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Private Equity in the Hospital Industry

Finance Working Paper N° 787/2021
April 2023

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Abstract

We examine the survival, profitability, and employment profiles of private equity (PE) acquired hospitals. Target hospitals sustain their survival rates and improve in profitability. Although employment and wage expenditures substantially decline, the effect differs across employee types: The decline in core medical workers is temporary and quickly reversed, while the decline in administrative workers and their wages persists. These changes are more pronounced for nonprofit targets, acquisitions into larger systems, and PEs with healthcare industry expertise. We do not find patient outcomes to worsen at acquired hospitals. Our results suggest that PE acquirers improve hospitals' operational efficiency without compromising healthcare quality.

Keywords: 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 past decade, a large fraction of which is invested in hospitals.[1] 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 expertise and operational reform, which help turn around struggling hospitals. Opponents voice concerns that PE firms load hospitals with debt, sell assets, lay off workers, and even close hospitals. This debate is particularly important given the economic significance of the healthcare industry. This industry contributes to nearly 20% of total U.S. GDP, provides critical healthcare to local communities, and ranks among the top ten job providers in the U.S. In this paper, we seek to shed light on this current debate by examining various outcomes at hospitals acquired by PE firms.

We study the survival, operating performance, and employee profiles at PE-acquired hospitals. We first examine closure rates and profitability outcomes after PE acquisitions, and then track the variation in employment. In this investigation, we separately examine the changes in core medical workers and administrative workers, because the former is key to providing high-quality healthcare, while the latter is a main source of hospitals' wasteful spending (Shrank et al., 2019). Finally, we look into changes in patient composition as well as mortality rates and readmission rates. Overall, our evidence suggests that PE acquisitions are associated with substantial profitability improvement and cost-cutting at target hospitals. The cost-cutting reflects PEs' operational expertise (Jensen, 2019; Kaplan and Stromberg, 2009), as it is focused on administrative expenditures but not on core medical functions. We also document little changes in patient composition or outcomes.

We compile a 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, a PE-owned hospital or a hospital with no PE ownership. These deals involve 610 unique target hospitals. We analyze PE-acquired hospitals relative to a control group of non-acquired hospitals that are closely matched by loca-

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

tion, 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. These comparisons help address concerns that our results may capture differences across location, hospital type, or the selection of targets by for-profit acquirers in general.

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 years [5, 8] after the event. 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 of reforms conducted at acquired hospitals. Indeed, prior studies on the roles of PEs examine both the short-run effects following PE buyouts (e.g., Kaplan 1989; Davis et al. 2014; Lerner et al. 2011; Bernstein 2022) and long-term consequences (e.g., Kaplan and Stromberg 2009). Kaplan and Stromberg (2009) report that holding periods of PE firms have increased substantially since the 1990s, documenting 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, evaluating the concerns raised in the popular press that PE firms tend to close hospitals. We find no evidence of excessive closure of PE-acquired hospitals. PE-acquired hospitals also significantly improve their operating profitability. The profitability boost persists over the 8-year window following PE acquisitions. It is thus unlikely to be a manifestation of PE firms' window-dressing efforts in the short-term while sacrificing the long term potential of acquired hospitals. These results help alleviate the concerns that PE owners excessively close down hospitals, leading to the loss of health care and jobs in the community.

The survival results do not imply, however, that all jobs are preserved at PE-acquired hospitals. In fact, an important driver of M&A transactions is to eliminate excess employment at acquired firms or overlapping employment between merging parties. We find that employment at PE-acquired hospitals declines by 7% over the first four-year event

window and this reduction reaches 10% over the long-term horizon. As a natural consequence, the total wage bill at PE-acquired hospitals goes down by 7% over the first four years and become 11% lower than its pre-acquisition level at the end of year 8 following the deal. These findings suggest substantial cost-savings at PE-acquired hospitals.

Employment cut can be a double-edged 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.

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. One interpretation of this finding is that the initial restructuring following an acquisition leads to a temporary decline in core workers. After the initial stage, the operational environment stabilizes and the hospital regains core workers back to the pre-event level. We confirm this finding using an alternative measure, 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, by 18%, at PE-acquired hospitals over the first event window. Different from core workers, the drop in administrative workers does not revert back, but stays at 22% under the pre-acquisition level by the of the second event window. Such reductions also show up when we scale administrative workers using total patient counts.

Tracking the evolution of core and administrative workers at PE target hospitals, we find that the above-documented changes do not start taking place prior to PE acquisitions, but occur after the acquisitions. The declines in administrative workers persist for many years after the takeover, while the reductions 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.

We perform several additional analyses to bolster our inferences. First, we perform a "placebo" test looking at the changes that occur at hospitals acquired by non-PE buyers. We find that target hospitals of non-PEs exhibit worse survival likelihood compared to their control group. After the acquisition, these hospitals also reduce their employment and wages, but such reductions are relatively small and statistically insignificant over the long run. In terms of worker composition, we observe a persistent decline in core workers, but not in administrative workers at non-PE target hospitals. By the end of the eight-year period, core workers are nearly 25% lower than their pre-acquisition levels. There is no reduction in administrative workers across either the short-run or the long-run event window. Results from this set of analysis suggest that the operational changes documented above are unique to PEs, but not present for other for-profit acquirers in general.

Next, we examine wage rates offered to core and administrative workers. We do not observe a meaningful change in the wage rate paid to core workers in PE-acquired hospitals, but a substantial decline in the wage rate of administrative workers, by around 7% over the long run. This result reinforces the argument that PE acquirers trim spending related to administrative functions. In addition, we consider an alternative definition of core workers that only consists of nurses and pharmacists, while excluding physicians. This helps address the concern that physicians may be hired through part-time contracts and that the cost reports do not track their hours in the same way as other full-time employees. Furthermore, we control for state-year fixed effects to remove the confounding effects of changing local conditions. Finally, we test the sensitivity of our results to the sampling procedure in several ways. In one test, we change the hospital characteristics used in the matching process. In another, we exclude cases where the target hospital and its matched control are located nearby, so as to mitigate the spillover effects from local acquisitions. We also keep a balanced sample by requiring hospitals to have observations for multiple years before and after the event. Our results remain largely unchanged to these measures or sample refinements.

Taken together, our analysis reveals stark contrasts between changes in core medical workers and administrative workers at PE-acquired hospitals. These findings suggest that PE firms focus on reducing excess overhead costs while sustaining critical healthcare providers, likely because of their operational expertise and business skills.

Next, we explore the heterogeneity of our findings to shed light on mechanisms. We start by comparing target hospitals that operated as nonprofit to those operated as for-profit organizations prior to being acquired. To the extent that nonprofit hospitals face no investor scrutiny, they may operate less efficiently prior to PE acquisitions and undergo greater cost-cutting under PE ownership. Our evidence is consistent with this conjecture. At previously nonprofit hospitals, both total employment and wage bills decline more substantially. Administrative workers experience a 36% decline over the long-term event horizon, and there is barely any change in core workers. In contrast, target hospitals with previously for-profit status experience much smaller cost-cutting, especially through the reduction of administrative workers.

We next examine economies of scale as a source of operational change at PE-acquired hospitals. PE firms purchase a large number of units and organize them into larger systems through a "roll-up" process. Doing so might give them greater flexibility to reallocate and consolidate human capital within systems to achieve higher efficiency.[2] For example, hospitals in larger systems can more easily combine various administrative functions such as finance, accounting, and marketing. To test this conjecture, we compare cases where PE firms purchase a target hospital from a relatively small system and include it in a much larger system to cases where the target hospital experiences a smaller increase in system size. We find that the reductions in total employment, wage bills, and administrative employees are primarily concentrated in the former case.

Finally, we look into PE firms' expertise in the healthcare industry. We posit that PE firms with greater specialization in the healthcare industry can better target and improve inefficiencies. Our evidence supports this conjecture. PE firms more focused on the healthcare industry are associated with greater employment cuts, more signifi-

[2]See Cohn et al. (2022) for evidence on how PEs use roll-up acquisitions outside the hospital industry.

cant increases in core workers, and larger reductions in administrative workers at target hospitals, compared to PE acquirers with less expertise in the healthcare industry.

These findings reveal some key mechanisms through which PE firms help improve the operations of target hospitals. Specifically, PE firms make nonprofit hospitals accountable to investors, form large hospital systems to achieve economies of scale, and accumulate experience in the healthcare industry to become more specialized in their operations. Our findings also help answer important questions such as why cutting administrative burden requires the intervention from PE firms. 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 business. Non-PE acquirers and pre-deal executives of target hospitals may not possess such expertise. They may also lack the high-powered incentives that PE firms have to trim employment and improve efficiency.

How do the changes in PE-acquired hospitals affect patients? The answer is not clear ex ante. 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, given that the trimmed employment largely consists of administrative 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. Similarly, readmission rates do not increase for PE-acquired hospitals across any of the health conditions we examine. Overall, we do not find deterioration of patient outcomes at PE-acquired hospitals.

Lastly, we examine changes in hospital characteristics and patient composition around PE acquisitions. This analysis sheds light on the concern that PE-acquired hospitals may shift their focus to younger and wealthier patients and offer more profitable services. However, we do not find evidence in favor of such an operational shift. We show that PE targets stay largely unchanged in size, either measured by the number of beds or the number of patients treated. They also do not generate significantly greater revenue, hence

the profitability boost we document likely originates from cost-cutting. As we examine patient composition in terms of the ratio of patients treated in the hospital as opposed to outside clinics as well as the percentage of Medicare and Medicaid patients, we find these metrics to stay roughly the same as their pre-acquisition levels. PE target hospitals increase their case-mix index which measures the number of resource intensive patients treated at a hospital, suggesting that target hospitals perform more clinically complex and resource intensive procedures after being acquired. Taken together, our evidence does not support the argument that hospitals drastically shift their operational focus to wealthier patients with better health profiles after PE acquisitions.

Our paper contributes to the growing literature on hospital mergers. The majority of the existing work in this literature focuses on the impact of mergers on hospital prices and costs (Dafny, 2009; Lewis and Pflum, 2017; Schmitt, 2017; Cooper et al., 2019; Dafny et al., 2019; Craig et al., 2021).[3] Prager and Schmitt (2021) investigate the implication of hospital mergers on the local labor market concentration for nurses and pharmacists. We extend this line of research by focusing on PE acquirers and examining their impact on operational efficiency and patient outcomes. Our results suggest that PEs' roles are not limited to aggressive cost-cutting across the board, but they implement selective changes concerning administrative functions. Our findings are also consistent with results in contemporaneous research including Andreyeva et al. (2022) and Duggan et al. (2022), which show that combining standalone hospitals into systems (i.e., "corporitization") and privatizing hospitals lead to efficiency gains. Our paper finds that hospitals are more likely to undergo these operational changes under PE ownership, and highlight the role of PEs' operational expertise in achieving such improvement.

Our paper is also related to the contemporaneous studies on the role 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 com-

[3] Beaulieu et al. (2020) examine the quality of healthcare at acquired hospitals, but do not focus on PE acquirers. Bruch et al. (2020) use a smaller sample to examine the effect of PE acquisitions on hospitals' accounting performance and patient characteristics, but do not look at their effects on hospital employee profiles.

plements 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 private insurers. Different from this study, our paper primarily focuses on operational and employment outcomes at PE-acquired hospitals. We also document important differences in post-acquisition outcomes between PE-targets and non-PE targets, generating a more nuanced and comprehensive understanding of the role of PE firms in this industry.

We contribute to the rich literature examining the operational and employment effects of PE buyouts (see, among others, Kaplan 1989, Bernstein and Sheen 2016 Boucly et al. 2011, Davis et al. 2014, Olsson and Tåg 2017, and Antoni et al. 2019), as well as the burgeoning research documenting PEs' involvement in specific industries (Bernstein and Sheen, 2016; Spaenjers and Steiner, 2021; Fracassi et al., 2022; Ewens et al., 2022; Howell et al., 2022). We find that in the hospital industry, PE firms implement operational changes by reducing administrative employees while preserving employees critical in providing health care. These results are consistent with the operational engineering role of PE firms as elaborated in Kaplan and Stromberg (2009). They are also complementary to evidence in Bernstein and Sheen (2016), which document operational changes in restaurant chain following PE buyouts. Importantly, we highlight key mechanisms through which PEs improve hospital operations such as achieving economies of scale and creating investor accountability.

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 and patient outcomes in the hospital industry, recent contributions have examined the effect of financial and credit constraints on hospital outcomes (e.g., Adelino et al. 2015, Adelino et al. 2021, and Aghamolla et al. 2021).

2 Data and Sample

We collect data from several sources. We compile a list of hospital mergers and acquisitions (M&A) from 2001 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 the Centers for Medicare & Medicaid Services (CMS). We extract data on patient 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, Factset, and 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 hospitals and acquirers, as well as the completion date of the deals. We also supplement the acquisition list based on information from these databases 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 search internet resources including local newspaper articles and American Hospital Directory (AHD) to verify the accuracy of the matches.

The above process yields 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 acquirers in both types of deals 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 a PE-owned hospital, with 419 unique target hospitals. We refer to acquirers that have had no PE ownership as *Non-PE Acquirers*. We have 164 deals by non-PE acquirers, involving 191 target hospitals.

Deals of PE acquirers involve a greater number of target 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 the CMS. Medicare-certified institutional providers are required to submit their annual cost report to a medicare administrative contractor. Such information is then compiled into the HCRIS. From these reports, we gather data regarding hospital characteristics, employment, and workforce composition.

Hospital characteristics include financial performance metrics such as gross margin, 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 log gross (net) patient sales (*Log(Gross (Net) Patient Sales)*), and the log number of patients (*Log(Patients)*), the complexity of operations measured by case mix index (CMI), outpatient ratio given by the ratio of outpatient charges over total charges, 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 the operational profile of target hospitals. To start, we construct a measure of 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. Specifically, annual employment is defined as the total paid work hours divided by 2,080 (40 hrs/week $\times$ 52 weeks), then converted to log terms (*Log(Employment)*). In addition, we look at the number of hospital workers in relation to the number of patients treated at the hospital by taking the ratio of the two, i.e., *Employment/Patients*. Following Schmitt (2017), the number of treated patients is defined as the number of inpatient discharges multiplied by $(1 + \frac{outpatient\ charges}{inpatient\ charges})$.[4]

For employee composition, we focus on core medical workers and administrative workers. Core medical workers include physicians (including contract physicians), nurses, and pharmacists, who are essential in providing quality health care.[5] Administrative 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)*). We also measure core and administrative workers scaled by the number of patients treated at the hospital, i.e., *Core Workers/Patients* and *Admin Workers/Patients*.

Finally, we measure the hourly wages paid to core workers and administrative 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 worker category.

[4]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.

[5]See Appendix A for detailed job categories. In Appendix C, we show that our results are robust when we apply a more restrictive definition of core workers.

2.3 Patient-Level Outcomes

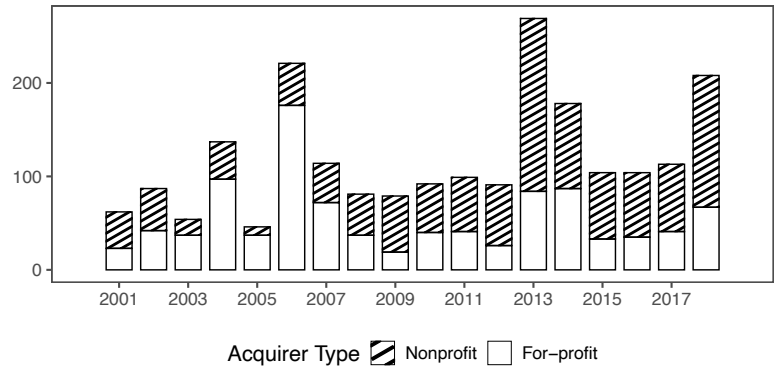
We obtain information on patient outcomes from Hospital Compare Outcome Measures, which is publicly disclosed by the CMS and the Hospital Quality Alliance (HQA). These databases provide rich information including details of medical treatment provided, patient recovery, complications during treatment, 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 the 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.[6]

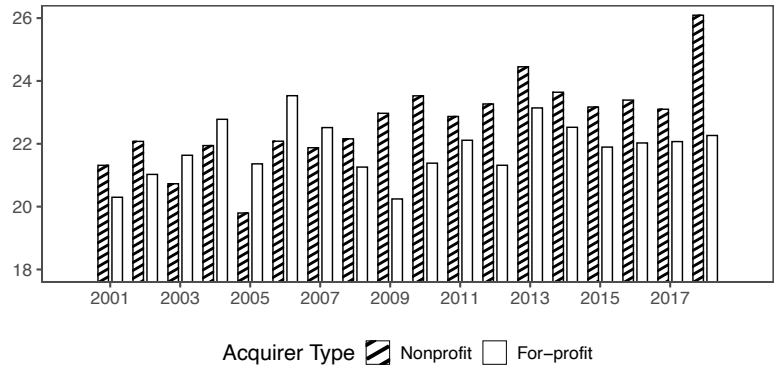
2.4 Initial Sample Construction

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.

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



(A) Number of Target Hospitals

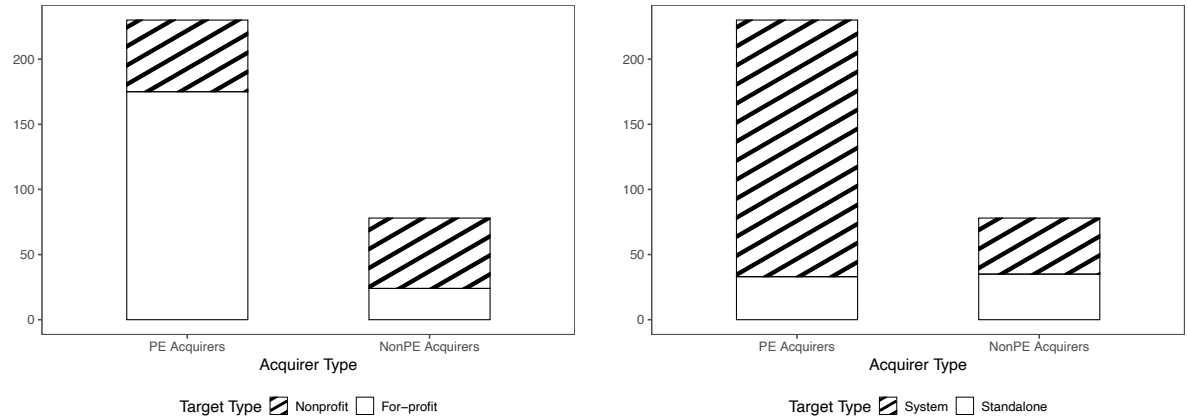


(B) Total Asset Value of Target Hospitals (log)

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 (in $) of target hospitals associated with each acquirer type.

2.5 Univariate Analysis

The hospital industry has experienced growing 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 our sample period, 46.5% of the target hospitals were acquired by for-profit organizations. Deal volume peaked in 2013, when nearly 240 hospitals were acquired, and again in 2018, when the total asset value of acquired hospitals reached $175 billion. Overall, hospitals acquired by for-profit organizations have a combined asset value of $79 billion, a substantial fraction of the total value across all acquisitions. These statistics suggest that for-profit acquirers play



(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 or non-PE. 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.

an economically important 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 classify target hospitals based on whether they belonged to a system of hospitals or not 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%). Across all acquirer categories, around 70% of target hospitals had for-profit status and around 80% of target hospitals belong to a system. The latter 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 hospitals that are never acquired during our sample period. Target hospitals have similar employment size, more core workers and fewer administrative workers compared to never-acquired hospitals. Once we scale these worker categories by the total number of patients, target hospitals have a smaller core worker-to-patient ratio as well as smaller administrative worker-to-patient ratio. In terms of real patient outcomes, target hospitals have lower mortality rates related to heart fail-

ure 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 non-target 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 of hospitals those that acquired other hospitals in our sample period. Hospitals also need to have at least two years of observations prior to the event year.

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 matched 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, as well as the log number of core workers and administrative workers during the year prior to the deal. The hospital characteristics that we use in the matching process include *Log(Beds)*, *CMI*, *%Medicare*, *%Medicaid*, and outpatient ratio. Matching based on core and administrative workers at

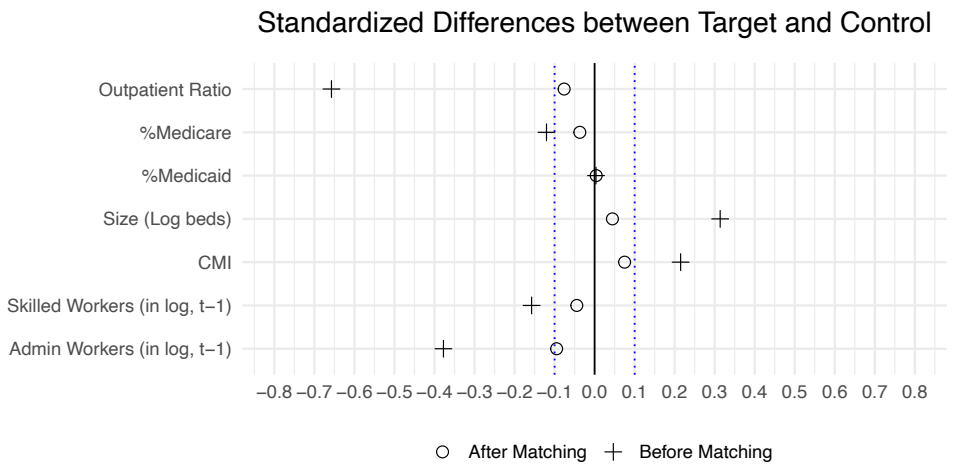


Figure 3. Covariate Balance. This figure shows the values of standardized differences between target and matched control hospitals. Standardized difference is computed as the average difference between the matched pairs (target − control) divided by the standard deviation computed over all observations. Detailed variable definitions are provided by Appendix A.

$t-1$ helps us control for pre-existing trends in the hospitals' labor force conditions prior to the acquisition.[7]

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. The literature indicates a threshold of 0.1 for the absolute standardized differences, under which the treated and control groups can be considered comparable (Austin 2009, 2011). After matching, we observe that the standardized differences between target and control hospitals fall below 0.1 across all dimensions.

Once each acquired hospital is matched with a control hospital, we track the pair over two event horizons. First, we examine the short-run effects of PE acquisitions, comparing the changes in target 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

[7]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; Hainmueller, 2012). In Appendix C, we verify the robustness of our results when we match on the total number of workers before the acquisition. In Appendix D, we show that our results remain unchanged if we remove matched pairs where the control hospitals may be indirectly affected by the acquisitions of other local hospitals.

periods of PE firms have increased since the 1990s with only half of deals being exited within 72 months of the acquisition date, we also investigate the long term effects by comparing target hospital conditions during the pre-acquisition period ($[-4, -1]$) to the following four-year period after the acquisition (i.e., $[+5, +8]$).[8] Observations from $[0, +4]$ are excluded from this sample. This comparison reveals whether changes we observe in the short-run persist, disappear, or revert back in the longer horizon. Finally, we stack these observations associated with all matched pairs together. Our testing sample is thus an event-hospital unit-year panel, whereby an event refers to the acquisition of a hospital.

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 883 people. Our sample hospitals have 184 beds and an outpatient discharge ratio of 0.42 on average. Among all job categories of which working hours are tractable in the HCRIS, 16% of aggregated working hours correspond to core workers and 24% to administrative workers in an average hospital. We note that these fractions rank among the highest across the 53 occupations provided in the HCRIS data.

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:

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

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, core and administrative workers, and the log of wage rates. *PE Target* indicates whether hospital i has been acquired by a PE acquirer in event e as of year t, and zero otherwise. *NonPE Target* is an indicator for

[8] In Appendix B, we verify that our results are not influenced by the attrition of hospital observations over the long-run horizon.

whether hospital i has been 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 are separate indicators for each pair of matched target and control hospitals. Including these fixed effects help us compare within a pair of treated and control hospitals. 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. We also include a multitude of hospital and county 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. Similar to existing studies (e.g., Schmitt, 2017; Gupta et al., 2021; Liu, 2021), we cluster standard errors by hospital.[9]

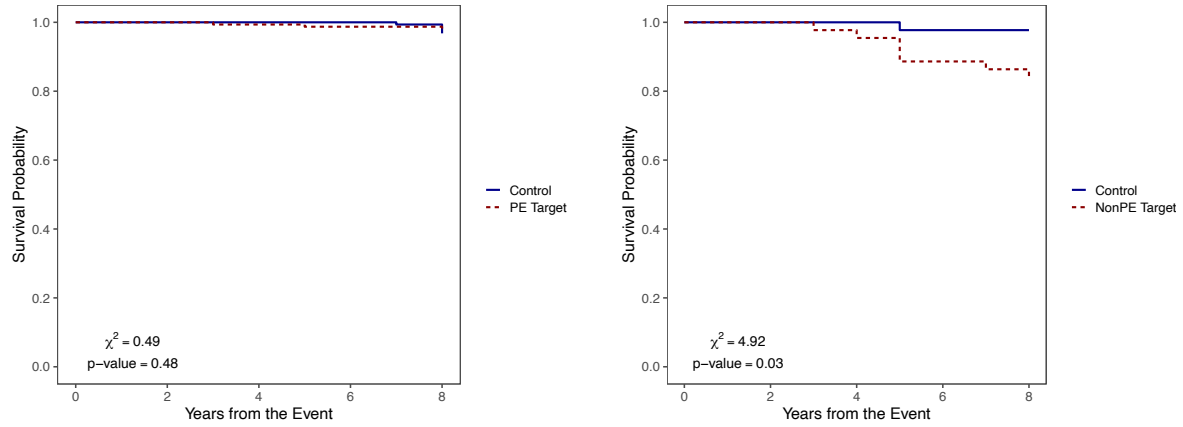
The coefficients of interest are β_1 and β_2, which measure how a target hospital changes subsequent to being acquired, compared to the concurrent changes in the conditions of its matched control hospital. We also report p-values from the Wald Chi-square test for $\beta_1 = \beta_2$, i.e., assessing whether the effects of PE and non-PE acquirers are statistically significantly different from each other.

4 Main Results

4.1 Hospital Survival and Profitability

There are concerns in the popular press that PE firms acquire hospitals, close them, and subsequently sell assets owned by those hospitals. To investigate the validity of such concerns using large scale data, we trace the survival likelihood of target and control hospitals in Figure 4. In Panel A (B), we compare the survival rates of PE (non-PE)-acquired hospitals and their matched control group. The lines indicate the survival rate of a hos-

[9]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 Targets (B) *Survival Analysis*, Non-PE Targets

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

pital from the acquisition event to the eighth year after the event. Higher values indicate that the hospital is more likely to remain open. The patterns suggest that PE-acquired hospitals are equally, if not 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 anecdotal claim that PE firms acquire hospitals with the purpose of closing them and profiting from the sale of their assets.

Next, we examine the profitability of acquired hospitals in Table 3. Profitability is measured by gross margins, operating income over total assets, and return on assets (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 2.5 percentage points, operating income by 5.4 percentage points and return on assets by 3.9 percentage points in the first four years after the acquisition. This profitability boost persists and further improves in the long run. Over the [5, 8]-year post event window, PE-acquired hospitals increase operating income by 7.4 percentage points, and ROA by 6.1 percentage points more than their control group. For context, we note that these magnitudes reflect the cumulative difference in hospital profitability between the pre-event years to the 8^{th} year after the

event. The year-to-year average change in profitability is thus around one percent. In contrast, hospitals taken over by non-PE acquirers do not exhibit any improvement in profitability over either horizon.

TABLE 3 ABOUT HERE

Overall, our results from the survival and profitability analyses are inconsistent with the narrative that PE firms acquire hospitals simply to shut them down and sell the assets in possession. Instead, they are consistent with the argument that PE firms provide management expertise to the acquired hospitals, allowing them to survive and improve, in line with the recent findings in Cohn et al. (2021) outside the hospital industry. These results are also informative regarding whether PE firms are short-term and myopic investors. Our observation that profitability improvement persists in the long run helps alleviate 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 with expertise in shaving off excess costs, we expect employment and total wage costs to decline at hospitals after PE acquisitions. Yet, the effects of PE firms on employment may not be uniform across worker types. On the one hand, PE firms may reduce core medical workers more than other workers, as core workers require higher wages. On the other hand, PE firms could retain core medical workers to sustain the quality of health care delivery, but cut administrative workers given the documented evidence that hospitals suffer from administrative inefficiency.

4.2.1 Total Employees and Wage Expenditures

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 em-

ployees, in columns (3) and (4), we examine the changes in the employee-to-patient ratio, and in columns (5) and (6), we look into total wage expenditures. Both total employment and total wages are in log terms, so the coefficients inform us of the percentage changes in these outcomes after acquisitions. For each outcome variable, we first present results over the short-term window ($[-4, -1]$ to $[0, +4]$-year windows), and then present effects from a longer horizon ($[-4, -1]$ to $[+5, +8]$-year windows).

TABLE 4 ABOUT HERE

We find a large and significant decline in employment at PE-acquired hospitals. After being acquired, the average PE target hospital reduces its employment by over 7% over the next four years, and the decline becomes even larger over the next four year period following the first event window. Consistently, we also find a significant decline in the employment-patient ratio and the total wage bills of target hospitals. In the four years after acquisitions, hospitals' wage costs decline by 7%. Over the next four years, wage costs decline further, reaching 11% lower than their pre-acquisition level.

We also find a reduction in employment and wages at non-PE targets, but the effects are barely statistically significant and economically smaller compared to PE targets. Over the [5, 8]-year window after acquisitions, employment at hospitals acquired by non-PE buyers is not significantly lower than its pre-acquisition levels.

Overall, our results suggest that PE acquirers undertake substantial employment cuts and generate wage savings at target hospitals. These findings are consistent with the improved profitability and survival rates at target hospitals, 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. First, we look at changes in the composition of employees, including core and administrative employees. Later in our analysis, we examine whether changes in the employee composition at target hospitals are reflected in patient outcomes, including mortality and readmission rates.

4.2.2 Employee Composition

According to the HCRIS reporting convention, hospital employees are classified into 53 different occupations, reflecting the complexity and multidimensionality of the services hospitals provide. Among these occupations, we focus on two types of hospital employees: core medical workers that include physicians, nurses, and pharmacists, and administrative workers. Core medical workers are critical at providing quality health care. While administrative employees support key administrative functions of hospitals such as finance and accounting, 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 an acquisition. Table 5 reports the results. Similar to total employment measures, we first look at the log number of core and administrative employees (Panel A), and then scale the number of core and administrative workers by the number of patients to gauge the extent to which a hospital has core medical workers and overhead staff to service patient needs (Panel B). 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 PE-acquired hospitals experience a temporary drop in the number of core workers by around 14% over the first event window. Notably, the effect dissipates over the second event window spanning from year 5 to year 8 following the acquisition. Comparing the core workers during this period to the pre-acquisition window, the difference is only 2% 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 as well.

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 14 basis points below its pre-acquisition levels.

Different from what we observe with core workers, we find a significant and persistent decline in administrative workers at PE-acquired hospitals. Within the first four years after PE acquisitions, the number of administrative workers drops by around 18% at acquired hospitals. The reduction aggravates in the next four years, staying at around 22%. In contrast, we do not observe a decline in administrative workers at non-PE targets across either measure or horizon we use.

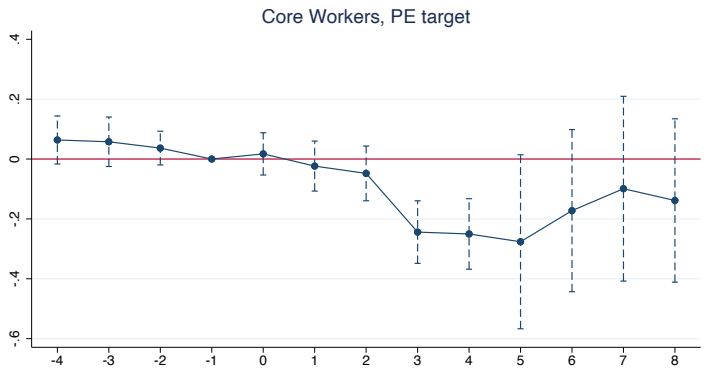
We next perform two refinements to our empirical design. First, we evaluate the concern that our results may be driven by changes in local conditions concurrent with PE acquisitions, such as the changes in local resident demographics, health conditions, income, or other preferences. These changes may drive hospital performance, employment, and even survival. We address this type of concerns by imposing state-year fixed effects in our baseline analysis. In Table 6, we find our results to be robust to including this stringent fixed effect structure.

TABLE 6 ABOUT HERE

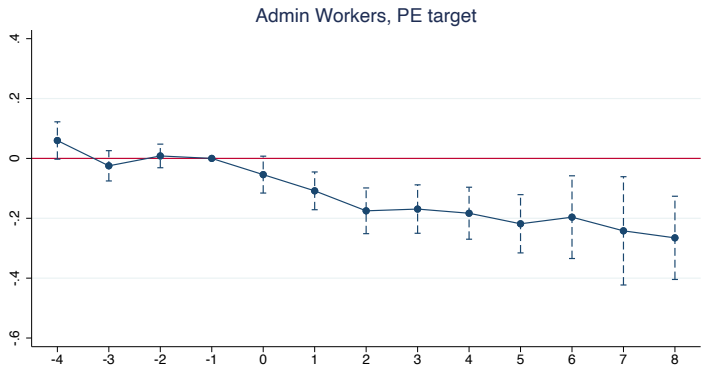
Second, we consider the possibility that our results may be biased by changes in sample composition over the event horizon. Note that this issue is alleviated by the inclusion of hospital fixed effects, which allow us to compare changes within the same hospital over time. We further address this concern by imposing more stringent sampling criteria, requiring each hospital to be in the sample for a minimum number of pre-event and post-event years. Appendix B shows that our results remain similar in these refined samples, despite the reduction in sample size.

4.3 Dynamic Effects of PE Acquisitions

We track how the number of core and administrative workers at PEs' target hospitals evolves over each year during our event horizon, compared to their matched control group. This examination allows us to infer when changes occur around the involvement of PE



(A) *Log(Core Workers)*



(B) *Log(Admin Workers)*

Figure 5. Dynamic Effect of PE Acquirers. This figure shows the changes in core workers and administrative workers for PE-acquired hospitals relative to their matched control hospitals over the [-4, +8]-year event window. The left panel represents outcomes for core workers, while the right panel reports outcomes for administrative workers. 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.

acquirers, and more importantly, evaluate whether PE buyers select hospitals based on their observable employment profiles. If they do, the changes in worker composition we document should start prior to the acquisition.

We track PE targets and their matched control hospitals over the [-4, +8] event horizon and require hospitals to have observations over the four years before and at least four years after the acquisition. With this sample, we extend the baseline regression model (Equation 1) by creating separate indicators of each year in the event horizon and interacting these indicators with *PE Target*. The estimation includes the same set of fixed effects and controls as in the baseline analysis, and further imposes state-by-year interactive fixed effects to help remove potential confounding effects from local conditions.

Figure 5 depicts the results. Panel A presents results for the log of total core workers,

and Panel B presents results for the log of total administrative workers. In each panel, the dots represent point estimates, surrounded by 95% confidence intervals. The year prior to the event (i.e., year -1) is omitted as the benchmark year. We do not observe any significant pre-event changes in either outcome for PE targets. After PE acquisitions, target hospitals experience a temporary dip in core workers, but this effect dissipates 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. Importantly, we observe that PE-acquired hospitals experience a sizable decline in the number of administrative employees, and this effect persists in the long run.

These observations lend further support to our baseline findings. Importantly, the lack of pre-event trend suggests that our results are unlikely to be driven exclusively by PEs targeting hospitals that already exhibit signs of change along these dimensions. The significant post-event effects are consistent with PE acquirers increasing the operating efficiency of the hospitals they acquire without excessively reducing core workers.

4.4 Wage Rates

Finally, we examine whether core and administrative workers are paid lower wages at PE-acquired hospitals. This examination helps us address possibilities such as PE acquirers may lay off some administrative workers but offer higher wages to remaining ones, or that they suppress the wages of core medical workers.

We compute the hourly wage rates for core and administrative workers separately. Wage rates are transformed to log terms, i.e., *Log(Core Wage Rate)* and *Log(Admin Wage Rate)*. From Table 7, we find no change to core workers' wage rate at PE-acquired hospitals. In contrast, administrative workers' wage rate declines. In the long-run window, the wage rate of administrative workers declines significantly by around 7% compared to its pre-acquisition level. These results are consistent with PE acquirers reducing the costs associated with administrative functions. We do not find such an effect at target hospitals of non-PE buyers.

TABLE 7 ABOUT HERE

5 Economic Mechanisms

In this section, we explore the heterogeneity of our results across deals to shed light on the economic mechanisms through which PE firms implement changes at target hospitals. We focus on three potential mechanisms. First, we examine the difference in post-acquisition outcomes based on whether a PE target hospital operated as a nonprofit or for-profit organization before being acquired. This investigation sheds light on whether PE firms create profit orientation and investor accountability in driving hospital performance. Second, we examine post-deal outcomes based on the extent to which a target hospital becomes a part of a larger system after being acquired. This helps us evaluate the role of scale economies in improving operating performance of a target hospital. Finally, we examine the role of PE firms' expertise in the healthcare industry based on their deal history in the healthcare industry.

5.1 For-Profit and Nonprofit Targets

Popular press has expressed concerns that PE firms acquire nonprofit hospitals and impose profit-orientation on their operations, and in some cases, they even downsize those hospitals significantly, compromising the provision of quality health care.[10] Meanwhile, others claim that PE firms improve the operating efficiency of nonprofit hospitals by creating accountability to investors. We formally evaluate these opposing views by comparing post-acquisition outcomes between targets that operated as for-profit and nonprofit organizations prior to being acquired. We focus on four outcomes, the log of total employment, total wage bill, core medical workers, and administrative workers. We regress each outcome on the interaction between the indicator for PE acquisition and targets' for-profit status prior to the deal. We also present statistics showing the difference between these interaction terms. We also include the indicator of non-PE acquisition, but suppress the coefficient for brevity.

Panel A of Table 8 reports results from this analysis. We note that both for-profit and nonprofit target hospitals experience significant declines in employment count and

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

total wage bills after being acquired, but the magnitudes of the declines are larger for nonprofit targets than for-profit ones over the first four-year window.

TABLE 8 ABOUT HERE

When we look into employee composition, we find that nonprofit targets 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 short-term decline at for-profit targets, but recovers in the longer term. For example, estimates in column (8) suggest that administrative workers decline by 36% at nonprofit targets over the [5, 8]-year window after PE acquisitions. This sizable reduction likely reflects the substantial restructuring efforts at nonprofit hospitals which did not have investor accountability prior to being acquired. This magnitude stands in contrast to the 10%, statistically insignificant reduction at for-profit targets over the same horizon. This finding reveals a novel role for PE firms in transforming non-profit organizations into for-profit ones, and improving their efficiency.

5.2 Economies of Scale

We next investigate whether PE acquirers create value from economies of scale by acquiring a hospital and including it in a larger hospital system. Over our sample period, PE firms build up significantly larger systems than non-PE buyers. A potential benefit of operating large systems is that hospitals can share resources and reduce overhead costs, for example, by combining finance, accounting and marketing functions of individual hospitals. (Andreyeva et al., 2022). We thus expect that, if a PE acquisition transforms a target hospital from a standalone status or from belonging to a small system into a larger system, the target hospital may experience greater cost reduction, especially in its administrative departments.

To test this hypothesis, we first measure the increase in system size for target hospitals after PE acquisitions. We track down the parent systems to which the target belongs before and after the acquisition and count the number of hospitals belonging to each

of those systems, and take the ratio between the two. Increases in system size is thus measured by:

$$\Delta System\ Size = \frac{\#Hospitals\ in\ System\ After\ Acquisition}{\#Hospitals\ in\ System\ Before\ Acquisition} - 1$$

We then define separate indicators *High* Δ*System Size* and *Low* Δ*System Size* for each deal, depending on whether Δ*System Size* exceeds the sample median. In Panel B of Table 8, we find that the effects of PE acquisitions are largely concentrated on targets that experience a large increase in system size. Those target hospitals exhibit significant reductions in employment, wage bills, and in particular, administrative workers. In the [5, 8]-year window after the events, these targets on average employ 30% fewer administrative workers than their pre-acquisition levels. While cost-cutting also occurs for deals where targets experience a smaller increase in system size, such changes are smaller in magnitude and often statistically insignificant.

5.3 Industry Expertise of PE Firms

In the last step of our cross-sectional analysis, we look into PE firms' expertise in the healthcare sector. Prior research documents that PE firms accumulate experience and develop expertise in an industry, which allows them to improve the operations of portfolio companies in that industry (Bernstein and Sheen, 2016). Hence, we expect PE buyers that are highly specialized in the healthcare industry to accumulate greater expertise and skills in restructuring hospitals. Such buyers should be associated with greater cost-cutting and larger reductions in administrative burden at target hospitals. We measure PE firms' industry expertise using the number of their past deals in healthcare over the total number of past deals they have completed.[11] This ratio is higher for PE firms that are highly focused on the healthcare industry.

Panel C of Table 8 provides evidence consistent with this conjecture. PE buyers with

[11] We utilize Capital IQ's MI Primary Industry classification and identify deals in the "Healthcare Facilities" industry. This industry includes hospitals, nursing homes, rehabilitation and retirement centers (https://www.spglobal.com/marketintelligence/en/documents/gics-mapbook-brochure.pdf).

greater specialization in the healthcare industry are associated with a greater reduction in total employment and wage bills as well as a substantial cut in administrative workers at target hospitals. In the long-run event horizon, administrative workers drop by 32% compared to the pre-event level at targets of specialized PE buyers, but only by around 18% for other PE buyers. Core workers at hospitals acquired by PE firms with greater healthcare specialization increase by the end of the longer event window, although not at a statistically significant level.Taken together, our findings highlight three mechanisms through which PE firms can improve the operations of portfolio hospitals: converting nonprofit hospitals into for-profit ones and hence, providing investor accountability, exploiting economies of scale, and leveraging on their industry expertise.

5.4 Additional Robustness Checks

In this section, we perform multiple additional analyses regarding the measures and sample we use to bolster our inferences.

First, we vary the definition of core medical workers. In our main analysis, core workers consist of physicians, nurses and pharmacists. 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 other full-time employees. To mitigate potential errors in measurement, we restrict our definition of core workers to only nurses and pharmacists. 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*). Table 9 shows that our results are robust to this alternative definition of core workers. As before, we observe that the number of nurses and pharmacists at PE-acquired hospitals 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. In contrast, at non-PE acquired hospitals, both the number and ratio of nurses and pharmacists experience a persistent and statistically significant decline subsequent to the acquisition. The initial decline does not reverse, but aggravates in the long run.

Table 9 About Here

Our second test explores alternative matching approaches. Our main matching method uses the total core workers and administrative workers during the year prior to the acquisition as key matching variables. In Appendix C, we switch our employment matching variable to total worker counts. Our results remain unchanged.

Third, we address the concern that control hospitals may be influenced by the spillover effects from the acquisition of local, peer hospitals by PE firms. For example, as PE firms cut employment at target hospitals, those employees losing their jobs may switch to other hospitals in the same region, leading to an increase in employment in the control units. In Appendix D, we address this concern in several ways. First, we delete all matched target-control pairs where the control hospital is located in the same hospital referral regions (HRR) as the target (Panel A). Next, we remove from our sample matched pairs where the control hospital is located in an HRR where over 25 percent (Panel B) or 5 percent (Panel C) of the hospitals have experienced an acquisition by PE acquirers. Our inferences remain unchanged in these alternative samples.

6 Patient Outcomes

Does PE acquirers' cost-cutting motive affect patient interest and well-being? To explore this question, we track the changes in patient outcomes at acquired hospitals, including mortality rates and readmission rates of discharged patients. We also look into if patient composition and the number of treated patients change at target hospitals.

6.1 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 and readmission rates are reported with 3-year rolling windows. In other words, for year 2007, we observe the cumulative mortality/readmission rates calculated based on data from 2005–2007. 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 $[t+4, t+6]$. We exclude the windows that straddle the year of the acquisition because patient outcomes in those windows reflect partly pre-event conditions and partly treatment effects.

Because the pre-event window does not overlap with post-event ones, we adopt a first-difference approach to examine the effect of an acquisition on patient mortality and readmission rates. For each post-event window, we compute the change in mortality rate for a given hospital 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. The first-difference approach allows us to directly measure the changes in mortality/readmission rates following hospitalization from pre-acquisition years to post-acquisition years. We do not require observations for the [-4, +8] event windows as in our earlier analysis to avoid further sample attrition.

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:

$$\Delta Y_{e,i,\tau} = \beta_1 PE\ Target_{e,i,\tau} + \beta_2 NonPE\ Target_{e,i,\tau} + \gamma \cdot \Delta X_{i,t} + \mu_e + \nu_{e,i,\tau}, \qquad (2)$$

where $\Delta Y_{e,i,\tau}$ represents the changes in mortality and readmission rates from the pre-event 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. In this specification, *PE Target* equals one for target hospitals of PE acquirers, and *NonPE Targets* indicates target hospitals of non-PE acquirers.

Table 10 reports the results from estimating Equation 2. We present coefficients from regressions with and without event fixed effects.

TABLE 10 ABOUT HERE

Panel A reports results regarding patient mortality. We do not find PE-acquired hospitals to exhibit significant increases in any of the three types of mortality rates we examine. There are mixed evidence regarding the effect of non-PE acquirers. While target hospitals of non-PE buyers have lower mortality rates regarding heart attacks compared to their control group, they also exhibit higher mortality rates related to heart failures. 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 0.9 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 along these dimensions. Overall our 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 Liu (2021) that there is no significant change in the service quality of PE target hospitals.

6.2 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.

We first examine changes in the operating scale of hospitals along several dimensions. Since the number of beds represent a hospital's capacity to treat patients, the change in the number of beds in target hospitals is the first measure we analyze. We then turn to the log number of patients, inferred based on outpatient charges and outpatient ratio (Section 2.2). Next, we consider the amount of revenue generated by target hospitals, measured by the log of gross sales as well as net sales, which is gross sales after deducting rebate and discounts offered to patients. Panel A of Table 11 reports the results. We do not find target hospitals to exhibit meaningful changes in operating scale after PE acquisitions. Importantly, we note that PE target hospitals do not generate significantly higher revenue, which suggests that the increased profitability documented in Table 3 likely arises from reduced costs.

Table 11 About Here

We next investigate the changes in the type of hospital operations, by examining the changes in case mix index, outpatient ratio, and the percentage of patients enrolled in Medicare or Medicaid programs. The CMI represents the diversity, clinical complexity, and resource needs of all the patients treated in a hospital. Atr PE target hospitals, the CMI increases over the four years following the acquisitions, suggesting that PE-acquired hospitals treat a higher number of resource-intensive patients. Outpatient ratio, on the other hand, declines significantly. Because outpatient procedures are a more cost efficient source of revenue for hospitals, a declining ratio suggests that PE acquired hospitals do not shift their operations to outpatient services to generate revenue at lower costs compared to other hospitals.

Finally, we find that PE-acquired hospitals experience a small decline (by 1 percentage point) in the proportion of Medicare patients, but this effect dissipates over the 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 the operating scale or patient composition at PE targets. While we do not have information regarding individual patient characteristics, we provide several arguments alleviating the concern that our results on patient outcomes 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.

7 Conclusion

Hospitals are an important sector of the economy. They not only provide essential healthcare, but are also key job providers in the U.S. As PE firms are increasingly involved in the hospital industry, in-depth research is needed to understand how such activity affects jobs, efficiency and patient outcomes at acquired hospitals.

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 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.

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.

Overall, our evidence suggests that PE acquirers improve the operating efficiency of target hospitals without a compromise in healthcare quality. Targets of non-PE acquirers do not exhibit the same improvement in their operating efficiency. Thus, our analysis reveals a unique role of PE investors in shaping the hospital industry.

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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***
Log(Admin Workers)	4.28	4.11	−0.16***
Admin Workers/Patients (×100)	0.99	0.64	−0.34***
Log(Total Wages)	17.07	17.10	0.03
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
Employment	4,332	882.86	659.89	706.23	445.30	1113.63
Log(Employment)	4,332	6.55	0.70	6.56	6.10	7.02
Core Workers	4,332	73.39	91.91	48.53	26.91	86.27
Log(Core Workers)	4,332	3.89	0.90	3.90	3.33	4.47
%Core Workers	4,332	0.16	0.08	0.15	0.11	0.20
Core Workers/Patients (×100)	4,330	0.49	0.40	0.38	0.28	0.57
Admin Workers	4,332	90.96	69.69	72.20	45.42	113.49
Log(Admin Workers)	4,332	4.29	0.68	4.29	3.84	4.74
%Admin Workers	4,332	0.24	0.09	0.23	0.16	0.30
Admin Workers/Patients (×100)	4,330	0.68	0.36	0.63	0.41	0.86
Total Wages (mil.$)	4,340	49.18	40.49	38.31	21.73	61.53
Log(Total Wages)	4,340	17.41	0.81	17.46	16.89	17.94
Core Wage Rate ($/hr)	4,251	43.83	11.69	41.86	35.94	48.87
Admin Wage Rate ($/hr)	4,203	26.97	7.27	26.11	21.54	31.75
Mortality for Heart Attack (AMI)	1,667	15.32	1.71	15.20	14.00	16.30
Mortality for Heart Failure	1,848	11.23	1.54	11.00	10.00	12.10
Mortality for Pneumonia	1,853	12.18	2.55	11.70	10.20	13.60
Readmission for Heart Attack (AMI)	1,275	18.78	1.73	19.00	17.60	20.00
Readmission for Heart Failure	1,577	23.91	2.09	24.00	22.40	25.40
Readmission for Pneumonia	1,580	17.98	1.58	18.00	16.90	19.00
Beds	4,358	184.22	120.50	160.00	101.00	235.00
CMI	4,323	1.38	0.21	1.37	1.25	1.52
%Medicare	4,358	0.38	0.13	0.38	0.28	0.46
%Medicaid	4,358	0.15	0.11	0.12	0.06	0.20
%Outpatient	4,357	0.42	0.14	0.40	0.31	0.53

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 (as given in HCRIS) over net patient revenues (as given in HCRIS). The dependent variable for columns (3) and (4) is *OI/TA*, which is net income from service to patients (as given in HCRIS) over total assets. The dependent variable for Column (5) and (6) is *ROA*, which is net income (total income−total other expenses, as given in HCRIS) over total assets. *PE Target* turns to one after a hospital is acquired by a PE acquirer. *Non-PE Target* turns to one after a hospital is acquired by a non-PE acquirer. 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 Target	0.0247**	0.0388	0.0542***	0.0739**	0.0386***	0.0605**
	(2.32)	(1.60)	(3.43)	(1.98)	(2.80)	(2.08)
NonPE Target	0.0365	0.0489	0.0238	0.0050	−0.0183	−0.0086
	(1.61)	(1.29)	(0.66)	(0.10)	(−0.75)	(−0.25)
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=NonPE	0.61	0.81	0.42	0.23	0.03	0.10
Obs	4,296	2,575	4,288	2,569	4,288	2,569
Adj. R^2	0.62	0.62	0.61	0.57	0.58	0.50

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 total employees 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). The dependent variable in column (5) and (6) is the log of total wages. *PE Target* turns to one after a hospital is acquired by a PE acquirer. *Non-PE Target* turns to one after a hospital is acquired by a non-PE acquirer. 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)*		*Employment/Patients*		*Log(Total Wages)*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-Event Window	$[0,4]$	$[5,8]$	$[0,4]$	$[5,8]$	$[0,4]$	$[5,8]$
PE Target	-0.0697^{***}	-0.0974^{**}	-0.0040^{***}	-0.0052	-0.0708^{***}	-0.1073^{**}
	(-4.68)	(-2.37)	(-3.56)	(-1.54)	(-3.85)	(-2.32)
NonPE Target	-0.0296	0.0085	-0.0006	-0.0030	-0.0639^{*}	-0.0109
	(-0.92)	(0.13)	(-0.20)	(-0.70)	(-1.91)	(-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=NonPE	0.21	0.13	0.24	0.63	0.84	0.19
Obs	4,305	2,581	4,304	2,581	4,305	2,581
Adj. R^2	0.98	0.97	0.84	0.82	0.98	0.98

Table 5
Core and Administrative Workers at Target 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 columns (1) and (2) is the log of total number of core workers, i.e., *Log(Core Workers)*. The dependent variable for columns (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. The number of patients is estimated by adjusted discharges, defined as the number of discharged inpatients multiplied by (1+outpatient charges/inpatient charges). *PE Target* turns to one after a hospital is acquired by a PE acquirer. *Non-PE Target* turns to one after a hospital is acquired by a non-PE acquirer. 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 Target	−0.1358***	−0.0200	−0.1792***	−0.2200***
	(−4.24)	(−0.24)	(−6.42)	(−3.68)
NonPE Target	−0.2041***	−0.2484	−0.0293	−0.0073
	(−2.74)	(−1.51)	(−0.51)	(−0.06)
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=NonPE	0.35	0.20	0.01	0.10
Obs	4,306	2,581	4,303	2,579
Adj. R^2	0.91	0.90	0.92	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 Target	−0.0006***	−0.0003	−0.0010***	−0.0015***
	(−3.63)	(−0.74)	(−4.89)	(−2.96)
NonPE Target	−0.0006*	−0.0014**	0.0000	−0.0005
	(−1.87)	(−2.29)	(0.12)	(−0.58)
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=NonPE	0.94	0.10	0.02	0.22
Obs	4,305	2,581	4,302	2,579
Adj. R^2	0.78	0.78	0.82	0.79

Table 6
Core and Administrative Workers, Controlling for Local Conditions
This table examines changes in core workers and administrative workers at target hospitals, while controlling for state-by-year interactive fixed effects. Panel A reports the results for the number of core and administrative workers. The dependent variable for columns (1) and (2) is the log of total number of core workers, i.e., *Log(Core Workers)*. The dependent variable for columns (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. The number of patients is estimated by adjusted discharges, defined as the number of discharged inpatients multiplied by (1+outpatient charges/inpatient charges). *PE Target* turns to one after a hospital is acquired by a PE acquirer. *Non-PE Target* turns to one after a hospital is acquired by a non-PE acquirer. 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 Target	−0.1330***	−0.0512	−0.1494***	−0.2673***
	(−3.85)	(−0.49)	(−4.54)	(−3.73)
NonPE Target	−0.1926***	−0.1847	−0.0272	0.0698
	(−2.61)	(−1.14)	(−0.49)	(0.55)
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
State-by-Year FEs	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.44	0.44	0.03	0.01
Obs	4,263	2,530	4,260	2,528
Adj. R^2	0.91	0.90	0.93	0.92

(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 Target	−0.0005***	0.0000	−0.0007***	−0.0012**
	(−2.72)	(0.02)	(−3.03)	(−2.10)
NonPE Target	−0.0006*	−0.0016**	−0.0001	−0.0004
	(−1.83)	(−2.34)	(−0.15)	(−0.50)
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
State-by-Year FEs	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.70	0.05	0.16	0.35
Obs	4,262	2,530	4,259	2,528
Adj. R^2	0.79	0.78	0.83	0.81

Table 7
Wage Rates for Core and Administrative Workers at Target 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 Target* turns to one after a hospital is acquired by a PE acquirer. *Non-PE Target* turns to one after a hospital is acquired by a non-PE acquirer. 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 Target	0.0097	−0.0358	−0.0000	−0.0731***
	(0.76)	(−1.08)	(−0.00)	(−2.60)
NonPE Target	−0.0376	0.0362	−0.0233	−0.0338
	(−1.47)	(0.72)	(−0.96)	(−0.75)
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=NonPE	0.07	0.17	0.35	0.39
Obs	4,216	2,526	4,143	2,493
Adj. R^2	0.70	0.70	0.80	0.77

Table 8
Heterogeneity of Effects

This table presents heterogeneity of our results across target and acquirer characteristics. Panel A compares the results between for-profit and nonprofit targets, Panel B compares between PE acquirers with larger and smaller hospital systems, and Panel C examines the differential effects for PE acquires that are more or less specialized in the healthcare industry. In each panel, we report the results for the log of total employment (columns (1) and (2)), log of total wages (columns (3) and (4)), the log of core medical workers (columns (5) and (6)), and the log of administrative workers (columns (7) and (8)) at target hospitals around acquisitions. Target hospital for-profit status is characterized based on its status prior to the acquisition. Acquirer size is characterized based on the ratio of the number of hospitals in the system after the acquisition scaled by the number of hospitals in the target's previous system before the acquisition. *High (Low) Increase in System Size* equals one if after acquisition, this relative size ratio is higher (lower) than the sample median across all acquisitions. PE expertise is characterized based on the ratio of a PE firm's acquisitions in the healthcare facilities industry over total acquisitions up to the event year. *High (Low) Healthcare Expertise* equals one if a hospital is acquired by a private equity firm with above-median (below-median) expertise ratio in healthcare industry. 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) For-profit vs. Nonprofit Targets

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.1379***	−0.1361**	−0.1816***	−0.1593**	−0.0814	0.0444	−0.2070***	−0.3627***
× *Nonprofit Target*	(−5.06)	(−2.13)	(−5.81)	(−2.19)	(−1.25)	(0.35)	(−3.29)	(−5.32)
PE Target	−0.0504***	−0.0651	−0.0393**	−0.0639	−0.1513***	−0.0739	−0.1714***	−0.1037
× *For-profit Target*	(−3.38)	(−1.53)	(−2.12)	(−1.38)	(−4.67)	(−0.83)	(−6.29)	(−1.36)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: For-Profit=Nonprofit	0.00	0.30	0.00	0.21	0.28	0.40	0.57	0.00
Obs	4,305	2,581	4,305	2,581	4,306	2,581	4,303	2,579
Adj. R^2	0.98	0.97	0.98	0.98	0.91	0.90	0.92	0.91

(B) High vs. Low Increase in System Size

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0704***	−0.1573***	−0.0694***	−0.1758***	−0.1497***	−0.0769	−0.1889***	−0.3002***
× *High ΔSystem Size*	(−4.56)	(−2.89)	(−3.70)	(−2.88)	(−4.50)	(−0.65)	(−6.50)	(−4.32)
PE Target	−0.0436*	−0.0324	−0.0411	−0.0332	−0.0759	0.0411	−0.0873*	−0.1332
× *Low ΔSystem Size*	(−1.89)	(−0.65)	(−1.35)	(−0.58)	(−1.15)	(0.44)	(−1.88)	(−1.64)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: High=Low	0.22	0.06	0.32	0.05	0.27	0.38	0.03	0.08
Obs	4,281	2,557	4,281	2,557	4,282	2,557	4,279	2,555
Adj. R^2	0.98	0.97	0.98	0.98	0.91	0.90	0.92	0.91

(C) High vs. Low Healthcare Expertise

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0533***	−0.1949***	−0.0366*	−0.1925***	−0.1660***	0.3752	−0.2040***	−0.3181***
× *High Healthcare Expertise*	(−3.25)	(−3.92)	(−1.87)	(−4.04)	(−4.84)	(1.28)	(−7.39)	(−5.95)
PE Target	−0.0955***	−0.0558	−0.1245***	−0.0594	−0.0884*	−0.0221	−0.1399***	−0.1830***
× *Low Healthcare Expertise*	(−4.96)	(−1.35)	(−5.18)	(−1.27)	(−1.89)	(−0.28)	(−3.21)	(−2.89)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: High=Low	0.03	0.01	0.00	0.01	0.11	0.16	0.13	0.04
Obs	4,305	2,581	4,305	2,581	4,306	2,581	4,303	2,579
Adj. R^2	0.98	0.97	0.98	0.98	0.91	0.90	0.92	0.91

Table 9
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 dependent variable for columns (5) and (6) is *Log(Nurses & Pharma Wage Rate)*, the log of hourly wage rate for nurses and pharmacists. *PE Target* turns to one after a hospital is acquired by a PE acquirer. *Non-PE Target* turns to one after a hospital is acquired by a non-PE acquirer. 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*		*Log(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 Target	−0.1136***	0.0088	−0.0002***	−0.0000	−0.0005	0.0002
	(−3.62)	(0.12)	(−3.32)	(−0.10)	(−0.04)	(0.01)
NonPE Target	−0.1866***	−0.3955***	−0.0004***	−0.0009***	−0.0236	−0.0050
	(−3.30)	(−2.67)	(−2.72)	(−2.93)	(−1.40)	(−0.19)
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=NonPE	0.22	0.01	0.22	0.01	0.17	0.86
Obs	4,292	2,571	4,291	2,571	4,153	2,495
Adj. R^2	0.91	0.93	0.78	0.78	0.76	0.79

Table 10
Mortality and Readmission Rates at Target Hospitals

This table examines the mortality and readmission rates at 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 Target	−0.2759	0.1875	−0.0632	−0.1858	0.2189	0.3028
	(−0.73)	(0.52)	(−0.15)	(−0.52)	(0.39)	(0.65)
NonPE Target	−0.9067*	−1.7223***	0.6163	0.8328*	0.9204	0.6212
	(−1.70)	(−3.36)	(1.36)	(1.84)	(1.18)	(0.96)
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=NonPE	0.32	0.01	0.23	0.08	0.39	0.68
Obs	202	201	252	251	253	253
Adj. R^2	0.14	0.50	0.06	0.36	0.09	0.46

(B) Changes in Readmission

Dep. Var.:	*Heart Attack (AMI)*		*Heart Failure*		*Pneumonia*	
	(1)	(2)	(3)	(4)	(5)	(6)
PE Target	0.3398	0.0409	0.2521	0.3993	0.0483	−0.0468
	(0.73)	(0.09)	(0.50)	(1.16)	(0.11)	(−0.11)
NonPE Target	0.3065	0.4724	0.0219	0.2061	−0.5590	−0.9205*
	(0.56)	(1.09)	(0.04)	(0.57)	(−1.11)	(−1.90)
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=NonPE	0.95	0.47	0.68	0.67	0.21	0.16
Obs	144	142	199	198	200	200
Adj. R^2	0.13	0.61	0.18	0.67	0.08	0.38

Table 11
Size and Operating Characteristics at Target Hospitals

This table examines changes in scale and operating characteristics at target hospitals around acquisitions. Panel A examines hospitals operating scale, measured by the log number of beds, patients, and sales. Panel B examines the composition of hospitals patients or operations, measured by case mix index, outpatient ratio, and the percentage of Medicare and Medicaid patients. 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) Hospital Operating Scale

Dep. Var.:	*Log(Beds)*		*Log(Patients)*		*Log(Gross Patient Sales)*		*Log(Net Patient Sales)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0076	−0.0473	−0.0115	−0.0815	0.0173	−0.0245	−0.0287	−0.0167
	(−0.42)	(−0.88)	(−0.53)	(−1.02)	(0.74)	(−0.35)	(−1.14)	(−0.23)
NonPE Target	−0.0576**	−0.0211	−0.0551	−0.0117	−0.0747*	0.0078	−0.0841**	0.0433
	(−2.40)	(−0.36)	(−1.24)	(−0.13)	(−1.96)	(0.08)	(−2.25)	(0.44)
Hospital Controls								
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.0316	0.6890	0.3087	0.4929	0.0165	0.7608	0.1287	0.5892
Obs	4,378	2,622	4,376	2,621	4,368	2,615	4,368	2,615
Adj. R^2	0.9657	0.9547	0.9528	0.9466	0.9792	0.9675	0.9668	0.9531

(B) Hospital Operation and Patient Composition

Dep. Var.:	*CMI*		*Outpatient Ratio*		*%Medicare*		*%Medicaid*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	0.0165**	0.0301	−0.0198***	−0.0251*	−0.0120**	0.0009	−0.0028	−0.0014
	(2.05)	(1.33)	(−3.63)	(−1.83)	(−1.97)	(0.06)	(−0.45)	(−0.08)
NonPE Target	−0.0176	−0.0056	−0.0047	−0.0114	0.0084	0.0171	−0.0062	−0.0287
	(−1.32)	(−0.21)	(−0.54)	(−0.83)	(1.03)	(0.98)	(−0.67)	(−1.59)
Hospital Controls								
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.0119	0.2379	0.0638	0.3173	0.0083	0.3751	0.7135	0.2063
Obs	4,330	2,594	4,377	2,621	4,378	2,622	4,378	2,622
Adj. R^2	0.9058	0.8896	0.9392	0.9299	0.8971	0.8772	0.7974	0.7515

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 physicians), 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).
- *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 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 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).
- *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 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 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).
- *Log(Nurses & Pharma)*: 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).
- *Nurses & Pharma/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 & Pharma 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 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 pa-

tients 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 Target*: An indicator variable that turns to one for a target hospital after it is acquired by a PE firm or a PE-backed hospital.
- *NonPE Target*: 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 in a given year.

Appendix B Robustness Check: Balanced Panel Over Event Windows

Table B1
Requiring Hospital Observations Throughout Event Window.
This table reports results when we impose additional requirement for hospital observations during our event window. Panel A presents results when we require both target and control hospitals to have observations in each year of the $[-2, +2]$-year event window. In Panel B, we require both target and control hospitals to have observations in each year of the $[-2, +4]$-year event window. In Panel C, we require both target and control hospitals to have observations in each year of the $[-2, +6]$-year event window. In Panel D, we require both target and control hospitals to have observations in each year of the $[-2, +8]$-year event window. In Panel E, we require both target and control hospitals to have observations in each year of the $[-4, +6]$-year event window. In Panel F, we require both target and control hospitals to have observations in each year of the $[-4, +8]$-year event window. Controls 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) Requiring Observations Throughout $[-2, +2]$

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$
PE Target	-0.0711^{***}	-0.1108^{***}	-0.0733^{***}	-0.1243^{***}	-0.1426^{***}	-0.0599	-0.1799^{***}	-0.2193^{***}
	(-4.73)	(-2.73)	(-3.95)	(-2.75)	(-4.46)	(-0.73)	(-6.40)	(-3.62)
NonPE Target	-0.0325	0.0049	-0.0663^{*}	-0.0157	-0.1936^{***}	-0.2528	-0.0317	-0.0103
	(-0.99)	(0.07)	(-1.95)	(-0.23)	(-2.60)	(-1.54)	(-0.54)	(-0.09)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.24	0.10	0.84	0.14	0.49	0.27	0.01	0.10
Obs	4,223	2,515	4,223	2,515	4,223	2,515	4,223	2,515
Adj. R^2	0.98	0.97	0.98	0.98	0.91	0.90	0.92	0.91

(B) Requiring Observations Throughout $[-2, +4]$

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0684***	−0.0984**	−0.0705***	−0.1144***	−0.1471***	−0.0738	−0.1804***	−0.2246***
	(−4.25)	(−2.58)	(−3.55)	(−2.74)	(−4.30)	(−0.96)	(−5.93)	(−3.68)
NonPE Target	−0.0496	0.0038	−0.0808**	−0.0217	−0.2005**	−0.2558	−0.0552	−0.0647
	(−1.54)	(0.06)	(−2.22)	(−0.31)	(−2.42)	(−1.50)	(−0.87)	(−0.54)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.56	0.14	0.78	0.20	0.51	0.31	0.05	0.21
Obs	3,748	2,213	3,748	2,213	3,748	2,213	3,748	2,213
Adj. R^2	0.98	0.98	0.98	0.98	0.91	0.90	0.92	0.91

(C) Requiring Observations Throughout $[-2, +6]$

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0851***	−0.0921**	−0.0730**	−0.1122**	−0.1282**	−0.0773	−0.1510***	−0.2133***
	(−2.97)	(−2.20)	(−2.34)	(−2.41)	(−2.26)	(−0.95)	(−3.40)	(−3.16)
NonPE Target	−0.0108	0.0290	−0.0272	−0.0013	−0.2021	−0.2715	−0.0553	−0.0397
	(−0.27)	(0.44)	(−0.64)	(−0.02)	(−1.60)	(−1.54)	(−0.77)	(−0.32)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.09	0.08	0.31	0.12	0.57	0.30	0.23	0.19
Obs	1,247	1,024	1,247	1,024	1,247	1,024	1,247	1,024
Adj. R^2	0.98	0.96	0.98	0.97	0.90	0.87	0.92	0.88

(D) Requiring Observations Throughout $[-2, +8]$

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0705**	−0.1028**	−0.0702*	−0.1316**	−0.0983	−0.0175	−0.1652***	−0.2464***
	(−2.19)	(−2.16)	(−1.93)	(−2.38)	(−1.49)	(−0.17)	(−2.83)	(−2.81)
NonPE Target	−0.0123	−0.0546	−0.0196	−0.0909	−0.1288	−0.3629	−0.1168	−0.2379
	(−0.21)	(−0.97)	(−0.36)	(−1.25)	(−0.59)	(−1.39)	(−1.08)	(−1.44)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.33	0.35	0.36	0.55	0.89	0.21	0.68	0.96
Obs	733	648	733	648	733	648	733	648
Adj. R^2	0.98	0.97	0.99	0.98	0.90	0.88	0.92	0.89

(E) Requiring Observations Throughout $[-4, +6]$

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.1262***	−0.1287**	−0.1042**	−0.1431**	−0.1455**	−0.1132	−0.1950***	−0.2640***
	(−3.19)	(−2.46)	(−2.52)	(−2.54)	(−1.99)	(−0.99)	(−3.58)	(−3.39)
NonPE Target	−0.0478	0.0159	−0.0812*	−0.0561	−0.3355***	−0.4207*	−0.1001	−0.1223
	(−1.09)	(0.17)	(−1.75)	(−0.60)	(−2.66)	(−1.76)	(−1.12)	(−0.72)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.13	0.12	0.65	0.34	0.17	0.23	0.35	0.42
Obs	723	587	723	587	723	587	723	587
Adj. R^2	0.97	0.95	0.98	0.97	0.89	0.84	0.91	0.84

(F) Requiring Observations Throughout $[-4, +8]$

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$	$[0, 4]$	$[5, 8]$
PE Target	-0.1118^{**}	-0.1418^{**}	-0.0915^{*}	-0.1594^{**}	-0.0824	-0.1338	-0.1930^{***}	-0.2326^{**}
	(-2.60)	(-2.36)	(-1.75)	(-2.24)	(-0.89)	(-1.00)	(-2.87)	(-2.16)
NonPE Target	-0.0771^{**}	-0.1425^{*}	-0.0859^{**}	-0.2493^{***}	-0.5012^{***}	-0.8851^{***}	-0.1608	-0.4318
	(-2.06)	(-1.89)	(-2.04)	(-3.57)	(-3.07)	(-2.83)	(-0.92)	(-1.46)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.42	0.99	0.88	0.09	0.03	0.03	0.87	0.52
Obs	371	326	371	326	371	326	371	326
Adj. R^2	0.98	0.97	0.99	0.98	0.91	0.89	0.90	0.83

Appendix C Alternative Matching

Table C1
Matching Based on Total Employment Count
This table shows the robustness of our main results when we match target hospitals to control hospitals based on pre-event *Log(Employment)*. Controls 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(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0787***	−0.1209***	−0.0727***	−0.1266***	−0.1517***	−0.0666	−0.1401***	−0.1607**
	(−5.18)	(−3.15)	(−4.02)	(−3.06)	(−4.30)	(−0.75)	(−4.51)	(−2.52)
NonPE Target	−0.0521	−0.0485	−0.0795**	−0.0741	−0.2091***	−0.2423	−0.0088	0.0104
	(−1.62)	(−0.74)	(−2.41)	(−1.10)	(−2.78)	(−1.62)	(−0.15)	(0.09)
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Event Time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.41	0.31	0.84	0.46	0.43	0.27	0.02	0.16
Obs	4,375	2,612	4,375	2,612	4,375	2,612	4,373	2,610
Adj. R^2	0.98	0.97	0.98	0.98	0.91	0.89	0.92	0.91

Appendix D Robustness Check: Spillover Effects of Local Mergers

Table D1
Alleviating Concerns Regarding the Spillover Effects of Local Mergers.
This table provides results from analysis to alleviate concerns regarding the spillover effects of local mergers. In Panel A, we drop matched pairs where the control hospital is located in the same HRR as the target hospital. In Panel B, we drop matched pairs where the control hospital is located in an HRR where over 25% of hospitals in that region are acquired by PEs over the $[-4, +8]$-year event period. In Panel C, we drop matched pairs where the control hospital is located in an HRR where 5% of hospitals are acquired by PEs over the $[-4, +8]$-year event period. Controls 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) Dropping Pairs with Control Located in the Same HRR as Target

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0662***	−0.0810*	−0.0677***	−0.0961*	−0.1378***	−0.0493	−0.1860***	−0.1783***
	(−4.29)	(−1.77)	(−3.58)	(−1.88)	(−4.14)	(−0.54)	(−6.51)	(−2.84)
NonPE Target	−0.0525	−0.0729	−0.0878**	−0.0935	−0.2380***	−0.3698*	−0.0467	−0.0953
	(−1.51)	(−1.47)	(−2.46)	(−1.55)	(−2.76)	(−1.86)	(−0.73)	(−0.75)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.69	0.89	0.57	0.97	0.24	0.13	0.03	0.54
Obs	3,832	2,263	3,832	2,263	3,833	2,263	3,830	2,261
Adj. R^2	0.98	0.98	0.98	0.98	0.91	0.91	0.93	0.92

(B) Dropping Pairs with Control Located in HRR over 25% of PE-Acquired Hospitals

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0764***	−0.0592	−0.0784***	−0.0687	−0.1557***	−0.0438	−0.1951***	−0.2067***
	(−4.75)	(−1.51)	(−3.94)	(−1.52)	(−4.55)	(−0.55)	(−6.86)	(−3.29)
NonPE Target	−0.0473	0.0127	−0.0761**	−0.0085	−0.2338***	−0.2687	−0.0444	−0.0124
	(−1.62)	(0.19)	(−2.33)	(−0.12)	(−3.13)	(−1.63)	(−0.77)	(−0.10)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.32	0.30	0.95	0.41	0.30	0.20	0.01	0.13
Obs	3,846	2,313	3,846	2,313	3,847	2,313	3,844	2,311
Adj. R^2	0.98	0.97	0.98	0.98	0.91	0.90	0.92	0.91

(C) Dropping Pairs with Control Located in HRR over 5% of PE-Acquired Hospitals

Dep. Var.:	*Log(Employment)*		*Log(Total Wages)*		*Log(Core Workers)*		*Log(Admin Workers)*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Event Window	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]	[0, 4]	[5, 8]
PE Target	−0.0719***	−0.0811	−0.0770***	−0.1153**	−0.1965***	−0.0793	−0.2361***	−0.1877**
	(−3.92)	(−1.62)	(−3.24)	(−2.24)	(−4.17)	(−0.81)	(−7.52)	(−2.45)
NonPE Target	−0.0704**	−0.0684	−0.1118***	−0.0995	−0.3411***	−0.2635**	−0.0303	0.0143
	(−2.00)	(−1.17)	(−2.66)	(−1.31)	(−4.42)	(−1.98)	(−0.36)	(0.12)
Controls and Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H_0: PE=NonPE	0.97	0.85	0.42	0.84	0.06	0.23	0.01	0.13
Obs	2,191	1,308	2,191	1,308	2,192	1,308	2,190	1,307
Adj. R^2	0.98	0.98	0.98	0.98	0.91	0.92	0.93	0.92

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