)	(2.05)	(1.48)	(2.29)
PE-Backed Public Acquirers	−0.0103	0.0181	0.0252	0.0281***
	(−1.00)	(0.80)	(1.17)	(2.98)
Non-PE Backed Acquirers	0.0066	0.0483	0.0270	−0.0229
	(0.64)	(0.85)	(0.87)	(−0.98)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Individual FEs	No	Yes	No	Yes
Observations	230,739	202,245	230,739	202,245
Adjusted R^2	0.08	0.37	0.09	0.41

Panel D: Skilled Employee Turnover by Acquirer Type and Experience

Dep. Var.:	*Leave Hospital*		*Join Hospital*	
	(1)	(2)	(3)	(4)
PE-Backed Private Acquirers	0.0428***	0.0595***	0.0852***	−0.0086
	(5.38)	(3.09)	(8.12)	(−0.71)
PE-Backed Private Acquirers × *Experienced*	−0.0563***	−0.0346**	−0.1460***	0.0580***
	(−5.28)	(−2.05)	(−9.51)	(3.83)
PE-Backed Public Acquirers	0.0079	0.0211	0.0846***	0.0073
	(0.87)	(0.84)	(3.05)	(0.66)
PE-Backed Public Acquirers × *Experienced*	−0.0361***	−0.0081	−0.1246***	0.0378***
	(−5.56)	(−0.44)	(−13.17)	(3.00)
Non-PE Backed Acquirers	0.0252***	0.0580	0.0782***	−0.0386*
	(2.64)	(1.07)	(2.70)	(−1.69)
Non-PE Backed Acquirers × *Experienced*	−0.0470***	−0.0221*	−0.1166***	0.0257***
	(−7.20)	(−1.87)	(−24.68)	(2.99)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Individual FEs	No	Yes	No	Yes
Observations	228,860	200,187	228,860	200,187
Adjusted R^2	0.08	0.37	0.10	0.41

Table 6
Overhead Costs at Target Hospitals
This table examines changes in overhead costs at target hospitals around the acquisition. The dependent variable in Panels A and B is the log of ratio of overhead costs over patients (adjusted discharge). Adjusted discharge is defined as inpatient discharges times total charges over inpatient charges. Panel A reports results for all target hospitals. Panel B reports results for different types of acquirers. Panel C reports the results for the ratio of overhead salaries over total operating costs. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Overhead Salaries at All Targets

Dep. Var.: *Log(Overhead/Patients)*	(1)	(2)	(3)
Target $(t = 0)$	−0.0299**	−0.0281**	−0.0296**
	(−2.24)	(−2.00)	(−2.11)
Target $(t > 0)$	−0.0866***	−0.0949***	−0.0942***
	(−4.55)	(−5.12)	(−5.48)
Hospital Controls	Yes	Yes	Yes
County Controls	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes
Year FEs	Yes	No	No
Event FEs	No	Yes	No
Event Time FEs	No	Yes	No
Event-by-Year FEs	No	No	Yes
Observations	4,831	4,831	4,716
Adjusted R^2	0.90	0.89	0.89

Panel B: Overhead Salaries at Targets by Acquirer Type

Dep. Var.: *Log(Overhead/Patients)*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	−0.0940***	−0.1034***		
	(−5.47)	(−5.99)		
PE-Backed Private Acquirers			−0.0843***	−0.0945***
			(−4.46)	(−4.63)
PE-Backed Public Acquirers			−0.1199***	−0.1269***
			(−4.67)	(−4.30)
Non-PE Backed Acquirers	−0.0312	0.0021	−0.0313	0.0020
	(−1.16)	(0.08)	(−1.17)	(0.08)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Observations	4,831	4,716	4,831	4,716
Adjusted R^2	0.89	0.89	0.89	0.89

Panel C: Ratio of Overhead Salaries to Total Cost

Dep. Var.: *Overhead Costs/Total Cost*	(1)	(2)	(3)	(4)
PE-Backed Acquirers	−0.0011	0.0005		
	(−0.19)	(0.08)		
PE-Backed Private Acquirers			0.0011	0.0050
			(0.16)	(0.58)
PE-Backed Public Acquirers			−0.0070**	−0.0117***
			(−2.07)	(−4.39)
Non-PE Backed Acquirers	0.0070	0.0021	0.0070	0.0020
	(1.27)	(0.68)	(1.27)	(0.66)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes
Observations	3,858	3,060	3,858	3,060
Adjusted R^2	0.75	0.70	0.77	0.73

Table 7
Public Acquirers With and Without PE-backing at IPO

This table compares the differential effects from PE-backed publicly traded acquirers and non-PE-backed public acquirers. The dependent variables include the log of employment, skilled employee ratio, and log of overhead costs over patients of the target hospital. Acquirers are further divided into PE-backed private, PE-backed public, Non-PE backed private, and Non-PE backed public. Coefficients for PE-backed private and non-PE backed private acquirers are suppressed. "Difference in Coeff" indicates the difference in coefficients between *PE-backed Public Acquirers* and *Non-PE Backed Public Acquirers*. p-values come from F-tests, where F-statistics are computed under the linear hypothesis that the two coefficients are equal. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Employment)*		*Skilled Worker Ratio*		*Log(Overhead/Patients)*	
	(1)	(2)	(3)	(4)	(5)	(6)
PE-Backed Public Acquirers	−0.1411***	−0.1450***	0.0188***	0.0239***	−0.1199***	−0.1272***
	(−6.60)	(−5.54)	(8.57)	(7.65)	(−4.66)	(−4.31)
Non-PE Backed Public Acquirers	−0.0609**	−0.0727**	0.0038**	0.0040**	0.0340	0.0602*
	(−2.41)	(−2.03)	(2.41)	(2.08)	(1.11)	(1.90)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	No	Yes	No	Yes	No
Event Time FEs	Yes	No	Yes	No	Yes	No
Event-by-Year FEs	No	Yes	No	Yes	No	Yes
Differnce in Coeff (PE − Non PE)	−0.0802**	−0.0723	0.0150***	0.0199***	−0.1539***	−0.1874***
p-value	(0.0104)	(0.1023)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Adjusted R^2	0.98	0.98	0.76	0.74	0.89	0.89
Observation	4,831	4,716	3,849	3,044	4,831	4,716

Table 8
Cross-sectional Results

This table examines changes in employment, skilled employee ratio, and overhead costs of the target hospital around mergers. Panel A reports results for targets that were transferred from a smaller or larger hospital system compared to the combined system after the merger. *Small PE Targets* (*Large PE Targets*)refer to targets with relative size below (above) the sample median, whereby relative size is defined as the number of hospital units in the previous system of the target scaled by the total number of hospital units in the acquirer system after the merger. Panel B reports results for in-state and out-of-state targets. *In-State Target*s refer to ones who are located in the same state as at least one hospital unit of the acquirer prior to the acquisition. *Out-of-State Targets* refer to ones that do not overlap in the same state as any unit in the acquirer system prior to the merger. Panel C presents results differentiating nonprofit and for-profit targets. Target for-profit status is characterized based on its status prior to the acquisition. "Difference in Coeff" indicates the difference between coefficients and p-values are associated with F-tests regarding the two coefficients being equal. In all panels, *Non PE Acquirers* is included in the regression but its coefficients are suppressed. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Large PE Targets vs. Small PE Targets

Dep. Var.:	(1) *Log(Employment)*	(2) *Skilled Worker Ratio*	(3) *Log(Overhead/Patients)*
Small PE Targets	−0.1359***	0.0198***	−0.1392***
	(−6.96)	(6.83)	(−6.03)
Large PE Targets	−0.0756***	−0.0057***	−0.0757***
	(−4.40)	(−4.31)	(−3.20)
Hospital Controls	Yes	Yes	Yes
County Controls	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes
Differnce in Coeff (Small − Large)	−0.0603**	0.0255***	−0.0635**
p-value	(0.017)	(0.000)	(0.048)
Adjusted R^2	0.98	0.93	0.89
Observation	4,716	3,044	4,716

Panel B: In-State PE Targets vs. Out-of-State PE Targets

Dep. Var.:	(1) *Log(Employment)*	(2) *Skilled Worker Ratio*	(3) *Log(Overhead/Patients)*
In-State PE Targets	−0.1617***	0.0229***	−0.1442***
	(−5.76)	(7.30)	(−4.93)
Out-of-State PE Targets	−0.0761***	−0.0027*	−0.0858***
	(−5.65)	(−1.87)	(−4.11)
Hospital Controls	Yes	Yes	Yes
County Controls	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes
Differnce in Coeff (In State − Out of State)	−0.0856***	0.0256**	−0.0584*
p-value	(0.005)	(0.000)	(0.098)
Adjusted R^2	0.98	0.73	0.89
Observation	4,716	3,044	4,716

Panel C: For-Profit PE Targets vs. Nonprofit PE Targets

Dep. Var.:	(1) *Log(Employment)*	(2) *Skilled Worker Ratio*	(3) *Log(Overhead/Patients)*
Nonprofit PE Targets	−0.1576***	0.0109**	−0.1761***
	(−6.03)	(2.32)	(−5.74)
For-Profit PE Targets	−0.0851***	0.0020	−0.0815***
	(−5.65)	(1.09)	(−4.11)
Hospital Controls	Yes	Yes	Yes
County Controls	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes
Differnce in Coeff (NonProfit − For Profit)	−0.0725**	0.0089*	−0.0946***
p-value	(0.017)	(0.083)	(0.009)
Adjusted R^2	0.98	0.69	0.89
Observation	4,716	3,044	4,716

Table 9
Mortality and Readmission at Target Hospitals

This table examines the mortality and readmission rates of target hospitals around mergers. Panel A reports the results for mortality rates. The dependent variables are the 30-day risk-standardized mortality rate following heart attack hospitalization, heart failure hospitalization, and pneumonia hospitalization. Panel B reports the results for readmission rates. The dependent variables are the 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of heart attack, heart failure, and pneumonia, respectively. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: Mortality

Dep. Var.: *Mortality for*	*Heart Attack (AMI)*		*Heart Failure*		*Pneumonia*	
	(1)	(2)	(3)	(4)	(5)	(6)
PE-Backed Acquirers	−0.0051	−0.0165	0.2068	0.1615	1.0511***	0.8292**
	(−0.03)	(−0.06)	(1.08)	(0.83)	(3.64)	(2.33)
Non-PE Backed Acquirers	0.0953	−0.0916	0.1710	0.3130*	1.5416***	1.6260***
	(0.45)	(−0.51)	(0.91)	(1.85)	(6.09)	(7.22)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	No	Yes	No	Yes	No	Yes
Observations	401	401	491	491	501	501
Adjusted R^2	0.04	0.42	0.04	0.42	0.07	0.38

Panel B: Readmission

Dep. Var.: *Readmission for*	*Heart Attack (AMI)*		*Heart Failure*		*Pneumonia*	
	(1)	(2)	(3)	(4)	(5)	(6)
PE-Backed Acquirers	0.0376	−0.0890	−0.7098***	−0.5089**	−0.0710	−0.0431
	(0.16)	(−0.40)	(−3.30)	(−2.41)	(−0.38)	(−0.26)
Non-PE Backed Acquirers	0.2667	0.0052	−0.4215*	−0.7082***	−0.6661***	−0.7147***
	(1.41)	(0.03)	(−1.79)	(−3.85)	(−3.27)	(−3.61)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	No	Yes	No	Yes	No	Yes
Observations	332	332	441	441	448	448
Adj Adjusted R^2	0.06	0.68	0.14	0.56	0.04	0.39

Table 10
Patient Satisfaction

This table examines changes in customer satisfaction of target hospitals around mergers. Panel A reports results for PE versus non-PE acquirers. Panel B reports results for PE-backed Private, PE-backed Public, and non-PE acquirers. In each panel, we examine five dimensions of satisfaction: nurses' communication with patients (*Nurse Comm.*), doctors' communication with patients (*Doctor Comm.*), whether patients can get help when needed (*Receive Help*), patients' overall rating of the hospital (*Hospital Rating*), and whether patients would recommend this hospital to others (*Recommend*). See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: PE versus Non-PE Acquirers

Dep. Var.:	(1) *Nurse Comm.*	(2) *Doctor Comm.*	(3) *Receive Help*	(4) *Hospital Rating*	(5) *Recommend*
PE-Backed Acquirers	−0.0125*	−0.0022	0.0029	0.0031	−0.0126
	(−1.87)	(−0.40)	(0.26)	(0.25)	(−1.24)
Non-PE Backed Acquirers	−0.0337***	−0.0329***	−0.0401***	−0.0566***	−0.0420***
	(−3.87)	(−5.21)	(−3.45)	(−5.30)	(−3.76)
Hospital Controls	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	2,668	2,668	2,668	2,668	2,668
Adjusted R^2	0.80	0.76	0.78	0.77	0.82

Panel B: PE-Backed Private, PE-backed Public, versus Non-PE Acquirers

Dep. Var.:	(1) *Nurse Comm.*	(2) *Doctor Comm.*	(3) *Receive Help*	(4) *Hospital Rating*	(5) *Recommend*
PE-Backed Private Acquirers	−0.0285***	−0.0129*	−0.0189	−0.0237*	−0.0217*
	(−3.54)	(−1.77)	(−1.39)	(−1.67)	(−1.96)
PE-Backed Public Acquirers	0.0063	0.0105	0.0287*	0.0346*	−0.0018
	(0.63)	(1.41)	(1.69)	(1.90)	(−0.11)
Non-PE Backed Acquirers	−0.0340***	−0.0331***	−0.0404***	−0.0570***	−0.0422***
	(−3.92)	(−5.32)	(−3.48)	(−5.38)	(−3.75)
Hospital Controls	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	2,668	2,668	2,668	2,668	2,668
Adjusted R^2	0.80	0.76	0.78	0.77	0.82

Table 11
Operating Characteristics at Target Hospitals
This table examines changes in operating characteristics at target hospitals around the acquisition. Panel A reports results for PE-backed acquirers versus non-PE backed acquirers. Panel B further decomposes PE-backed acquirer into PE-backed private acquirers and PE-backed public acquirers. See Appendix A for variable definitions. t-statistics are reported in parentheses and are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Panel A: PE-Backed and Non-PE-backed Acquirers

Dep. Var.:	(1) *Log(Beds)*	(2) *CMI*	(3) *Outpatient Ratio*	(4) *% Medicare*	(5) *% Medicaid*
PE-Backed Acquirers	0.0167	0.0105	−0.0227***	−0.0084*	0.0021
	(1.16)	(1.58)	(−5.99)	(−1.92)	(0.39)
Non-PE Backed Acquirers	−0.0163	−0.0301*	0.0031	0.0045	0.0026
	(−0.68)	(−1.78)	(0.36)	(0.62)	(0.28)
Hospital Controls	No	No	No	No	No
County Controls	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	4,798	4,762	4,796	4,798	4,798
Adjusted R^2	0.97	0.91	0.95	0.90	0.79

Panel B: PE-Backed Private and PE-Backed Public Acquirers

Dep. Var.:	(1) *Log(Beds)*	(2) *CMI*	(3) *Outpatient Ratio*	(4) *% Medicare*	(5) *% Medicaid*
PE-Backed Private Acquirers	0.0170	0.0124*	−0.0223***	−0.0125***	−0.0036
	(1.02)	(1.66)	(−5.80)	(−2.61)	(−0.59)
PE-Backed Public Acquirers	0.0161	0.0054	−0.0238***	0.0029	0.0178
	(0.56)	(0.40)	(−2.71)	(0.31)	(1.50)
Non-PE Backed Acquirers	−0.0163	−0.0301*	0.0031	0.0045	0.0026
	(−0.68)	(−1.78)	(0.36)	(0.62)	(0.28)
Hospital Controls	No	No	No	No	No
County Controls	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes
Event-by-Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	4,798	4,762	4,796	4,798	4,798
Adjusted R^2	0.97	0.91	0.95	0.90	0.79

Appendix A Variable Definitions

A Employment and Cost Variables

- *Log(Employment)*: The log of total employees (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II.
- *Skilled Worker Ratio*: The ratio of nurses (including nurses and pharmacists) and physicians relative to all employee (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II.
- *Skilled Worker Wage Ratio*: The ratio of salary payment to nurses and physicians relative to the payment to all workers. The information is obtained from the HCRIS Worksheet S-3, Part II.
- *Skilled Workers/Patients*: The ratio of nurses and physicians (measured in full-time equivalent employees based on paid hours) relative to total discharges. The information is obtained from the HCRIS Worksheet S-3, Part II.
- *Log(Overhead Cost/Patients)*: The log of the ratio of overhead costs over adjusted discharge. Adjusted discharge is defined as inpatient discharges times total charges over inpatient charges. We define overhead costs following the definition from HCRIS Worksheet S-3, Part II, but excluded nurses and pharmacists from the list.
- *Overhead Cost/Costs*: The ratio of overhead costs to total operating costs.

B Patient Outcome and Satisfaction Variables

- *Mortality for Heart Attack (AMI)*: 30-day risk-standardized mortality rate following heart attack hospitalization.
- *Mortality for Heart Failure*: 30-day risk-standardized mortality rate following heart failure hospitalization.
- *Mortality for Pneumonia*: 30-day risk-standardized mortality rate following pneumonia hospitalization.
- *Readmission for Heart Attack (AMI)*: 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of heart attack.
- *Readmission for Heart Failure*: 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of heart failure.
- *Readmission for Pneumonia*: 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of pneumonia.
- *Nurse Comm.*: A variable computed by $3\times$("Top-box" Answer %) $+2\times$ ("Middle-box" Answer %)$+1\times$("Bottom-box" Answer %) for the Communication with Nurses questions.
- *Doctor Comm*: A variable computed by $3\times$("Top-box" Answer %) $+2\times$ ("Middle-box" Answer %) $+1\times$ ("Bottom-box" Answer %) for the Communication with Doctors questions.
- *Receive Help*: A variable computed by $3\times$("Top-box" Answer %) $+2\times$ ("Middle-box" Answer %) $+1\times$ ("Bottom-box" Answer %) for the Responsiveness of Hospital Staff questions.
- *Hospital Rating*: A variable computed by $3\times$("Top-box" Answer %) $+2\times$ ("Middle-box" Answer %) $+1\times$ ("Bottom-box" Answer %) for the Overall Rating of Hospital questions.
- *Recommendation*: A variable computed by $3\times$("Top-box" Answer %) $+2\times$ ("Middle-

box" Answer %) + 1 × ("Bottom-box" Answer %) for the Willingness of Recommendation questions.

C Independent Variables

- *Target*: An indicator variable that turns to one if a hospital has been acquired in a merger deal in the current year or the past.
- *PE Acquirer*: An indicator variable that turns to one if a hospital has been acquired by a PE-backed Private or Public acquirer as of a given year.
- *PE-backed Private Acquirer*: An indicator variable that turns to one if a hospital has been acquired by a private equity owned hospital (or hospital system) or directly by a private equity as of a given year.
- *PE-backed Public Acquirer*: An indicator variable that turns to one if a hospital has been acquired by a PE-backed public hospital (or hospital system) as of a given year.
- *Non-PE Acquirer*: An indicator variable that turns to one if a hospital has been acquired by Non-PE owned hospital (or hospital system) as of a given year.

D Control Variables

- *Log(Beds)*: The log of number of beds.
- *CMI*: The cost-mix index.
- *%Medicare*: The ratio of Medicare discharges relative to total discharges.
- *%Medicaid*: The ratio of Medicaid discharges relative to total discharges.
- *Outpatient Ratio*: The ratio of outpatient charges relative to total charges.
- *FracBlack*: The fraction of Black in a given county at a given year.
- *FracAsian*: The fraction of Asian in a given county at a given year.
- *logPop*: The log of population in a given county at a given year.
- *logFMR*: The log of one bedroom rent price in a give county a t a given year.

Appendix B Patient Satisfaction Survey Questions

HCAHPS measures are publicly available as "top-box," "middle-box," and "bottom-box" answer percentages for each topics. The top-box includes most positive answers for each items: "Always" for Communication with Nurses, Communication with Doctors, and Responsiveness of Hospital Staff, "9" or "10" for Overall Rating of Hospital, and "Definitely Yes" for Willingness to Recommend Hospital. The bottom-box captures the least positive responses: "Sometimes" or "Never" for Communication with Nurses, Communication with Doctors, and Responsiveness of Hospital Staff, "6" or lower for Overall Rating of Hospital, and "Definitely No" or "Probabily No" for the Willingness to Recommend Hospital. Finally, the middle-box is intermediate responses category for the HCAHPS Survey items. The HCAHPS topics and questions analyzed in this paper are listed below.

COMMUNICATION WITH NURSES

During this hospital stay, how often did nurses treat you with courtesy and respect?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

During this hospital stay, how often did nurses listen carefully to you?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

During this hospital stay, how often did nurses explain things in a way you could understand?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

COMMUNICATION WITH DOCTORS

During this hospital stay, how often did doctors treat you with courtesy and respect?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

During this hospital stay, how often did doctors listen carefully to you?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

During this hospital stay, how often did doctors explain things in a way you could understand?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

RESPONSIVENESS OF HOSPITAL STAFF

During this hospital stay, after you pressed the call button, how often did you get help as soon as you wanted it?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)
☐ I never pressed the call button

How often did you get help in getting to the bathroom or in using a bedpan as soon as you wanted?

☐ Never (Bottom)
☐ Sometimes (Bottom)
☐ Usually (Middle)
☐ Always (Top)

OVERALL RATING OF HOSPITAL

Using any number from 0 to 10, where 0 is the worst hospital possible and 10 is the best hospital possible, what number would you use to rate this hospital during your stay?

☐ 0 Worst hospital possible	(Bottom)
☐ 1	(Bottom)
☐ 2	(Bottom)
☐ 3	(Bottom)
☐ 4	(Bottom)
☐ 5	(Bottom)
☐ 6	(Bottom)
☐ 7	(Middle)
☐ 8	(Middle)
☐ 9	(Top)
☐ 10 Best hospital possible	(Top)

WILLINGNESS TO RECOMMEND HOSPITAL

Would you recommend this hospital to your friends and family?

☐ Definitely no	(Bottom)
☐ Probably no	(Bottom)
☐ Probably yes	(Middle)
☐ Definitely yes	(Top)