Private Equity in the Hospital Industry

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Abstract

We examine the survival, profitability, and employment profiles of hospitals acquired by PE firms. Target hospitals do not experience higher closure rates, but become more profitable after the acquisition, likely due to cost cutting. Employment and wage expenditures substantially decline at PE-acquired hospitals. This effect differs across employee types. The number of core medical workers temporarily drops after acquisition but quickly reverts to pre-acquisition levels, while administrative workers are permanently reduced. There is no clear evidence of worsening patient outcomes. Our results suggest that PE firms help improve the operations of acquired hospitals without compromising healthcare quality in the long run.

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

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1 Introduction

It is estimated that private equity (PE) firms invested around $200 billion into the U.S. healthcare industry over the last decade, a large fraction of which is invested in hospitals.[1] Hospitals are economically very important, accounting for nearly 20% of total GDP. Aside from providing critical healthcare, the hospital industry ranks among the top ten job providers in all U.S. states, especially to female workers. There are opposing views regarding the growing presence of PE firms in the hospital industry. Proponents claim that they provide hospitals with much needed managerial and operating efficiency and help turn around struggling hospitals. Opponents voice concerns that PE firms load hospitals with debt, sell assets, lay off workers, and even close hospitals. In this paper, we seek to shed light on this important and current debate by examining hospitals acquired by private equity (PE) firms.

To this end, we provide an in-depth analysis of these opposing views by studying survival and operational efficiency of hospitals acquired by PE firms. First, we examine if PE-acquired hospitals experience excessive closure rates. Second, motivated by the "operational engineering channel" proposed in Jensen (2019) and Kaplan and Stromberg (2009), we investigate if PE-acquired hospitals experience reduction in administrative burden and inefficiency. This focus is motivated by empirical evidence 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 waste, PE firms could improve acquired hospitals by cutting excess employment and administrative expenditures.

We test this conjecture by compiling a comprehensive sample of 1,218 M&A deals in the hospital industry over the period spanning from 2001 to 2018. Our focus is on 281 deals where the acquirer is a for-profit organization, either a PE firm, PE-owned hospital or hospital not backed by PE firms. These deals involve 610 unique target hospitals. Since PE firms are not the only type of acquirers and many hospitals have been acquired by other hospitals with no PE involvement, we analyze PE-acquired hospitals relative to

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

a control group of non-acquired hospitals that are closely matched by location, time, and pre-event characteristics. We also benchmark the effects of PE buyers against non-PE, for-profit buyers by comparing the outcomes of the hospitals they acquire.

We track target and control hospitals over two horizons around the events: a short-run horizon where we compare outcomes during the four-year pre-event window ([-4, -1]) with those in the four-year post-event window ([0, 4]), and a long-run horizon where we contrast the pre-event window with the following four years after the event (i.e., [5, 8]). This choice is motivated by the consideration that restructuring events often involve large scale transformation and take a long time to implement. Looking only at the short-run effects could mask important implications from reforms conducted at acquired hospitals. Indeed, prior studies on the roles of private equity examine both the short-run horizon following PE acquisitions (e.g., Kaplan 1989; Davis et al. 2014; Bernstein 2022) and long-term implications (e.g., Kaplan and Stromberg 2009; Lerner et al. 2011). In particular, Kaplan and Stromberg (2009) reports that holding periods of PE firms have increased substantially since the 1990s. Using a sample ending in 2007, they document that only 12% of deals are exited within 24 months, while in half of the deals, PE firms maintain ownership for over 6 years.

We start our analysis with the survival and profitability of acquired hospitals, motivated by the concerns in the popular press that PE firms tend to close hospitals prematurely. We find no evidence of excessive closure of PE-acquired hospitals. In fact, relative to the matched control group and hospitals acquired by non-PE buyers, PE-acquired hospitals have a higher survival likelihood after being acquired. Similarly, we find that PE-acquired hospitals improve their operating profitability while non-PE acquired hospitals do not. Importantly, the improvement in profitability persists over the 8 year window following the acquisition, and hence, is unlikely to be a manifestation of PE firms short-term window dressing efforts potentially sacrificing long term potential of acquired hospitals. These results address and alleviate the concerns that PE owners aggressively close down hospitals, leading to the loss of health care and jobs in the community.

These results do not imply, however, that all jobs are preserved at PE-acquired hospi-

tals. In fact, an important driver of M&A transactions is to eliminate excess employment at acquired firms or overlapping employment between merging parties. Hence, we examine employment outcomes as an outcome of PEs' operational engineering at acquired hospitals. We find that employment at PE-acquired hospitals declines by 8% over the first event window and this reduction persists over the second event window. As a natural consequence, the total wage bill at PE-acquired hospitals goes down by 9% over the first event window. By the end of the second event window, the wage bill at PE acquired hospitals is 12% lower than its pre-acquisition level, suggesting a significant amount of savings. While non-PE-acquired hospitals also reduce their employment and wages, such reductions are economically small and statistically insignificant over the long run.

Employment cut can be a double-edge sword. On the one hand, it helps reduce costs and improve profitability. On the other hand, laying off essential medical workers can compromise health care quality and the long run viability of acquired hospitals. Therefore, we examine employment outcomes separately for administrative workers and core workers. We define core workers as nurses, pharmacists and physicians—those critical in the delivery of health care. This classification is similar to Prager and Schmitt (2021) who examine the impact of hospital mergers on nurses and pharmacists.

We find that the number of core workers at PE-acquired hospitals temporarily drops over the first event window but bounces back over the second event window. In other words, at the end of our eight-year horizon, the number of core workers at PE-acquired hospitals does not differ from its pre-acquisition level. At hospitals acquired by non-PE institutions, we observe a larger, and more persistent decline in core workers. At the end of the eight-year period, core workers are nearly 30% lower than their pre-acquisition levels. These results suggest that the core worker decline over the first event window at PE-acquired hospitals likely reflects initial changes involved in a significant restructuring event. After the initial stage, the operational environment stabilizes and the hospital attains and retains a stable level of core workers similar to the level before it was acquired. We confirm this finding using an alternative measure, which measures the ratio of core workers relative to the number of patients.

Our examination of administrative workers reveals different dynamics from that of core workers. We observe a large decline in administrative workers at PE-acquired hospitals over the first event window. Different from core workers, the drop in administrative workers does not revert back to its pre- acquisition level over the second event window. In particular, our estimates suggest that administrative workers at PE-acquired hospitals drop by 16% in the short run and 13% in the long run, compared to their pre-acquisition levels. Such reductions also show up when we scale administrative workers using total patient counts. This result suggests that PE firms focus on reducing excess overhead costs, likely because their operational strategies and business skills help improve the administrative efficiencies of a hospital. For non-PE-acquired hospitals, there is no reduction in administrative workers across any of the event windows and any of the measures we use.

Overall, our analysis reveals different outcomes between core medical workers and administrative workers at PE-acquired hospitals. The number of core medical workers temporarily declines but reverts in the long run. In contrast, the cut in administrative workers is substantial and persists over time. This suggests that PE firms do not focus exclusively on cutting employment across the board, but instead sustain core workers who are critical in maintaining long-term viability and healthcare quality of acquired hospitals.

Next we turn our attention to wages. As discussed earlier before, PE-acquired hospitals experience a significant decline in their total wage bill. Reductions in wage expenditures could be a direct result of reduced employment, but also could arise from lower wage rates for core workers or administrative workers. We do not observe a change in the wage rate paid to core workers in acquired hospitals after PE acquisitions. In contrast, wage rate paid to administrative workers declines significantly, by around 13% over the long run. Combined with the previous results on employment composition, these results suggest that PE firms trim excess employment in administrative functions and reduce the compensation rate for those workers. Core medical workers, on the other hand, do not experience any material change in their hourly wage rates.

Core workers in our analysis consist of physicians, nurses and pharmacists. While

nurses and pharmacist hours are straightforward to track down, physician employment hours are difficult to measure. As physicians may be hired through part-time contracts and be affiliated with multiple hospitals simultaneously, their hours are not tracked in the cost reports in the same way as full-time employees. This could lead to errors in measuring their employed hours. To address this concern, we repeat our analysis by defining core workers using only nurses and pharmacists. Results are robust to this new definition. Again, we observe a temporary decline in nurses and pharmacists over the first four years after acquisition, but not over the longer horizon. In addition, there is no evidence that those employees receive lower wage rates after the acquisition.

Tracking the evolution of total employment as well as employee composition at PE-acquired hospitals, we find these changes do not start occurring prior to PE acquisitions, but occur after the acquisitions. The declines in administrative workers and total employment persist for many years after the event, while changes in core workers are short-lived. The lack of pre-event trends alleviates the concern that PE firms may select targets that already started implementing improvements along those observable dimensions prior to being acquired.

Overall, our results are inconsistent with the narrative that PE firms compromise the quality of healthcare at acquired hospitals due to their focus on profit generation and cost cutting. Instead, they suggest that PE acquirers reduce overhead cost but maintain the core healthcare workers inside hospitals.

Next we compare the outcomes at for-profit and nonprofit targets to shed light on a mechanism through which PE firms improve operating efficiency at acquired hospitals. To the extent that nonprofit hospitals may operate less efficiently due to their lack of investor accountability, PE firms could be more effective in cutting administrative costs in such hospitals. Consistent with this conjecture, we find that both total employment and wage bills decline more substantially at nonprofit target hospitals. When we examine core workers and administrative workers separately, we find larger declines in administrative workers in nonprofit hospitals than for-profit ones. Perhaps strikingly, our findings regarding core workers show that there is no significant decline in core workers in nonprofit

hospitals over any event window and across any measure of core workers we use. These findings highlight that PE firms are instrumental in acquiring nonprofit hospitals and promoting their efficiency by making them accountable to investors. They also help alleviate the concern that converting nonprofit hospitals to for-profit hospitals may diminish the quality of healthcare.

Our findings so far indicate that PE acquirers significantly cut administrative workers as well as their wages, but non-PE acquirers do not. This raises the question: Why does cutting administrative burden require specialized skills of PE firms? Why can these changes be not implemented without PE intervention? We argue that, while it may be easy to detect administrative burden, it requires expertise and strategic decisions to restructure administrative functions smoothly without interrupting the normal course of businesses. Non-PE acquirers and original hospital owners may not possess such expertise. They may also lack the high-powered incentives that PE firms have to trim employment and improve efficiency. This is particularly the case if non-PE owners have attachment to local communities and aim to preserve jobs. Finally, compared to non-PE acquirers, PE firms are more likely to acquire large hospital systems. The resulting economies of scale may allow them to combine administrative functions of acquired hospitals such as finance, accounting and marketing.

How do the changes in hospital employment affect patients? The answer is not obvious. On the one hand, the reduction in overall employment may result in worse patient experiences and outcomes. On the other hand, patient outcomes may not deteriorate, as the trimmed employment largely consists of administrate workers and not core workers, especially in the long run. To see how patients fare at PE-acquired hospitals, we examine mortality rates and readmission rates related to heart attack, heart failure, and pneumonia at acquired hospitals. We do not find that patients at PE-acquired hospitals experience significant increases in mortality rates, while those at non-PE-acquired hospitals do exhibit marginally higher mortality rates. Similarly, readmission rates do not increase for PE-acquired hospitals across any health condition we examine. Overall, results from patient outcomes do not reveal deteriorating patient outcomes at PE-acquired hospitals.

The majority of the prior research regarding hospital mergers focuses on their impact on prices and costs (Dafny, 2009; Lewis and Pflum, 2017; Schmitt, 2017; Cooper et al., 2019; Dafny et al., 2019; Craig et al., 2021). Beaulieu et al. (2020) examine the quality of healthcare at acquired hospitals, but do not focus on PE acquirers.[2] We extend the literature by focusing on PE acquirers and examining their impact on employment and patient outcomes. Our results suggest that PEs' roles are not limited to aggressive cost-cutting across the board, but implement selective changes to administrative functions. These results are consistent with the operational engineering role of PE firms (Stromberg and Kaplan 2008). Finally, our paper documents meaningful differences in post-acquisition outcomes between PE and non-PE acquirers, which allow us to generate more nuanced and comprehensive understanding of the role of PE firms in this industry.

Our paper is also related to the contemporaneous studies on the presence of PE firms in the healthcare industry. Gandhi et al. (2020) document positive effects of PE firms on nursing homes in highly competitive markets. Gupta et al. (2021), on the other hand, find that PE owners reduce the quality of care at nursing homes. Our analysis complements these studies by examining PE acquirers in the hospital industry, an industry accounting for a large fraction of employment in many local labor markets. Liu (2021) investigates the mechanisms through which PE firms increase healthcare prices and attributes a large portion of such price impact to PEs' superior bargaining power with respect to private insurers. Different from this study, our paper primarily focuses on employment outcomes at PE-acquired hospitals and evaluates the effect of PE acquirers relative to the effect of non-PE acquirers. We are also the first to explore how PE acquirers influence operational profiles of hospitals, relative to non- PE acquirers.

We contribute to the growing literature examining the labor effects of PE buyouts (see, among others, Kaplan (1989) and Davis et al. (2014)). We discuss our findings in detail within the context of this literature in Section 4.2.2. More generally, our paper is related to the emerging literature studying the intersection of healthcare and finance. Complementary to our focus on how PE firms affect survival, profitability, employment

[2] Bruch et al. (2020) examines the effect of PE acquisitions on hospitals' accounting performance and patient characteristics.

and patient outcomes in the hospital industry, recent contributions have examined the effect of financial and credit constraints on hospital outcomes. For example, Adelino et al. (2015, 2021) examine how nonprofit hospitals respond to financial constraints in adjusting their investment policy and treatment quality. Aghamolla et al. (2021) examine the impact of credit access on the health care quality of for-profit hospitals.

2 Data and Sample

We collect data from several sources. We compile a list of hospital mergers and acquisitions (M&A) from 2000 to 2018 by manually cleaning and combining data from multiple sources, including SDC, Factset, and Becker's Hospital Review. Information regarding hospital characteristics and performance comes from Centers for Medicare & Medicaid Services (CMS). We extract patient outcome data such as mortality and readmission rates from Hospital Compare Outcome Measures, published by the CMS and Hospital Quality Alliance (HQA).

2.1 Hospital M&As and the Classification of Acquirers

Data on hospital M&A activity come from multiple sources. We start from the merger roster during the period of 2001 through 2014 provided by Cooper et al. (2019), and then extend the sample to 2018 following their methodology.

We start from the AHA's Annual Survey of Hospitals and identify the changes in system identifiers of individual hospitals, which likely suggest changes in hospital ownership. We verify whether a change in system identifier is indeed associated with an acquisition by manually validating these events across several M&A 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 these databases based on 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 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 verify the accuracy of the matches.

The above process gives us a sample of 1,218 M&A deals that occurred during the period of 2001 through 2018. The deals involve 478 unique acquirers and 1,686 unique target hospitals. Among these deals, we focus on 281 acquisitions where the acquirer is a for-profit organization. These deals involve 610 unique target hospitals.

There are two types of hospital acquisitions where the acquirer is associated with a PE firm. First, a PE firm directly acquires a hospital or a system of hospitals. Second, PE-acquired hospitals conduct acquisitions themselves, commonly referred to as "roll-up acquisitions." We label both types of acquirers as "PE acquirers." To identify PE acquirers, we obtain information from Preqin, CapitalIQ, and descriptions in Becker's, and manually verify this information. In the manual verification process, we supplement our data regarding the identities of hospital acquirers from news articles. We identify 117 deals where the acquirer is either a PE firm or PE-owned hospital, with 419 unique target hospitals.

An important feature of our paper is that we compare acquisitions conducted by PE acquirers with those where the acquirer is a for-profit hospital but has no PE ownership. This differentiates us from most existing studies on PE firms, which draw inferences about PE firms by only comparing outcomes observed for PE acquired firms and control firms who are not acquired. We refer to acquirers that have had no PE ownership as *Non-PE Acquirers*. We have 164 deals where the acquirer is non-PE acquirer, involving 191 target hospitals.

Deals involving PE acquirers involve a greater number of hospitals belonging to a system, with a typical deal involving 3.58 target hospitals. The average deal conducted by non-PE acquirers, in comparison, involves only 1.16 target hospitals.

2.2 Hospital Characteristics Data

We obtain hospital characteristics data from the Healthcare Cost Report Information System (HCRIS) maintained by CMS. Medicare-certified institutional providers are

required to submit their annual cost report to a Medicare Administrative Contractor (MAC). Such information is then compiled into HCRIS. From these reports, we gather data regarding hospital characteristics, employment, and workforce composition.

Hospital characteristics include financial performance metrics such as gross margins, operating income over total assets (*OI/TA*), and returns on assets (*ROA*). It also includes other operational characteristics such as hospital size as measured by the log number of beds (*Log(Beds)*), the complexity of operations measured by case mix index (*CMI*), outpatient ratio, as well as the percentage of patients that receive Medicare (*%Medicare*) and Medicaid insurance (*%Medicaid*).

We compile various measures of hospital employment, worker composition, and wages to study changes in employee characteristics in acquired hospitals. To start, we construct a measure for total employment. The HCRIS provides data on paid work hours and wages for employees in various occupations. Paid work hours are then converted to full-time equivalent (FTE) employee counts based on the total number of work hours in a year. In other words, we determine annual employment as paid work hours divided by 2,080 (40 hours a week multiplied by 52 weeks). We consider total employment in log terms (*Log(Employment)*).

For employee composition, we focus on core medical workers and administrative workers. Core medical workers include physicians (including contract physicians), nurses, and pharmacist, who are essential to providing quality health care. Administrative and general purpose employees are a subset of non-core workers, whose wages constitute an important component of hospital overhead costs (Shrank et al. 2019). Employees outside these categories include maintenance and repair staff, housekeeping, cafeteria employees, etc.

Based on HCRIS' wage breakdown across employee categories, we construct various metrics of worker composition. First, we examine the log number of core workers (*Log(Core Workers)*) as well as the log number of administrative workers (*Log(Admin Workers)*). In addition, we look at the number of core and administrative workers in comparison to the number of patients being treated at the hospital, i.e., *Core Workers/Patients* and *Admin Workers/Patients*. In constructing these ratios, we measure

the number of treated patients using the adjusted discharge measure in Schmitt (2017), defined as the number of inpatient discharges multiplied by $(1 + \frac{outpatient\ charges}{inpatient\ charges})$. This adjustment is necessary for two reasons. First, information on outpatient discharges, i.e., the number of patients treated outside a hospital, is not available to us. Second, since outpatient treatment generally takes up less hospital resources and requires less time from nurses and physicians than inpatient treatment, the adjustment discounts the number of outpatients proportionately.

Aside from calculating the proportion of core workers, we also construct metrics measuring the wages paid to core workers and administrative workers. Our measures include the average hourly wage rate for those workers (*Log(Core Wage Rate)* and *Log(Admin Wage Rate)*). Hourly wage rate is computed as the total wages paid divided by the total paid hours within each occupation category.

2.3 Patient-Level Outcomes

We obtain information on patient outcomes from Hospital Compare Outcome Measures, which is publicly disclosed by CMS and Hospital Quality Alliance (HQA). These databases provide rich information including details of medical treatment provided, 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 health care provision (e.g., Ho and Hamilton, 2000; Propper et al., 2004; Cooper et al., 2011; Gaynor and Town, 2011; Aghamolla et al., 2021). Mortality rate is the most commonly used indicator for quality of care in hospitals. Readmission rate is also used as a measure of the effectiveness of treatment.

Our main measures of healthcare quality 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. Those measures 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 such as stroke as well as infection rate and complications during treatment. From these additional analyses, We obtain similar results to the ones reported in the paper.

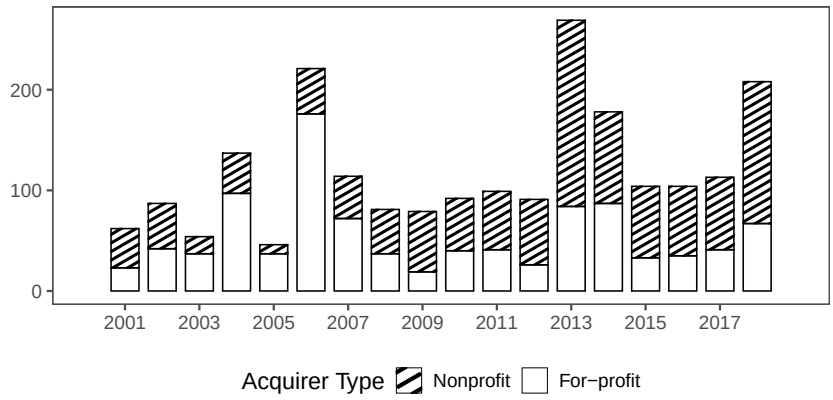
2.4 Initial Sample Construction

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. For hospitals acquired more than once, we keep the first acquisition if those deals are over five years apart. We remove the hospitals that experience more than one acquisition within a five-year period. Target hospitals are required to have at least two years of observations before and after the acquisition year, so we can track the same hospital around the event.

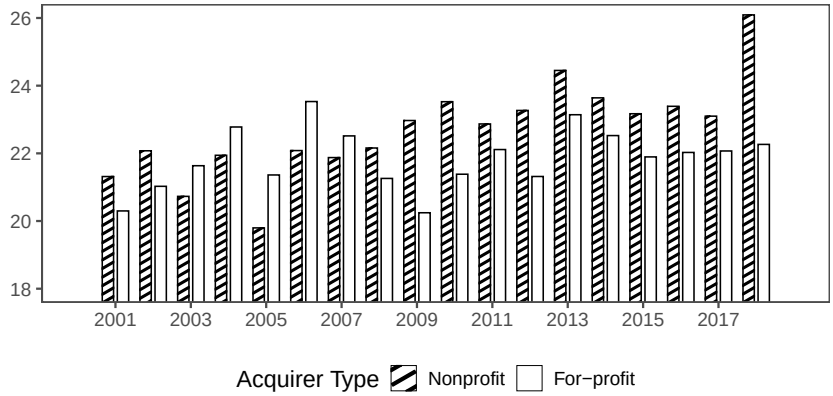
2.5 Univariate Analysis

The hospital industry has experienced persistent growth in its M&A activity over the past two decades. Figure 1 illustrates this time trend. Panel A reports the total number of U.S. hospitals acquired each year and Panel B reports the natural logarithm of total asset values of hospitals acquired each year. In both panels, white (patterned) columns represent deals conducted by for-profit (nonprofit) acquirers. Over the period of 2000–2018, 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 spiked again in 2018, when the total asset value of target hospitals reached $175 billion, a record-high value in recent history. Overall, hospitals acquired by for-profit organizations have a combined asset value of $79 billion, a substantial fraction of the total value across

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



(A) Number of Target Hospitals

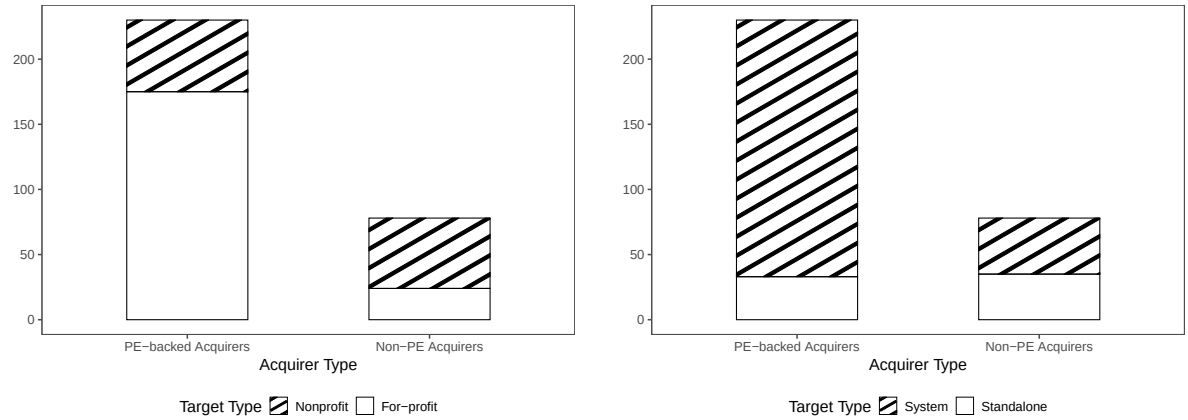


(B) Total Asset Value of Target Hospitals (log)

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

all acquisitions. These statistics suggest that for-profit acquirers play a growing and an economically meaningful role in the M&A landscape in the hospital industry.

Figure 2 reports the composition of deals involving different types of target hospitals acquired by for-profit organizations. In Panel A, we separate deals based on the for-profit status of targets prior to the acquisitions, while in Panel B, we decompose target hospitals based on whether they belonged to a system of hospitals before being acquired. In each panel, we separately count the number of targets by PE and non-PE acquirers. We first note that PE acquirers account for the majority of the deals made by for-profit entities (74%). This is because PE acquirers tend to purchase multiple hospitals in each deal. Across all acquirer categories, more than half of target hospitals have for-profit



(A) Nonprofit and For-profit Targets

(B) System and Standalone Targets

Figure 2. Composition of Target Hospitals. This figure reports the breakdown of our sample of target hospitals by different types of for-profit acquirers. We first separate target hospitals based on whether the acquirer is PE-backed or non-PE backed. In Panel A, we classify targets into two groups based on whether they operated as for-profit or nonprofit hospitals prior to being acquired. In Panel B, we group targets based on whether they belonged to a system of hospitals or were stand-alone prior to being acquired. The height of the each column represents the number of target hospitals within each classification.

status (70%). In addition, the vast majority (around 80%) of target hospitals belong to a system. This proportion is particularly high for hospitals acquired by PE firms.

In Table 1, we report and compare the characteristics of all target hospitals during the four years prior to their acquisition and the characteristics of hospitals that are never acquired during our sample period. Target hospitals have similar employment size, slightly higher core worker ratio and lower administrative worker ratio than non-targets. For an average target (non-target) hospital, wages paid to core employees and administrative workers account for 18% and 16% of total wages, respectively. We note that this fraction ranks among the highest across the 53 occupations provided in HCRIS data.

In terms of real patient outcomes, target hospitals have lower mortality rates related to heart failure and pneumonia, but higher mortality related to heart attack. Finally, in terms of operating characteristics, target hospitals have more beds, higher case mix index, and a lower outpatient ratio (the ratio of outpatient charges over total charges). While target hospitals treat a greater proportion of Medicaid patients (those with limited financial resources to pay for health care), they have a smaller proportion of Medicare patients (65 years or older) than other hospitals.

TABLE 1 ABOUT HERE

3 Empirical Methodology

Given that target and non-target 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 track each target hospital to a matched control hospital over a $[-4, +8]$ year event window around the year of the acquisition.

The matched control group is constructed as follows. We start with an initial pool of hospitals that includes all hospitals that have not been acquired in the corresponding event window. We also exclude from this pool hospitals that acquire other hospitals in our sample period. 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 target hospital. More importantly, the group of matched control unit needs to have the closest Mahalanobis distance to the target hospitals based on their average hospital characteristics during the four year period prior to the acquisition and total employment during year $t-1$ and $t-2$ before the deal.[4] 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 inpatients with Medicare insurance), the fraction of Medicaid discharges, and the fraction of outpatient charges. Matching based on employment during during $t-1$ and $t-2$ helps us control for pre-existing trend in hospital conditions prior to the acquisition.[5]

[4] In Appendix B, we verify the robustness of our results when we match on core workers as a ratio of total workers during the two years prior to the acquisitions.

[5] This helps prevent us matching a target hospital with deteriorating conditions with a healthy, stable control hospital. 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).

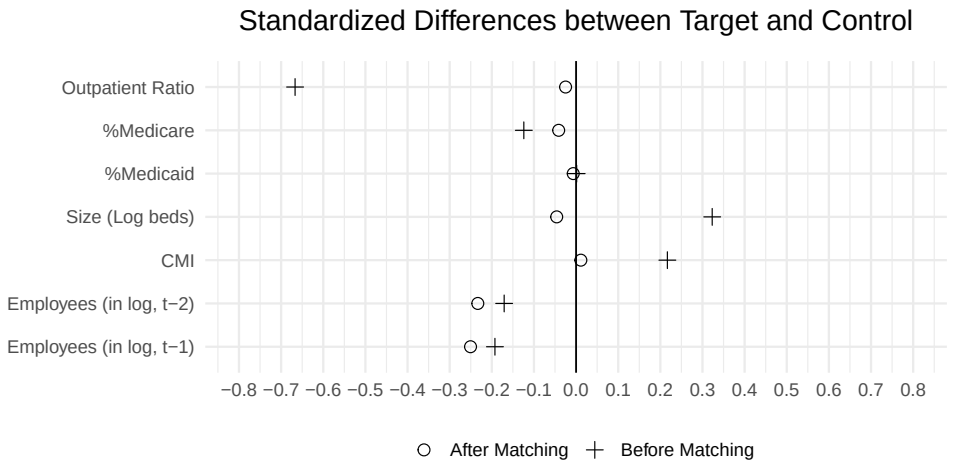


Figure 3. Covariate Balance. This figure shows the values of standardized differences between target and matched control hospitals. The difference is computed as values in target hospitals minus values in control hospitals. Detailed variable definitions are provided by Appendix A.

Figure 3 summarizes the covariate balance before and after matching. Similarity between target and control hospitals is measured by standardized difference, given by the average difference between the 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 parallel pre-event trend in employment, discussed later in Figure 5.

Once each acquired hospital is matched with a control hospital, we stack these matched pairs across all events. Our testing sample is thus an event-hospital unit-year panel, whereby an event refers to an acquisition of a hospital. We track the matched treated and control hospitals over two horizons. We start by examining short-run effects of private equity takeover, comparing the changes in hospital characteristics from four years prior to the acquisition ($[-4, -1]$) to four years after ($[0, +4]$). This horizon is consistent with the literature examining short to medium term changes brought by PE firms (Kaplan 1989; Lerner et al. 2011). In addition, based on the evidence in Kaplan and Stromberg (2009) that holding periods of PE firms have increased since the 1990s with only 51% of deals being exited within 72 months of the acquisition date, we also investigate the long term effects by comparing hospital conditions during the pre-acquisition period ($[-4, -1]$)

to the following four-year period after the acquisition (i.e., $[+5, +8]$). Observations from $[0, +4]$ are excluded from this sample. This comparison helps inform us regarding whether changes we observe in the short-run persist, disappear, or revert back in the longer horizon. For both horizons, we perform difference-in-difference analysis, benchmarking the changes in performance and operational characteristics at acquired hospitals with those changes at control hospitals.

Table 2 reports the summary statistics related to key variables in our matched sample over the $[-4, +8]$ event window. The average hospital in this sample employs 880 people, with 17% corresponding to core workers and 25% to administrative workers. Out of the total wage bill, 18% and 16% are paid to core and administrative workers, respectively. Our sample hospitals have 187 beds and an outpatient ratio of 0.42 on average.

TABLE 2 ABOUT HERE

We examine post-acquisition outcomes at target hospitals relative to their matched control hospitals in a difference-in-difference framework. Specifically, we estimate the following regression, both for the short-run and the long-run windows:

$$Y_{e,i,t} = \beta_1 PE\ Backed\ Acquirer_{e,i,t} + \beta_2 Non\ PE\ Backed\ Acquirer_{e,i,t} + \gamma \cdot X_{i,t} + \alpha_i + \mu_e + \tau_t + \epsilon_{e,i,t}, \quad (1)$$

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 operating performance, the log of employment, worker composition measures, wage metrics, as well as mortality and readmission rates. *PE-Backed Acquirer* is an indicator variable that turns to one if hospital i has been acquired by a PE firm or a PE-owned hospital in event e as of year t, and zero otherwise. *Non-PE-Backed Acquirer* is an indicator for whether hospital i is acquired by a non-PE acquirer in event e as of year t. Both indicators equal zero for years $[-4, -1]$ prior to the event.

We control for hospital fixed effects (α_i), event fixed effects (μ_e), and event-time

fixed effects (τ_t). Hospital fixed effects allow us to trace the same hospital over the event horizon; event fixed effects help us compare within a pair of treated and control hospitals; and event-time fixed effects are a set of 9 indicators for each year in the event window. They absorb the common time-series changes across the matched pair around the event. Similar to existing studies (e.g., Schmitt, 2017; Gupta et al., 2021; Liu, 2021), we cluster standard errors by hospital.[6] We also include a multitude of hospital and county-level controls (X_{it}). Hospital controls include all variables in the matching process. County controls include population size, one-bedroom rent, and population demographics (e.g., the percentage of residents that are Asian and African American) in the county that the target hospital is located.

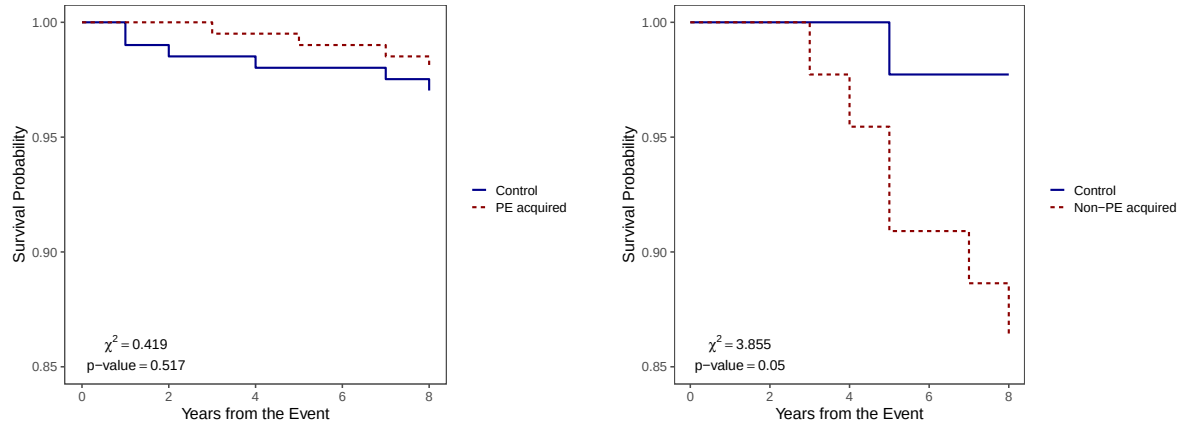
In this analysis, we are interested in β_1 and β_2, which measure how a target hospital changes subsequent to being acquired, compared to the concurrent changes in the conditions of its matched control hospital. We also report p-values from the Wald Chi-square test to assess whether coefficients from PE and non-PE acquirers of acquirers are statistically significantly different from each other.

4 Main Results

4.1 Hospital Survival and Profitability

There are concerns in popular press that PE firms acquire hospitals, close them subsequently and sell assets owned by the hospital. To investigate the validity of such concerns using large scale data, we compare the survival likelihood of PE acquired hospitals and non-acquired hospitals. We start by analyzing the survival rate of acquired and control hospitals. Using the Cox model, we test whether the time till closure differs between PE acquired hospitals and non-acquired hospitals. Figure 4 provides the results. In Panel A, we compare the survival time of PE-acquired hospitals and their matched control group, and in Panel B, we compare the survival time of non-PE acquired hospitals and their control group. The lines indicate the survival rate of a hospital from the acquisition event to

[6] Our results are robust to several alternative clustering methods, including clustering by hospital-system, double clustering by hospital and system, and double clustering by hospital and acquirer.



(A) *Survival Analysis*, PE Acquirers (B) *Survival Analysis*, Non-PE Acquirers

Figure 4. Survival Analysis of Hospitals of PE and Non-PE Acquirers. This figure shows the survival rates of hospitals in each year after the acquisition. We compare survival likelihoods of hospitals acquired by PE, hospitals acquired by Non-PE, and their respective matched control hospitals. The left-side panel represents the difference between PE targets (yellow dashed line) and their control hospitals (black line), while the right panel reports the difference between non-PE targets (yellow dashed line) and matched control hospitals (black line).

the eighth year after the event. Higher values indicate that the hospital is more likely to remain open, potentially because it is healthier. The patterns suggest that PE-acquired hospitals are more likely to survive than their matched control group. In comparison, non-PE acquired hospitals are less likely to survive compared to their control group. This observation is at odds with the claim that PE firms acquire hospitals with the purpose of closing them and profiting from the sale of their fixed assets.

In addition, we examine the profitability of acquired hospitals in Table 3. Profitability is measured by gross margins, operating income over total assets, and ROA. We find that PE-acquired hospitals become significantly more profitable than their matched control hospitals shortly after the acquisition. Our estimates suggest that PE-acquired hospitals increase their gross margin by 2 percentage points, operating income by 6 percentage points and return on assets by 5 percentage points in the first four years after the acquisition. This profitability boost persists and further improves in the long run. For example, PE-acquired hospitals have 8 percentage points higher operating income and 9 percentage points higher ROA than their control group. In contrast, hospitals taken over by non-PE acquirers do not exhibit any improvement in profitability over either horizon.

Overall, our results from the survival and profitability analyses are inconsistent with

the narrative that PE firms often acquire hospitals simply to shut them down and sell the assets in possession. Instead, they are consistent with the argument that PE firms provide capital and management expertise to the acquired hospitals, allowing them to survive and grow. These results are also important regarding if PE firms are short term and myopic investors. Our observation that profitability improvement persists in the long run rules out such concerns.

4.2 Employment Outcomes

We next examine changes in the number and composition of employees at acquired hospitals, relative to those at matched control hospitals. To the extent that PE firms are efficiency-driven acquirers who have expertise in shaving off excess costs, we expect employment and total wage costs to decline at hospitals after PE acquisitions. Yet, PE firms' effects on employment composition remain less clear. On the one hand, PE firms may reduce core medical workers more relative to other workers, as core workers are highly skilled and "expensive." On the other hand, PE firms could help target hospitals to hire and retain core medical workers, and cut administrative workers given the importance of core workers in delivering quality health care and given the documented evidence that hospitals suffer from administrative inefficiency.

4.2.1 Total Number of Employees

We examine the changes in the total number of employees as well as total wage expenditures at acquired hospitals following the specification in Equation 1. Table 4 reports the results. In columns (1) and (2), we examine the changes in the total number of employees, and in columns (3) and (4), we look into the changes in total wage expenditures. Both outcome variables are in log terms, so the coefficients inform us of the percentage changes in these outcomes after the acquisition. For each outcome variable, we first present results related to the short-term effect ($[-4,-1]$ to $[0,+4]$-year windows), and then present effects from a longer horizon ($[-4,-1]$ to $[+5,+8]$-year windows).

TABLE 4 ABOUT HERE

Results from columns (1) and (2) indicate a large and robust decline in employment at acquired hospitals. After being acquired, the average PE target hospital reduces its employment by over 8% over the next four years, and the decline persists over the next four year period following the first event window. Consistently, the total wage bills of PE-acquired hospitals shrink by a similar scale. In the four years after acquisitions, hospitals' wage costs decline by 9%. Over the next four years, wage costs experience further decline, and are 12% lower compared to their pre-acquisition level.

We also find a reduction in employment and wages for hospitals acquired by non-PE-backed acquirers, but the long-run effects seem smaller in magnitude compared to PE-acquired hospitals. Over the [5, 8]-year window after acquisitions, employment at hospitals acquired by non-PE-backed hospitals seems to recover partially and is no longer significantly lower than its pre-acquisition levels.

Overall, our results suggest that PE acquirers undertake greater reduction in total employment and generate larger savings than non-PE acquirers. These findings are consistent with the improved profitability and greater survival rates that they are associated with, as documented earlier.

An important question is whether by cutting employment, PE acquirers compromise the quality of healthcare and patient welfare at the hospitals they acquire. We attempt to answer this question in two ways. We start by looking at changes in the composition of employees. In particular, we focus on "core" employees such as physicians, nurses, and pharmacists, and administrative and overhead employees. Later in our analysis, we examine patient outcomes (i.e., mortality and readmission rates) to see if changes in the employee composition at target hospitals are reflected in patient outcomes.

4.2.2 Employee Composition

According to the HCRIS reporting convention, hospital employees are classified into 54 different occupations, reflecting the complexity and multidimensionality of the services

hospital provide. Among these large number of occupations ranging from physicians to cafeteria and housekeeping workers, we focus on two types of hospital employees when examining the change in worker composition following PE acquisitions: core workers that include physicians, nurses, and pharmacists, and administrative workers. Core medical workers are critical at providing quality health care. While administrative employees also support key functions of hospitals, U.S. hospitals are often criticized for having a bloated overhead structure, employing too many administrative workers and spending excessively on overhead costs (e.g., Shrank et al. 2019; Kocher 2013).

We track the changes in worker composition at acquired and control hospitals after the year of the acquisition. Table 5 reports the results. We consider three measures of worker composition. Our primary measure is the log number of core and administrative employees (Panel A). In Panel B, we compute the ratio of core and administrative workers over the number of patients to gauge the extent to which a hospital has core medical workers and overhead staff to cover patient needs. Within each panel, columns (1) and (2) contain results regarding core workers, and columns (3) and (4) provide results for administrative workers.

Table 5 About Here

We find that after PE acquisitions, acquired hospitals experience a temporary drop in the number of core workers by around 15%. Notably, the decline disappears over the second event window spanning from year 5 to year 8 following the acquisition year. Comparing the core workers during this period to the pre-acquisition window, the difference is less than 5% and is statistically insignificant from zero. The core worker-patient ratio at hospitals acquired by PE firms drops by about 6 basis points over the short term. This decline becomes statistically insignificant in the longer term.

In contrast, hospitals acquired by non-PE acquirers exhibit a stronger and more persistent decline in core workers across both measures we use. In the long-term, the number of core workers stays at a level that is around 25% lower than the pre-acquisition count. The ratio of core worker over patients also continues to be 13 basis points below the pre-acquisition levels.

Different from what we observe regarding core workers, we find a significant and persistent decline in administrative and general purpose workers at PE-acquired hospitals. Within the first four years after PE acquisitions, the number of administrative workers drops by around 16% at acquired hospitals. The reduction persists in the next four years, staying at around 14%. In contrast, we do not observe a decline in administrative workers at hospitals acquired by non-PE acquirers across either measure or horizon we use.

4.3 Wage Analysis

We next examine whether core and administrative workers are paid lower wages at PE-acquired hospitals. In this analysis, we focus on the hourly wage rates for each type of workers, i.e., (*Log(Core Wage Rate)* and *Log(Admin Wage Rate)*. This examination helps inform us of whether PE acquirers may lay off some administrative workers but offer higher wages to remaining ones, or whether they suppress the wages of core medical workers.

Table 6 reports results from this analysis. We find a small decline in the wage rate for administrative workers over the four year horizon after PE acquisitions. In the longer horizon, however, the wage rate of administrative workers declines significantly by around 12% compared to its pre-acquisition level. We do not find such a decline for hospitals acquired by non-PE buyers.

Table 6 About Here

4.4 Dynamic Effects of PE Acquisitions

In this section, we track how the employment and worker composition at target hospitals evolve over our event horizons, compared to their matched control group. This examination allows us to infer the timeline of changes that occur around the involvement of PE and non-PE acquirers. Moreover, this analysis helps us evaluate whether PE buyers select hospitals based on their observable employment profiles. If they do, the changes in worker composition we document should have taken place prior to the acquisition.

We estimate the dynamic effect of PE and non-PE hospital acquisitions by running separate regressions as listed below:

$$Y_{e,i,t} = \Sigma_{k=-4}^{8} \beta_{1,k} PE\ Acquirer_{e,i,t=k} + \gamma \cdot X_{i,t} + \alpha_i + \tau_t + \epsilon_{e,i,t} \tag{2}$$

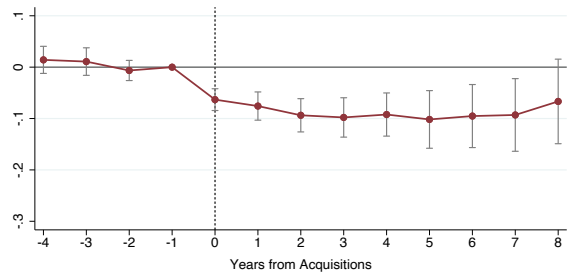
$$Y_{e,i,t} = \Sigma_{k=-4}^{8} \theta_{1,k} NonPE\ Acquirer_{e,i,t=k} + \mu \cdot X_{i,t} + \alpha_i + \tau_t + \nu_{e,i,t} \tag{3}$$

where k indicates years during the event window. $PE\ Acquirer_{e,i,t=k}$ is an indicator for whether hospital i is acquired by a PE acquirer k years prior to the observation point. $NonPE\ Acquirer_{e,i,t=k}$ is defined analogously. In this estimation, the year prior to the event $k = -1$ is omitted as the benchmark year. We control for hospital fixed effects and year fixed effects in our analysis.

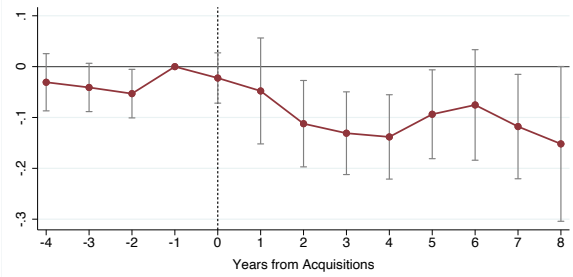
Figure 5 depicts the results. Panels A and B report coefficients for *Log(Employment)*, Panels C and D report results for the log of total core workers, and Panels E and F present results for the log of total administrative and overhead workers. We present the coefficients for PE acquirers ($\beta_{1,k}$) on the left panels and the coefficients for non-PE acquirers ($\beta_{2,k}$) on the right, so that the effects of PE and non-PE acquirers can be compared directly. We do not observe any significant pre-event changes for PE targets or non-PE targets. Following acquisitions, targets of both PE-backed and non-PE-backed acquirers experience strong and persistent employment cuts.

Targets of PE acquirers experience a temporary dip in the number of core workers, but this effect quickly reverts in the longer term. Starting Year 5, PE target hospitals no longer have significantly fewer core workers compared to their own pre-event levels, or relative to the control hospitals. In contrast, at hospitals acquired by non-PE buyers, there is a significant drop in the percentage of core medical workers. This effect is persistent, although becomes less precisely estimated in later part of the event window.

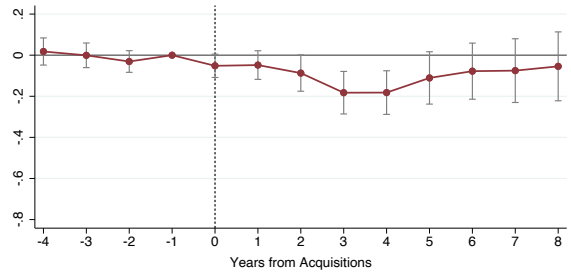
Importantly, we observe that PE acquirers are associated with a sizable decline in the number of administrative employees at acquired hospitals. This effect persists in the long run. In contrast, hospitals acquired by non-PE buyers only exhibit a temporary reduction in administrative workers. At Year 7, the number of administrative workers at



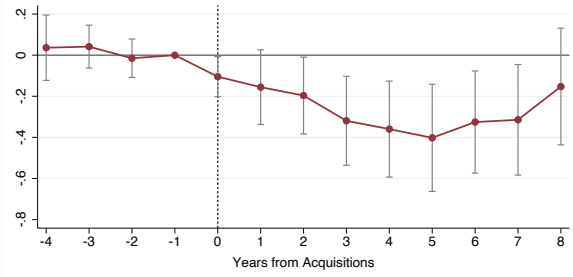
(A) *Log(Employment)*, PE Acquirers



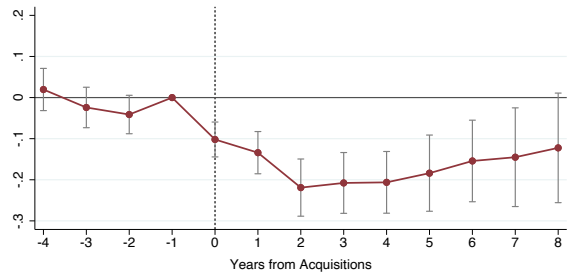
(B) *Log(Employment)*, Non-PE Acquirers



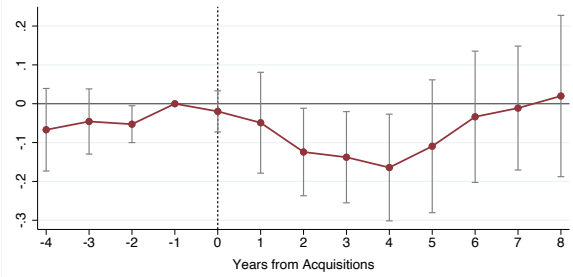
(C) *Log(Core Workers)*, PE Acquirers



(D) *Log(Core Workers)*, Non-PE Acquirers



(E) *Log(Admin Workers)*, PE Acquirers



(F) *Log(Admin Workers)*, Non-PE Acquirers

Figure 5. Dynamic Effect of PE and Non-PE Acquirers. This figure shows the changes in total employment, core worker ratio, and administrative worker ratio for acquired hospitals relative to their matched control hospitals over the [-4, +8]-year event window. The left-side panels represent outcomes for PE acquirers (β_1) and the right-side panels report outcomes for non-PE acquirers (β_2). In each panel, the dots and intervals represent the coefficients and the associated 95-percentile confidence intervals, respectively. Year -1 is absorbed as the base year.

non-PE-acquired hospitals reverts back completely to its pre-event level.

These observations are consistent with our baseline findings. Importantly, the lack of pre-event trend suggests that our results are unlikely to be driven exclusively by PE acquirers targeting hospitals that already exhibit signs of improvement along these dimensions. Put differently, while we do not claim that PE acquirers maintain core medical workers in the long run and cut administrative employees at any random hospital they acquire, our findings are unlikely to be explained by a pure selection mechanism. The significant post-event effects are consistent with PE acquirers increasing the operating

efficiency of the hospitals they acquire without excessively reducing core workers.

4.5 Nurses and Pharmacists

In this section, we assess the possibility that our core worker results could be influenced by contract physicians. Many physicians are affiliated with hospitals through a contract and do not contribute to full-time employee counts. While our measures include contract labor reported in HCRIS, it is possible that this item may not perfectly capture physicians' contract hours. As such, we repeat the analysis on core workers focusing only on nurses and pharmacists using analogous measures. Specifically, we examine changes in the log number of nurses and pharmacists (*Log(Nurses&Pharma)*) and the ratio of nurses and pharmacists to patients (*Nurses&Pharma/Patients*).

Results are reported in Table 7. We find a similar pattern for nurses and pharmacists as we find for all core workers: the number of nurses and pharmacists temporarily drops in the short run, but reverts back in the longer horizon. We document the same effect for the nurses and pharmacists-to-patient ratio. At non-PE acquired hospitals, both the number and ratio of nurses and pharmacists experience a persistent and statistically significant decline after acquisitions. Such a decline does not recover, but aggravates in the long run. These findings are consistent with those in Table 5, suggesting that PE acquirers generate distinct effects from other for-profit acquirers. While PE firms engage in more extensive restructuring of the workforce and cost cutting, hospitals under their ownership seem to survive and maintain their hiring of nurses and pharmacists in the long run after experiencing a temporary drop in these workers.

Table 7 About Here

4.6 For-Profit and Nonprofit Targets

Popular press often argues that PE firms acquire hospitals with non-profit status and no investor accountability, convert them into for-profit hospitals, and downsize them sig-

nificantly, compromising the provision of quality health care.[7] Meanwhile, others claim that PE firms improve operating efficiency of nonprofit hospitals by creating accountability to investors. We formally examine these opposing anecdotal views by comparing post-acquisition outcomes between for-profit and nonprofit target hospitals. To do so, we divide the targets of PE acquirers into two groups, based on whether they operated as nonprofit or for-profit hospitals prior to being acquired.

Table 8 reports results from this analysis. In Panel A, we examine the overall cost-cutting trends at nonprofit and for-profit targets. We note that both types of target hospitals experience significant declines in employment count and total wage bills. Over the first four-year window after acquisition, nonprofit targets undergo more significant cost-cutting than for-profit ones, as evidenced by greater reductions in employment and total wages.

TABLE 8 ABOUT HERE

When we look into the changes in core and administrative workers, we find that nonprofit targets of PE acquirers exhibit no change in core worker counts, but a significant reduction in administrative workers both in the short-run and in the long-run. In contrast, the number of administrative workers only exhibits a decline in the short-term in for-profit target hospitals targets, but recovers in the longer term. For example, estimates in column (4) of Panel B suggest that administrative workers decline by 27% at nonprofit targets over the eight years after PE acquisitions. This stands in contrast to the 4%, statistically insignificant reduction at for-profit targets over the same horizon. We find similar results for the ratio of core and administrative workers scaled by patients.

Through this analysis, we identify a novel role for PE firms in transforming non-profit organizations into for-profit ones, and improving their efficiency. At the same time, we find no evidence that hospitals with prior nonprofit status experience a decline in critical core workers, which may lead to compromised health care quality because these hospitals are converted into for-profit hospitals. In fact, we do observe these hospitals gain additional core workers in the short run after being acquired, with the effect being

[7] See, e.g., How private equity makes you sicker, *The American Prospect*, Oct. 2019.

persistent in the long run.

5 Patient Outcomes

We next examine whether PE acquirers' profit maximization motives conflict with patient interest and well-being. To do so, we track the changes in patient outcomes at acquired hospitals across various dimensions, including mortality rates, readmission rates of discharged patients, and the composition of patients.

5.1 Patient Mortality and Readmission Rates

We consider two measures of patient outcomes, mortality and readmission rates. Mortality rate 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 percentage points.

Readmission rates after discharge are also an important indicator of the effectiveness of medical treatment (Ho and Hamilton, 2000). Similar to mortality rates, we also evaluate readmission rates using a 30-day window after discharge, and we focus on the same illnesses as before — heart attack, heart failure, and pneumonia.

In the CMS Hospital Compare database, mortality rates are reported with 3-year rolling windows. In other words, for year 2007, we observe the cumulative mortality rates calculated based on data from 2005–2007. To examine the effect of an acquisition on mortality rates, 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 hos-

pital from the pre-event window to each of the four post-event windows. This gives us up to four observations for each hospital-acquisition event. We exclude the windows that straddle the year of the acquisition because mortality rates in those windows are only partially affected by the treatment. The first-difference approach allows us to directly measure the changes in mortality rate following a hospitalization from pre-acquisition years to post-acquisition years. We do not compute the difference relative to the 4-year short and long run event windows that we used in our earlier analysis because that would lead to more sample attrition. We perform the same procedure to construct the changes in readmission rates around each acquisition event.

We regress the changes in mortality and readmission rates for PE and non-PE acquirers, with all control variables transformed in a first-difference approach. We also remove hospital fixed effects, which are absorbed by the first-difference approach. Our specification is as follows:

$$\Delta Y_{e,i,\tau} = \beta_1 PE\ Acquirer_{e,i,\tau} + \beta_2 NonPE\ Acquirer_{e,i,\tau} + \gamma \cdot \Delta X_{i,t} + \mu_e + \nu_{e,i,\tau}, \quad (4)$$

where $\Delta Y_{e,i,\tau}$ represents the changes in mortality and readmission 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 10 reports the results from estimating Equation 4. We present coefficients from regressions with and without event fixed effects.

TABLE 10 ABOUT HERE

We do not find PE-acquired hospitals to exhibit significant increases in any of the three types of mortality rates we examine. In comparison, non-PE acquirers are associated with higher mortality rates related to both heart failure and pneumonia by about 1 percentage point. Panel B presents results regarding readmission rates. We again do not find PE acquirers to be associated with significant changes in any type of readmission rates. Non-PE acquirers are associated with a one percentage point decrease in readmission rates following pneumonia, but no changes in other readmission rates.

In untabulated analyses, we also look into other patient outcomes, including stroke, complications and infection during hospitalization. We do not find evidence that PE-acquired hospitals differ from the control group, or from non-PE acquired hospitals mortality or readmission rates. Our body of evidence does not support the argument that PE acquirers reduce the quality of medical treatment at target hospitals compared to targets of non-PE acquirers as well as control hospitals. This finding complements the results from the nursing home industry where nursing homes acquired by PE firms do not necessarily exhibit deterioration of health outcomes (Gandhi et al., 2020).

5.2 Changes in Operational Characteristics

In the last step of our analysis, we discuss the possibility that changes in patient outcomes around PE acquisitions could be driven by acquired hospitals changing their patient composition or the type of medical procedures provided. Without data on individual patients and treatments, we follow Schmitt (2017) and directly examine the changes in observable hospital characteristics around acquisitions.

Table 11 reports 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.

Table 11 About Here

We do not find any change in target hospital size, as measured by the log number of beds, or operation complexity, proxied by the case mix index. We next investigate the outpatient ratio at target hospitals. Despite outpatient procedures being a cost efficient source of revenue for hospitals, outpatient ratio declines significantly at PE-acquired hospitals. This suggests that PE acquirers do not rely more on outpatient services to generate revenue at lower costs compared to other hospitals.

Finally, we look at patient mix using the percentage of patients enrolled in Medicare and Medicaid programs. PE-acquired hospitals experience a small decline (by 1 percent-

age point) in the proportion of Medicare patients, but this effect dissipates over a longer horizon. We do not observe any changes in the percentage of Medicaid patients at either PE- or non-PE-acquired hospitals, alleviating the concern that target hospitals may cater to younger and wealthier patients after being acquired.

Overall, our investigation reveals little change in patient composition and operating characteristics at target hospitals of PE acquirers. While we cannot observe the changes in the patient population of target hospitals, we provide several arguments alleviating the concern that our results might be purely driven by changes in the patient composition at target hospitals. To start, we do not see PE acquirers decrease the percentage of Medicare and Medicaid patients, or to rely more on outpatient services. Second, our sample hospitals involve only acute-care hospitals providing a large array of basic services ranging from cardiology to neurology. This suggests limited scope for PE acquirers to shift their services to younger and wealthier patients and offer, for example, more profitable services such as cosmetic surgery.

6 Conclusion

Hospitals are an important sector of the economy. They not only provide essential healthcare, but also a high fraction of jobs in the U.S. As the hospital industry has been going through a tremendous level of M&A activity, in-depth research is needed to understand how such activity affects jobs, efficiency and patient outcomes at acquired hospitals. The need for research becomes even more pressing when one recognizes the increasing pace of acquisitions conducted by for-profit institutions such as PE firms.

We find that PE-acquired hospitals have better survival prospects and operating profitability compared to similar non-acquired hospitals as well as hospitals acquired by non-PE buyers. While we find that PE acquirers are associated with significant employment cuts, this cut largely involves administrative workers. In fact, there is no long term reduction in the number of core critical workers such as nurses and physicians as well as the number of core workers per patient once the initial high turnover period of 4 years

is over. On the other hand, there is a significant decline in administrative workers which persists over time. As a natural consequence, the wage bill paid to such employees goes down, providing the hospital an important source of savings.

In short, our analysis reveals that while PE acquirers cut employment more significantly compared to non PE acquirers, this cut largely concerns administrative functions of the hospital than the core workers critical in providing quality health care. Hence, PE firms employment strategies appear more refined and targeted than cutting employment across the board. Perhaps as a result of preserving core workers especially in the long run, we do not observe a deterioration in real patient outcomes such as mortality rates or readmission rates at PE-acquired hospitals. This result alleviates the concerns that PE firms improve efficiency and profitability at the expense of patients.

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Table 1
Summary Statistics For the Initial (Unmatched) Sample
This table reports the summary statistics for the main variables used in our study. The sample includes target hospital observations during the four years prior to their acquisition and all observations from non-target hospitals. Target − Non Target represents the difference between the two groups. Detailed variable definitions are provided by Appendix A. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

	Non Target	Target	Target−Non Target
Log(Employment)	6.37	6.38	0.02
Log(Core Workers)	3.72	3.84	0.13***
Core Workers/Patients (×100)	0.67	0.52	−0.16***
%Core Workers	0.15	0.17	0.02***
Log(Admin Workers)	4.28	4.11	−0.16***
Admin Workers/Patients (×100)	0.99	0.64	−0.34***
%Admin Workers	0.25	0.23	−0.03***
Log(Total Wages)	17.07	17.10	0.03
%Core Wages	0.18	0.19	0.01***
%Admin Wages	0.18	0.16	−0.01***
Core Wage Rate ($/hr)	48.00	40.70	−7.30***
Admin Wage Rate ($/hr)	25.62	25.52	−0.10
Mortality for Heart Attack (AMI)	15.00	15.54	0.54***
Mortality for Heart Failure	11.70	11.01	−0.69***
Mortality for Pneumonia	13.25	12.07	−1.18***
Readmission for Heart Attack (AMI)	17.98	19.47	1.48***
Readmission for Heart Failure	23.07	24.29	1.22***
Readmission for Pneumonia	17.39	18.36	0.97***
Beds	106.50	168.18	61.68***
CMI	1.31	1.36	0.05***
%Medicare	0.47	0.41	−0.06***
%Medicaid	0.13	0.14	0.01***
%Outpatient	0.58	0.41	−0.17***

Table 2
Summary Statistics for the Matched Sample
This table reports the summary statistics for the matched sample of targets and controls. Both target and control hospitals remain in the sample during the [-4, +8] event period. Detailed variable definitions are provided by Appendix A.

	Obs	Mean	Std	Median	P25	P75
Log(Employment)	4,767	6.53	0.72	6.53	6.06	7.02
Log(Core Workers)	4,768	3.90	0.94	3.86	3.30	4.51
%Core Workers	4,768	0.17	0.08	0.15	0.11	0.21
Core Workers/Patients (×100)	4,766	0.50	0.41	0.39	0.28	0.58
Log(Admin Workers)	4,765	4.31	0.72	4.30	3.87	4.79
%Admin Workers	4,765	0.25	0.09	0.24	0.17	0.31
Admin Workers/Patients (×100)	4,763	0.70	0.36	0.66	0.44	0.89
Log(Total Wages)	4,772	17.39	0.83	17.43	16.90	17.93
%Core Wages	4,768	0.18	0.08	0.17	0.13	0.23
%Admin Wages	4,770	0.16	0.06	0.16	0.12	0.20
Core Wage Rate ($/hr)	4,645	44.23	11.51	42.30	36.41	49.52
Admin Wage Rate ($/hr)	4,558	27.01	7.22	26.13	21.59	31.81
Mortality for Heart Attack (AMI)	1,810	15.38	1.75	15.40	14.10	16.40
Mortality for Heart Failure	2,042	11.30	1.62	11.10	10.00	12.20
Mortality for Pneumonia	2,058	12.28	2.52	11.90	10.40	13.80
Readmission for Heart Attack (AMI)	1,383	18.73	1.74	19.00	17.40	20.00
Readmission for Heart Failure	1,742	23.91	2.08	24.00	22.40	25.30
Readmission for Pneumonia	1,755	17.90	1.59	18.00	16.90	19.00
Beds	4,813	187.45	124.67	157.00	102.00	255.00
CMI	4,766	1.39	0.21	1.39	1.25	1.54
%Medicare	4,813	0.38	0.13	0.38	0.28	0.46
%Medicaid	4,813	0.15	0.11	0.12	0.06	0.20
%Outpatient	4,812	0.42	0.14	0.39	0.31	0.52

Table 3
Profitability at Target Hospitals

This table examines changes in profitability at target hospitals around acquisitions. The dependent variable for columns (1) and (2) is *Gross Margin*, which is net income from service to patients over net patient revenues. The dependent variable for columns (3) and (4) is *OI/TA*, which is net income from service to patients over total assets. The dependent variable for Column (5) and (6) is *ROA*, which is net income (total income−total other expenses) over total assets. *PE-Backed Acquirers* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed Acquirers* turns to one for a target hospital after it is acquired by a non-PE-backed hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls include the log of total beds (*Log(Beds)*), case-mix index (*CMI*), percentage of patients covered by Medicare (*%Medicare*), percentage of patients with Medicaid (*%Medicaid*), and the percentage of patients that are outpatients (*%Outpatient*). County Controls include the percentage of Black residents (*%Black*), the percentage of Asian residents (*%Asian*), log of population (*Log(Pop)*), and the log of one bedroom rent in a county (*Log(FMR)*). See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Gross Margin*		*OI/TA*		*ROA*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	0.0220**	0.0584**	0.0600***	0.0847**	0.0540***	0.0876***
	(2.35)	(2.50)	(3.93)	(2.32)	(4.17)	(2.89)
Non-PE Backed Acquirers	0.0279	0.0434	0.0263	0.0006	−0.0080	−0.0058
	(1.40)	(1.10)	(0.79)	(0.01)	(−0.35)	(−0.16)
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	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.77	0.73	0.34	0.15	0.01	0.04
Obs	4,118	2,432	4,110	2,428	4,110	2,428
Adj. R^2	0.59	0.59	0.60	0.59	0.56	0.51

Table 4
Employment and Wage Expenditures at Target Hospitals
This table examines changes in the employment and wages at target hospitals around acquisitions. The dependent variable in column (1) and (2) is the log of total employees (measured in full-time equivalent employees based on employed hours). The dependent variable in column (3) and (4) is the log of total wages. *PE-Backed Acquirers* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed Acquirers* turns to one for a target hospital after it is acquired by a non-PE-backed hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls and County Controls are defined in the same way as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	−0.0825***	−0.0848**	−0.0931***	−0.1229***
	(−5.54)	(−2.15)	(−4.95)	(−2.79)
Non-PE Backed Acquirers	−0.0626*	−0.0477	−0.1010***	−0.0908
	(−1.88)	(−0.88)	(−2.83)	(−1.53)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.55	0.51	0.83	0.60
Obs	4,124	2,436	4,124	2,436
Adj. R^2	0.98	0.98	0.98	0.98

Table 5
Core and Administrative Workers at PE-Acquired Hospitals

This table examines changes in core workers and administrative workers at target hospitals around acquisitions. Panel A reports the results for the number of core and administrative workers. The dependent variable for Column (1) and (2) is the log of total number of core workers, i.e., *Log(Core Workers)*. The dependent variable for Column (3) and (4) is the log of total number of administrative workers, i.e., *Log(Admin Workers)*. Panel B reports the results for the number of workers per patient. *PE-Backed Acquirers* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed Acquirers* turns to one for a target hospital after it is acquired by a non-PE-backed hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls and County Controls are defined in the same way as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

(A) Log Number of Core and Administrative Workers

Dep. Var.:	*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	−0.1464***	−0.0463	−0.1644***	−0.1391**
	(−3.91)	(−0.57)	(−5.69)	(−2.21)
Non-PE Backed Acquirers	−0.2410***	−0.2526*	−0.0388	0.0776
	(−2.95)	(−1.84)	(−0.75)	(0.72)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.24	0.14	0.02	0.06
Obs	4,125	2,436	4,122	2,434
Adj. R^2	0.90	0.91	0.93	0.91

(B) Core and Administrative Workers per Patient

Dep. Var.:	*Core Workers/Patients*		*Admin Workers/Patients*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	−0.0006***	−0.0005	−0.0008***	−0.0009**
	(−3.18)	(−1.20)	(−3.79)	(−2.05)
Non-PE Backed Acquirers	−0.0007*	−0.0013**	0.0002	0.0006
	(−1.86)	(−2.11)	(0.43)	(0.83)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.89	0.20	0.02	0.06
Obs	4,124	2,436	4,121	2,434
Adj. R^2	0.83	0.84	0.83	0.80

Table 6
Wage Rates for Core and Administrative Workers at PE-Acquired Hospitals
This table examines changes in per hour salary paid to core workers and administrative workers at target hospitals around acquisitions. In Columns (1) and (2), we present results related to *Log(Core Wage Rate*, the log of hourly wage rate for core workers. In Columns (3) and (4), we present results related to *Log(Admin Wage Rate*, the log of hourly wage rate for administrative workers. *PE-Backed Acquirers* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed Acquirers* turns to one for a target hospital after it is acquired by a non-PE-backed hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls and County Controls are defined in the same way as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Core Wage Rate)*		*Log(Admin Wage Rate)*	
	(1)	(2)	(3)	(4)
Post-Event Window	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$
PE-Backed Acquirers	-0.0038	-0.0450	-0.0094	-0.1268^{***}
	(-0.27)	(-1.28)	(-0.69)	(-4.53)
Non-PE Backed Acquirers	-0.0567^{**}	0.0010	-0.0310	-0.0654
	(-1.99)	(0.02)	(-1.21)	(-1.30)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.07	0.41	0.42	0.25
Obs	4,029	2,372	3,941	2,328
Adj. R^2	0.71	0.72	0.83	0.81

Table 7
Nurses and Pharmacists at Target Hospitals

This table examines changes in the proportion of nurses and pharmacists at target hospitals around acquisitions. In Columns (1) and (2), we present results related to the log of total number of nurses and pharmacists, i.e., *Log(Nurses & Pharma)*. The dependent variable for Columns (3) and (4) is *Nurses & Pharma/Patients*, the number of nurses and pharmacists scaled by the number of patients. The number of patients is estimated by adjusted discharges, defined as the number of discharged inpatients multiplied by (1+outpatient charges/inpatient charges). The dependent variable for Columns (5) and (6) is *Log(Nurse & Pharma Wage Rate*, the log of hourly wage rate for nurses. *PE-Backed Acquirers* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed Acquirers* turns to one for a target hospital after it is acquired by a non-PE-backed hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls and County Controls are defined in the same way as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Nurses & Pharma)*		*Nurses & Pharma/Patients*		*Nurse & Pharma Wage Rate*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	−0.1552***	0.0777	−0.0003***	0.0000	0.0006	−0.0084
	(−4.85)	(1.04)	(−4.26)	(0.24)	(0.06)	(−0.33)
Non-PE Backed Acquirers	−0.2416***	−0.3135**	−0.0005***	−0.0007**	−0.0139	−0.0008
	(−4.02)	(−2.24)	(−2.95)	(−2.35)	(−0.83)	(−0.02)
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	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.17	0.01	0.27	0.02	0.39	0.82
Obs	4,114	2,425	4,113	2,425	3,948	2,357
Adj. R^2	0.91	0.93	0.78	0.81	0.77	0.79

Table 8
For-profit and Nonprofit Targets

This table presents results across for-profit and nonprofit targets. Target hospitals' for-profit status is characterized based on its status prior to the acquisition. Panel A reports the results for employment and wages at target hospitals around acquisitions. Panel B reports the results for the number of core and administrative workers. Panel C reports the results for the number of core and administrative workers per patient. *For-Profit PE Target* turns to one for a for-profit hospital after it is acquired by a PE firm or a PE-backed hospital. *Nonprofit PE Target* turns to one for a nonprofit target hospital after it is acquired by a PE firm or a PE-backed hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls and County Controls are defined in the same way as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

(A) Total Employment and Wage Bill

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
For-Profit PE Target	−0.0627***	−0.0695	−0.0618***	−0.1109**
	(−4.16)	(−1.62)	(−3.20)	(−2.40)
Nonprofit PE Target	−0.1537***	−0.1067*	−0.2058***	−0.1402**
	(−5.63)	(−1.78)	(−6.60)	(−2.03)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: For-Profit=Nonprofit	0.0008	0.5659	0.0000	0.6856
Obs	4,124	2,436	4,124	2,436
Adj. R^2	0.9801	0.9791	0.9810	0.9800

(C) Log Number of Workers By Category

Dep. Var.:	*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
For-Profit PE Target	−0.1574***	−0.0663	−0.1529***	−0.0446
	(−4.13)	(−0.76)	(−5.35)	(−0.63)
Nonprofit PE Target	−0.1067	−0.0174	−0.2059***	−0.2780***
	(−1.50)	(−0.14)	(−3.09)	(−3.49)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: For-Profit=Nonprofit	0.4697	0.7161	0.4292	0.0073
Obs	4,125	2,436	4,122	2,434
Adj. R^2	0.9037	0.9088	0.9284	0.9161

(A) Workers per Patient By Category

Dep. Var.:	*Core Workers/Patients*		*Admin Workers/Patients*	
	(1)	(2)	(3)	(4)
Post-Event Window	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$
For-Profit PE Target	-0.0006^{***}	-0.0002	-0.0006^{***}	-0.0002
	(-2.70)	(-0.55)	(-2.94)	(-0.42)
Nonprofit PE Target	-0.0008^{**}	-0.0008	-0.0013^{***}	-0.0020^{***}
	(-2.40)	(-1.28)	(-2.99)	(-2.90)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: For-Profit=Nonprofit	0.5424	0.4242	0.1407	0.0253
Obs	4,124	2,436	4,121	2,434
Adj. R^2	0.8329	0.8395	0.8343	0.7984

Table 10
Mortality and Readmission Rates at Target Hospitals

This table examines the mortality and readmission rates of target hospitals around acquisitions. 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. Mortality rates and readmission rates are presented in percentage points. The regressions take a first-difference approach, with both the dependent variables and continuous control variables representing changes from the pre-acquisition window to a post-acquisition window. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Control variables are the same as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

(A) Changes in Mortality

Dep. Var.:	*Heart Attack (AMI)*		*Heart Failure*		*Pneumonia*	
	(1)	(2)	(3)	(4)	(5)	(6)
PE-Backed Acquirers	0.1869	0.1976	−0.0077	−0.3316	0.7114	0.3624
	(0.43)	(0.31)	(−0.02)	(−0.80)	(1.64)	(0.86)
Non-PE Backed Acquirers	−0.4409	−0.4874	0.8922*	0.7723**	1.2877*	1.0592*
	(−0.68)	(−1.03)	(1.78)	(2.13)	(1.77)	(1.77)
Hospital Controls (differenced)	Yes	Yes	Yes	Yes	Yes	Yes
County Controls (differenced)	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs		Yes		Yes		Yes
H_0: PE=Non-PE	0.36	0.43	0.17	0.05	0.41	0.39
Obs	192	191	222	221	226	225
Adj. R^2	0.11	0.45	0.06	0.56	0.05	0.40

(B) Changes in Readmission

Dep. Var.:	*Heart Attack (AMI)*		*Heart Failure*		*Pneumonia*	
	(1)	(2)	(3)	(4)	(5)	(6)
PE-Backed Acquirers	0.6143	0.2780	−0.2648	−0.2885	−0.2402	0.0321
	(1.60)	(0.65)	(−0.48)	(−0.62)	(−0.53)	(0.06)
Non-PE Backed Acquirers	0.3048	0.4602	−0.3990	−0.4963	−1.1383**	−1.2475***
	(0.72)	(1.58)	(−0.71)	(−1.51)	(−2.22)	(−3.59)
Hospital Controls (differenced)	Yes	Yes	Yes	Yes	Yes	Yes
County Controls (differenced)	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs		Yes		Yes		Yes
H_0: PE=Non-PE	0.54	0.73	0.83	0.73	0.08	0.05
Obs	155	154	188	187	192	191
Adj. R^2	0.19	0.56	0.23	0.63	0.12	0.39

Table 11
Operating Characteristics at Target Hospitals

This table examines changes in operating characteristics at target hospitals around acquisitions. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Control variables are the same as in Table 3. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Beds)*		*CMI*		*Outpatient Ratio*		*%Medicare*		*%Medicaid*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	0.0218	0.0425	0.0088	0.0257	−0.0216***	−0.0343***	−0.0114**	−0.0094	−0.0030	0.0052
	(1.37)	(0.86)	(1.09)	(1.13)	(−5.06)	(−2.83)	(−2.15)	(−0.74)	(−0.50)	(0.34)
Non-PE Backed Acquirers	−0.0295	0.0184	−0.0186	−0.0122	−0.0109	−0.0226*	0.0127	0.0245	−0.0066	−0.0263
	(−1.30)	(0.37)	(−1.41)	(−0.40)	(−1.34)	(−1.70)	(1.59)	(1.49)	(−0.65)	(−1.44)
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Obs	4,173	2,460	4,148	2,444	4,172	2,459	4,173	2,460	4,173	2,460
Adj. R^2	0.9673	0.9560	0.9071	0.8969	0.9435	0.9403	0.9007	0.8988	0.8071	0.7771

Appendix A Variable Definitions

A Employment 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.
- *Log(Total Wages)*: The log of total wages. The information is obtained from the HCRIS Worksheet S-3, Part II.
- *%Core Workers*: The ratio of nurses, physicians (including contract labor), and pharmacists relative to all employee trackable in HCRIS Worksheet S-3, Part II (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II. Core workers include Non-physician anesthethist Part A (Line Number 2), Non-physician anesthethist Part B (Line Number 3), Physician - Part A - Administrative (Line Number 4), Physician - Part A - Teaching (Line Number 4.01), Physician and Non Physician-Part B (Line Number 5), Interns & residents (in an approved program) (Line Number 7), Contracted interns & residents (in an approved program) (Line Number 7.01), Contract labor: Direct Patient Care (Line Number 11), Contract labor: Physician - Part A - Administrative (Line Number 13), Home office: Physician Part A - Administrative (Line Number 15), Home office & Contract Physician Part A - Teaching (Line Number 16), Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).
- *Core Workers/Patients*: The ratio of nurses, physicians, and pharmacists, 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. Core workers include Non-physician anesthethist Part A (Line Number 2), Non-physician anesthethist Part B (Line Number 3), Physician - Part A - Administrative (Line Number 4), Physician - Part A - Teaching (Line Number 4.01), Physician and Non Physician-Part B (Line Number 5), Interns & residents (in an approved program) (Line Number 7), Contracted interns & residents (in an approved program) (Line Number 7.01), Contract labor: Direct Patient Care (Line Number 11), Contract labor: Physician - Part A - Administrative (Line Number 13), Home office: Physician Part A - Administrative (Line Number 15), Home office & Contract Physician Part A - Teaching (Line Number 16), Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).
- *Log(Core Workers)*: The log number of nurses, physicians, and pharmacists (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II. Core workers include Non-physician anesthethist Part A (Line Number 2), Non-physician anesthethist Part B (Line Number 3), Physician - Part A - Administrative (Line Number 4), Physician - Part A - Teaching (Line Number 4.01), Physician and Non Physician-Part B (Line Number 5), Interns & residents (in an approved program) (Line Number 7), Contracted interns & residents (in an approved program) (Line Number 7.01), Contract labor: Direct Patient Care (Line Number 11), Contract labor: Physician - Part A - Administrative (Line Number 13), Home office: Physician Part A - Administrative (Line Number 15), Home office & Contract Physician Part A - Teaching (Line Number 16), Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).
- *%Core Wages*: The ratio of salary payment to nurses, physicians, and pharmacists relative to the payment to all workers trackable in HCRIS Worksheet S-3, Part II. The information is obtained from the HCRIS Worksheet S-3, Part II. Core workers include Non-physician anesthethist Part A (Line Number 2), Non-physician anesthethist Part B

(Line Number 3), Physician - Part A - Administrative (Line Number 4), Physician - Part A - Teaching (Line Number 4.01), Physician and Non Physician-Part B (Line Number 5), Interns & residents (in an approved program) (Line Number 7), Contracted interns & residents (in an approved program) (Line Number 7.01), Contract labor: Direct Patient Care (Line Number 11), Contract labor: Physician - Part A - Administrative (Line Number 13), Home office: Physician Part A - Administrative (Line Number 15), Home office & Contract Physician Part A - Teaching (Line Number 16), Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).

- *Log(Core Wage Rate)*: The log of hourly wages for nurses and physicians. The information is obtained from the HCRIS Worksheet S-3, Part II. Core workers include Non-physician anesthethist Part A (Line Number 2), Non-physician anesthethist Part B (Line Number 3), Physician - Part A - Administrative (Line Number 4), Physician - Part A - Teaching (Line Number 4.01), Physician and Non Physician-Part B (Line Number 5), Interns & residents (in an approved program) (Line Number 7), Contracted interns & residents (in an approved program) (Line Number 7.01), Contract labor: Direct Patient Care (Line Number 11), Contract labor: Physician - Part A - Administrative (Line Number 13), Home office: Physician Part A - Administrative (Line Number 15), Home office & Contract Physician Part A - Teaching (Line Number 16), Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).
- *%Admin Workers*: The ratio of administrative and general workers relative to all employee trackable in HCRIS Worksheet S-3, Part II (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II. Administrative and general workers include Administrative & General (Line Number 27) and Administrative & General under contract (Line Number 28).
- *Admin Workers/Patients*: The ratio of administrative and general workers, 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. Administrative and general workers include Administrative & General (Line Number 27) and Administrative & General under contract (Line Number 28).Administrative and general workers include Administrative & General (Line Number 27) and Administrative & General under contract (Line Number 28).
- *Log(Admin Workers)*: The log number of administrative and general workers (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II. Administrative and general workers include Administrative & General (Line Number 27) and Administrative & General under contract (Line Number 28).
- *%Admin Wages*: The ratio of salary payment to administrative and general workers (including contract labor) relative to the payment to all workers trackable in HCRIS Worksheet S-3, Part II. The information is obtained from the HCRIS Worksheet S-3, Part II. Administrative and general workers include Administrative & General (Line Number 27) and Administrative & General under contract (Line Number 28).
- *Log(Admin Wage Rate)*: The log of hourly wages for administrative and general workers (including contract labor). The information is obtained from the HCRIS Worksheet S-3, Part II. Administrative and general workers include Administrative & General (Line Number 27) and Administrative & General under contract (Line Number 28).
- *%Nurses & Pharms*: The ratio of nurses and pharmacists relative to all employee trackable in HCRIS Worksheet S-3, Part II (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II. Nurses and Pharmacists include Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).

- *Nurses & Pharms/Patients*: The ratio of nurses and pharmacists, 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. Nurses and Pharmacists include Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).
- *Log(Nurses & Pharms Workers)*: The log number of nurses and pharmacists (measured in full-time equivalent employees based on paid hours). The information is obtained from the HCRIS Worksheet S-3, Part II. Nurses and Pharmacists include Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).
- *Log(Nurses & Pharms Wage Rate)*: The log of hourly wages for nurses and pharmacists. The information is obtained from the HCRIS Worksheet S-3, Part II. Nurses and Pharmacists include Nursing Administration (Line Number 38), and Pharmacy (Line Number 40).

B Patient Outcome and Satisfaction Variables

- *Mortality for Heart Attack (AMI)*: 30-day risk-standardized mortality rate following heart attack hospitalization, in percentage points.
- *Mortality for Heart Failure*: 30-day risk-standardized mortality rate following heart failure hospitalization, in percentage points.
- *Mortality for Pneumonia*: 30-day risk-standardized mortality rate following pneumonia hospitalization, in percentage points.
- *Readmission for Heart Attack (AMI)*: 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of heart attack, in percentage points.
- *Readmission for Heart Failure*: 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of heart failure, in percentage points.
- *Readmission for Pneumonia*: 30-day risk-standardized readmission rates for patients discharged from the hospital with a principal diagnosis of pneumonia, in percentage points.

C Independent Variables

- *PE-Backed Acquirers*: An indicator variable that turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital.
- *Non-PE Backed Acquirers*: An indicator variable that turns to one for a target hospital after it is acquired by a non-PE backed hospital.

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*: The ratio of outpatient charges relative to total charges.
- *%Black*: The fraction of Black in a given county at a given year.
- *%Asian*: The fraction of Asian in a given county at a given year.
- *Log(Pop)*: The log of population in a given county at a given year.
- *Log(FMR)*: The log of one bedroom rent price in a give county a t a given year.

Appendix B Alternative Matching

In this section, we present our main results when we match our target hospitals to control hospitals based on core worker ratio (*%Core Workers*) and control variables.

Table B1
Profitability at Target Hospitals
This table examines changes in profitability at target hospitals around acquisitions. The dependent variable for columns (1) and (2) is *Gross Margin*, which is net income from service to patients over net patient revenues. The dependent variable for columns (3) and (4) is *OI/TA*, which is net income from service to patients over total assets. The dependent variable for Column (5) and (6) is *ROA*, which is net income (total income−total other expenses) over total assets. The dependent variable for Column (7) and (8) is *Log(Cost per Patient)*, which is the cost per patient. The number of patients is estimated by adjusted discharges, defined as the number of discharged inpatients multiplied by (1+outpatient charges/inpatient charges). *PE-Backed* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed* turns to one for a target hospital after it is acquired by a non-PE-backed private hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls include *Log(Beds)*, *CMI*, *%Medicare*, *%Medicaid*, and *%Outpatient*. County Controls include *%Black*, *%Asian*, *Log(Pop)*, and *Log(FMR)*. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Gross Margin*		*OI/TA*		*ROA*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	0.0291***	0.0131	0.0706***	−0.0017	0.0622***	0.0545
	(2.79)	(0.24)	(3.88)	(−0.02)	(3.67)	(0.81)
Non-PE Backed Acquirers	0.0110	−0.0137	−0.0097	−0.0463	−0.0033	0.0012
	(0.37)	(−0.11)	(−0.24)	(−0.34)	(−0.10)	(0.01)
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	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.55	0.84	0.07	0.78	0.06	0.58
Obs	2,213	1,149	2,210	1,148	2,210	1,148
Adj. R^2	0.73	0.68	0.68	0.64	0.66	0.61

Table B2
Employment and Worker Composition at Target Hospitals
Panel A examines changes in the employment at target hospitals around acquisitions. The dependent variable in column (1) and (2) is the log of total employees (measured in full-time equivalent employees based on employed hours). The dependent variable in column (3) and (4) is the log of total salaries. Panel B reports the results for the number of workers. Columns (1) and (2) examine the log of total number of core workers, i.e., *Log(Core Workers)* and Columns (3) and (4) examine the log of total number of administrative workers, i.e., *Log(Admin Workers)*. Panel C reports the results for the number of workers per patient. Columns (1) and (2) (columns (3) and (4)) report results for *Core Workers/Patients* (*Admin Workers/Patients*).*PE-Backed* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed* turns to one for a target hospital after it is acquired by a non-PE-backed private hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls include *Log(Beds)*, *CMI*, *%Medicare*, *%Medicaid*, and *%Outpatient*. County Controls include *%Black*, *%Asian*, *Log(Pop)*, and *Log(FMR)*. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

(A) Total Employment and Wages

	Log(Employment)		*Log(Total Wages)*	
	(1)	(2)	(3)	(4)
Post-Event Window	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$
PE-Backed Acquirers	-0.0586^{***}	-0.0618	-0.0687^{***}	-0.1392^{*}
	(-3.94)	(-1.06)	(-4.09)	(-1.76)
Non-PE Backed Acquirers	-0.0445	-0.0949	-0.0824	-0.0910
	(-0.70)	(-1.54)	(-1.53)	(-1.04)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.82	0.65	0.80	0.63
Obs	2,216	1,151	2,216	1,151
Adj. R^2	0.98	0.99	0.98	0.99

(B) Log Number of Workers by Category

Dep. Var.:	*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	−0.1295***	0.0297	−0.1788***	−0.2843**
	(−3.12)	(0.19)	(−5.89)	(−2.48)
Non-PE Backed Acquirers	−0.2814**	−0.8755***	−0.1118	−0.2296
	(−2.36)	(−2.84)	(−1.30)	(−1.16)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.22	0.01	0.43	0.79
Obs	2,216	1,151	2,216	1,151
Adj. R^2	0.91	0.92	0.95	0.95

(C) Workers per Patient

Dep. Var.:	*Core Workers/Patients*		*Admin Workers/Patients*	
	(1)	(2)	(3)	(4)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE-Backed Acquirers	−0.0004**	−0.0002	−0.0007***	−0.0022***
	(−2.47)	(−0.24)	(−4.01)	(−2.70)
Non-PE Backed Acquirers	−0.0001	−0.0021**	0.0001	−0.0017
	(−0.15)	(−2.46)	(0.19)	(−1.15)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.53	0.05	0.17	0.71
Obs	2,214	1,149	2,214	1,149
Adj. R^2	0.91	0.92	0.87	0.86

Table B3
Wage Decomposition at Target Hospitals

This table examines changes in hourly salary paid to core workers and administrative workers at target hospitals around acquisitions. In Columns (1) and (2), we present results related to *Log(Core Wage Rate)*, the log of hourly wage rate for core workers. In Columns (3) and (4), we present results related to *Log(Admin Wage Rate)*, the log of hourly wage rate for administrative workers. *PE-Backed* turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital. *Non-PE Backed* turns to one for a target hospital after it is acquired by a non-PE-backed private hospital. Rows with H_0's provide p-values from Wald Chi-square tests indicating whether two coefficients are statistically significantly different from each other. Hospital Controls include *Log(Beds)*, *CMI*, *%Medicare*, *%Medicaid*, and *%Outpatient*. County Controls include *%Black*, *%Asian*, *Log(Pop)*, and *Log(FMR)*. See Appendix A for variable definitions. t-statistics are reported in parentheses and standard errors are heteroskedasticity robust and clustered by hospital. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Dep. Var.:	*Log(Core Wage Rate)*		*Log(Admin Wage Rate)*	
	(1)	(2)	(3)	(4)
Post-Event Window	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$
PE-Backed Acquirers	-0.0425^{**}	-0.1453^{*}	-0.0067	-0.2093^{***}
	(-2.09)	(-1.93)	(-0.38)	(-4.20)
Non-PE Backed Acquirers	-0.1425^{***}	-0.0144	0.0005	0.0301
	(-3.47)	(-0.11)	(0.01)	(0.81)
Hospital Controls	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes
H_0: PE=Non-PE	0.02	0.35	0.82	0.00
Obs	2,185	1,140	2,150	1,128
Adj. R^2	0.72	0.75	0.82	0.84