Private Equity, Consumers, and Competition: Evidence from the Nursing Home Industry*

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This Version: August 5, 2020
Initial Version: May 20, 2019

Abstract

This paper studies the impact of private equity (PE) acquisitions on quality of care in U.S. nursing homes. To do this, we examine 77 PE deals covering 1451 nursing homes between 1993 and 2017. We find significant heterogeneity in the effect of PE ownership according to levels of local market concentration. In highly competitive markets, PE owners increase staffing by $72,501 worth of care annually, while in less competitive markets they reduce staffing by an average of $18,604. These results suggest that PE owners are more sensitive to competitive incentives than non-PE owners. Policymakers concerned about the potential adverse effects of PE ownership on consumer stakeholders should therefore pay careful attention to whether acquisitions occur in concentrated markets. We further show that PE-owned nursing homes respond more strongly to policies intended to spur competition. We study the introduction of the Five-Star Quality Rating System, a policy that increased the salience of staffing for consumers. Following its introduction, PE-owned facilities increased their staffing by an average of $77,063 worth of care more than their non-PE counterparts. Moreover, PE managers more aggressively shift their staffing composition towards registered nurses (RNs) in response to the rating system's emphasis on RN staffing. Taken together, the effect of market concentration and pro-competition policies are substantial. PE owners in highly competitive markets under the five-star system raise staffing expenditure by 3.6% of the mean, or enough to raise RN staffing by 18% of the mean. In contrast, acquisitions in less competitive markets prior to the five-star system lowered staffing expenditure by 4.3% of the mean, cost-equivalent to reducing RN staffing by 21% of the mean.

*We thank Manuel Adelino, Victor Bennett, Paul Eliason, David Grabowski, John Graham, Nathan Hipsman, Filippo Mezzanotti, Manju Puri, and David Robinson for valuable discussions. In addition, we appreciate helpful feedback and comments from the participants of the 2019 Private Equity Research Symposium as well as seminar participants at Duke's Fuqua School of Business. Chase McDonald and Huizi Yu provided excellent research assistance. Ashvin Gandhi gratefully acknowledges financial support from the Fink Center for Finance & Investments.

1 Introduction

The private equity (PE) industry has grown more than eightfold in the last two decades, reaching a record $3.9 trillion of asset value in 2019 (McKinsey & Company, 2020). This growth has persisted in spite of an overwhelmingly negative public perception that PE firms prioritize short-term returns over other shareholders and stakeholders, such as customers and employees. The narrative of PE as insidious pervades media coverage, with headlines like "This Is Your Life, Brought to You by Private Equity" (Daniel et al., 2016) and "What is private equity, and why is it killing everything you love?" (Stewart, 2020). In addition, many legislators and regulators share these concerns. For example, in November 2019, the House Financial Services Committee held a hearing entitled "America for Sale? An Examination of the Practices of Private Funds" to discuss "whether Congress should take action to prevent the predatory practices of some private equity firms."

In contrast to the public consensus, the academic literature offers mixed evidence regarding the impact of PE on stakeholders. Prior work has shown PE ownership to improve food safety (Bernstein and Sheen, 2016), workplace safety (Cohn, Nestoriak and Wardlaw, 2019), and product offerings (Fracassi, Previtero and Sheen, 2019). Even though PE firms often do destroy jobs, losses are largely offset by productive reallocation and new job creation (Davis et al., 2014). On the other hand, PE firms have also been shown to raise prices (Chevalier, 1995) and lower quality (Matsa, 2011) in supermarkets, as well as in higher education, an industry where PE firms exploit large government subsidies and the opacity of product quality (Eaton, Howell and Yannelis, 2019). In this paper, we revisit the question of whether PE harms other stakeholders. Specifically, we examine how competition shapes the effects of PE ownership on consumers.

Unlike the literature examining consumer outcomes, the literature studying the impact of PE ownership on operating performance is in greater agreement. PE owners have been consistently shown to improve targets' productivity (Lichtenberg and Siegel, 1990; Harris, Siegel and Wright, 2005; Davis et al., 2014), valuation (Kaplan, 1989), performance metrics (Bergström, Grubb and Jonsson, 2007; Boucly, Sraer and Thesmar, 2011), innovation success (Lerner, Sorensen and Strömberg, 2011) and management practices (Bloom, Sadun and Van Reenen, 2015). Another important dimension of managerial quality is responsiveness to competitive incentives. For example, a recent literature has shown that many firms inadequately adjust their policies in response to competitors (DellaVigna and Gentzkow, 2019; Arcidiacono et al., 2020). We may therefore expect that PE owners also improve operations by tailoring targets' policies to local market competition.

We find that PE owners are more responsive to competitive incentives than non-PE owners. As a result, even within the same industry, we observe significant heterogeneity in the impact of PE ownership

on consumers. In fact, in our setting, consumers benefit from PE ownership in competitive markets but are harmed in concentrated ones. Furthermore, we explore how pro-competitive policy interventions can be used to regulate the impact of PE acquisitions. We study a policy intervention that strengthens the salience of product quality and find that it induced much larger quality improvements from PE-owned firms than non-PE firms. These results suggest that by stimulating greater competition, regulators can mitigate or even reverse the potential detrimental effects of PE ownership to consumers.

We perform our analysis by studying PE acquisitions in the nursing home industry. Dramatic increases in healthcare buyouts in recent decades have sparked concern from regulators (U.S. Government Accountability Office, 2010), legislators (U.S. House of Representatives, 2007; U.S. Senate, 2008; Cumming, 2019), and the press (Duhigg, 2007; Whoriskey and Keating, 2018; Elk, 2019; Sanger-Katz, Creswell and Abelson, 2019; Kolhatkar, 2020).[1] For a number of reasons, these concerns have been particularly strong in the nursing home industry, where PE firms acquired 12% of the nation's nearly 16,000 facilities (U.S. Government Accountability Office, 2010).

Nursing homes serve a population of over 1.3 million elderly and infirm residents that may be particularly vulnerable if PE-owned facilities prioritize profits over patient care. Moreover, as the vast majority of nursing care is publicly financed through Medicare and Medicaid, taxpayers share a vested interest in the quality of patient care. Chairman of the Subcommittee on Health, Rep. Pete Stark (D-CA) articulated these sentiments in a 2007 Congressional hearing that largely regarded the prominent PE acquisition of major nursing home chain HCR ManorCare:

> *The industry is publicly supported, and therefore must be held accountable to the public for the care it provides. The nursing home chains should be striving to improve care and not cut corners to increase profits at the expense of the seniors and people with disabilities.*

More than a decade later, scrutiny of PE ownership in the industry persists. In 2019, members of Congress sent letters to the executives of several PE firms with investments in the nursing home industry (including The Carlyle Group, Formation Capital, Fillmore Capital Partners, and Warburg Pincus LLC) to request additional information about the transactions. Most recently, media outlets have suggested that PE firms exacerbated the death toll of COVID-19 at nursing homes by introducing cost-cutting measures, such as reducing staffing (Goldstein, Silver-Greenberg and Gebeloff, 2020).

In examining these concerns, we focus on whether the effect of PE ownership on quality varies with competitive incentives. We emphasize competition in quality rather than prices since the reimbursement

[1] For example, the opening statement of the 2019 House Committee on Financial Services hearing entitled "America for Sale? An Examination of the Practices of Private Funds" expressed concern that "private equity firms increasingly hold ownership of our hospitals, nursing homes and emergency services."

rates for most care are set unilaterally by the government. As nursing home markets are highly localized, we expect facilities to compete primarily with their local competitors. We therefore measure the strength of competitive incentives using local market concentration and expect that the competitive incentives to provide quality care decreases with market concentration (Gaynor, 2006).

We measure each facility's quality of care by its level of staffing per patient day. Nursing staff typically fall into three categories: registered nurses (RNs), licensed practical nurses (LPNs), and certified nurse aides (CNAs). RNs receive the most training prior to certification and command the highest wages, while CNAs receive the least training and the lowest wages. Direct care from these nurse staff represents the primary service patients receive at nursing homes. Correspondingly, it also constitutes the largest fraction of facilities' expenditures. Academics (Institute of Medicine, 2004; Clarke and Donaldson, 2008; Castle and Anderson, 2011; Harrington et al., 2016) and policymakers (Centers for Medicare & Medicaid Services, 2019) alike have emphasized the importance of adequate staffing at nursing homes, as staffing levels—especially RN staffing levels—have been show to substantially impact patient health (Friedrich and Hackmann, 2019).

We use a matched difference-in-differences approach to estimate the impact of PE ownership on staffing for facilities facing different levels of local market concentration. At all levels, PE owners shift the composition of staffing towards highly trained registered nurses. The magnitudes of these effects, however, are not uniform: PE owners increase the share of RN staffing by 21% of the mean in highly competitive markets, and by only 8.7% of the mean in less competitive markets.[2] These shifts in composition do not necessarily signify increased expenditure on staffing. In fact, we find that in less competitive markets, the predominant effect of PE ownership is to decrease LPN and CNA staffing such that the change in total staffing expenditure is cost-equivalent to reducing RN care by 4.5% of the mean.[3] In contrast, we observe a staffing expenditure increase in highly competitive markets that is equivalent to a 15.7% of the mean increase of RN care. Taken together, these results suggest that PE's impact on product quality may depend significantly on the concentration of the market in which an acquisition occurs. Therefore, policymakers concerned about potential adverse effects on consumer stakeholders should be attentive to whether PE targets are located in concentrated or non-concentrated markets.

We extend this analysis by considering whether policy tools can take advantage of PE managers' heightened responsiveness to competitive incentives. To do this, we examine how PE-owned facilities responded differently to the introduction of the Five-Star Quality Rating System ("five-star") by CMS in December

[2]Note that because we use a difference-in-differences approach, these numbers are relative to the contemporaneous changes made by matched non-PE control facilities.

[3]To compute this cost-equivalency, we first determine the total expenditure changes associated with staffing adjustments to RNs, LPNs, and CNAs by applying the mean hourly wages for each nurse type from the Bureau of Labor Statistics. For ease of interpretation, we translate this to the amount of additional RN care a facility could purchase with this change in expenditure. We express effects in terms of equivalent RN care—rather than LPN or CNA care—due to the considerable emphasis placed by policymakers on increasing RN care at facilities.

2008. The five-star system provides consumers with a set of easily-digestible quality ratings for each facility on a five-point scale. By allowing consumers to quickly and easily evaluate facilities' quality, CMS hoped to both guide patients to better facilities and to encourage facilities to compete on quality. Staffing is one of three primary measures published by the system. This staffing rating takes into account both a facility's RN staffing levels and total staffing levels (RNs, LPNs, and CNAs together). The system emphasizes the importance of RN care by requiring high levels of RN staffing to receive a high rating, even when levels of other staffing are high. The system also de-emphasized LPNs by treating them equivalently to CNAs, who are less costly to employ.

We find that PE-owned facilities were acutely responsive to these incentives and increased their share of RN staffing by 1.8% (18% of the mean share) more than did comparable non-PE facilities. Consistent with strategic behavior from PE owners, this shift was driven by an increase in RNs (20.24% of the mean) and a reduction in LPNs (3.23% of the mean). When taken together, the staffing changes that PE owners introduced constitute an expenditure increase of $77,063. This is enough to increase RN staffing by 16.9% of the mean at a typical facility. This increase almost entirely offsets the adverse effects of PE-ownership before the five-star system. As might be expected, PE-owned facilities in unconcentrated markets were the most responsive to the five-star system. These facilities increased staffing expenditure by 5.4% of the mean, the equivalent of a 26.7% increase in RN staffing. The importance of competitive incentives is most striking when comparing the impact of PE ownership in our most- and least-competitive settings. In unconcentrated markets under the five-star system, PE ownership increased staffing expenditure by the 3.6% of the mean, while in more concentrated markets prior to the five-star system, PE ownership decreased staffing expenditure by 4.3% of the mean.

Our results underscore how competition may be a decisive factor in whether PE ownership benefits or harms consumers. This contributes to the existing literature on the effect of PE ownership on non-investor stakeholders (Chevalier, 1995; Davis et al., 2014; Bernstein and Sheen, 2016; Eaton, Howell and Yannelis, 2019; Cohn, Nestoriak and Wardlaw, 2019; Fracassi, Previtero and Sheen, 2019) by presenting a potential resolution to the literature's seemingly conflicting results. For example, PE-induced operational changes may benefit consumers in the restaurant industry (Bernstein and Sheen 2016) but harm them in the market for higher education (Eaton, Howell and Yannelis 2019). In the restaurant industry, switching costs are low and product quality measures like health inspection grades and online customer reviews are easily observable. On the other hand, transferring between colleges is costly, and students may have trouble discerning quality and fit prior to attending. This suggests that restaurants experience greater competitive pressure to provide quality, and therefore that PE ownership is much more beneficial to consumers in the restaurant industry.

To our knowledge, this study is the first to demonstrate the heightened sensitivity of PE managers to

competitive incentives. Rather than performing a meta-analysis of multiple industries, we exploit spatial and temporal variation within a single industry. This allows us to hold fixed the various institutional details that differ across industries, ensuring that the variation in our measures of competition is not confounded by other industry-specific factors. Considering a single industry also helps emphasize the types of variation most useful to policymakers. Changing major institutional features of an industry is implausible. However, policymakers might reasonably consider regulating acquisitions in concentrated markets or promoting the salience of quality.

This paper relates to a broad literature exploring the determinants of healthcare quality, including competition (Ho and Hamilton, 2000; Kessler and McClellan, 2000; Capps, 2005; Gaynor, 2006; Hayford, 2012; Gaynor, Moreno-Serra and Propper, 2013). We also contribute to the literature on nursing home quality in particular, including research on competition (Nyman, 1985; Gertler, 1989; Grabowski and Town, 2011; Hackmann, 2019), the salience of quality (Stevenson, 2006; Werner et al., 2012), the five-star system (Konetzka et al., 2015; Werner, Konetzka and Polsky, 2016), and even recent (Grabowski and Stevenson, 2008; Pradhan et al., 2013, 2015; Bos and Harrington, 2017) and contemporaneous (Gupta et al., 2020) studies of PE investment. Our key finding, that PE managers are more responsive to competitive incentives, regards firm ownership and operational strategy (Bloom, Sadun and Van Reenen, 2015; Eliason et al., 2020). For example, in trying to amplify competition by increasing awareness of quality differences (Jin and Leslie, 2003; Zhao, 2016), CMS coincidentally induced PE owners to change their operational strategies. Our paper is therefore distinguished from other studies of PE effects on non-investor stakeholders by its focus on the heterogeneity of impacts along the dimension of competition. Our findings caution against an overly simplified portrayal of PE as being either uniformly beneficial or uniformly harmful to consumers. We demonstrate how the effects of PE ownership are varied—even within a single industry—depending on competitive incentives. Our results suggest that concerned policymakers should pay careful attention to competitive incentives and consider encouraging competition as a means to regulate, or even harness, PE.

The paper proceeds as follows. In Section 2, we provide institutional background regarding the nursing home industry and discuss the public and regulatory scrutiny surrounding PE acquisitions and their perceived effects on quality of care. Section 3 describes our data sources and the procedure we employ to construct a matched control sample. In Section 4, we examine the impact of PE ownership on quality of care in nursing homes, focusing on whether PE managers interact differently with local market competition than their non-PE counterparts. Upon finding evidence of heightened responsiveness by PE-owned facilities to competition, we investigate whether shocks to competitive incentives differentially affect PE managers. To do so, we study the introduction of the Five-Star Quality Rating System in Section 5. We illustrate how PE-owned facilities were the most responsive to this policy, which sought to increase quality competition

among nursing homes. Finally, Section 6 concludes.

2 Industry Background

We examine the impact of private equity ownership on nursing homes—facilities certified by the Centers for Medicare and Medicaid Services (CMS) to provide a variety of healthcare services, including skilled nursing, rehabilitative therapy, and other medical care requiring an institutional setting (42 U.S.C. §1395i and §1396r).[4] Facilities are broadly certified and therefore serve a broad range of patients, from short-stay patients requiring exclusively post-acute rehabilitative therapy to long-stay patients requiring treatment for chronic conditions, such as Alzheimer's disease and related dementia. There are approximately 15,600 nursing homes in the United States serving 1.3 million residents (Harris-Kojetin et al., 2019). In this section, we describe a few key features of our setting that are relevant to our study, including public expenditure on nursing homes, concerns about quality in the industry, and the increasing prevalence of PE acquisitions.

2.1 Public Expenditure on Nursing Homes

Nursing home care is largely paid for by the government. In our data, Medicare and Medicaid respectively cover 64% and 13% of patient-days.[5] Moreover, these figures understate Medicare's share of expenditures, as Medicare typically covers costly post-acute rehabilitative therapy care, which it reimburses at a significantly higher rate than Medicaid and private-pay per-diems.[6] Medicaid's large share of patient-days is due to the fact that all patients over the age of 65 qualify for Medicaid coverage of their nursing home care once their private financial resources are exhausted. Long-term care insurance is uncommon (Brown and Finkelstein, 2007, 2009, 2011), and private-pay rates are substantial: Loomer et al. (2019) estimate a national average per-diem of $224 for a private room between 2008 and 2010. As a result, long-stay patients are extremely likely to become eligible for Medicaid during their stay.[7]

There are a few important implications of Medicare and Medicaid funding the vast majority of nursing home care. First, firms are largely unable to compete on price, as Medicare and Medicaid reimbursement rates are set unilaterally by the government.[8] Consequently, we expect facilities to compete on quality

[4]Importantly, we do not study assisted living facilities. Though assisted living facilities are sometimes incorrectly referred to as "nursing homes" in the vernacular, they are not certified by CMS to provide the same level of care as nursing homes.

[5]We estimate these values using self-reported census in facilities' yearly filings.

[6]For example, Gandhi (2019) finds that Medicare accounts for nearly 40% of revenue and less than 20% of patient-days in a sample of California facilities in the 2000s.

[7]In fact, both Gandhi (2019) and Hackmann (2019) find that the majority of care-days are for patients who complete their stay on Medicaid, regardless of whether the patient's initial coverage was Medicare, Medicaid, or private-pay.

[8]Moreover, many private-pay patients anticipate long stays during which they will exhaust their financial resources and transition to Medicaid. These patients are likely to price-insensitive because marginal changes in price do not affect the eventuality of exhausting their financial resources.

rather than price.[9] The second implication is that the public has a vested interest in the quality of care in nursing homes. This interest, in conjunction with the fact that nursing homes serve a particularly vulnerable population, has led to significant public scrutiny of nursing homes, especially surrounding private equity acquisitions. We discuss these concerns in the sections below.

2.2 Concerns about Quality

Quality of care has long been a concern in the nursing home industry. In 1960, the newly established Subcommittee on the Problems of the Aged and Aging summarized "the condition of American nursing homes" (U.S. Senate, 1960):

> *Every troubled son or daughter, anxious to find a good nursing home for a father or mother, is dismayed, and often shocked, by the inadequacy, the hopelessness, inherent in most nursing homes. Those who have wandered from home to home seeking decent facilities, a therapeutic environment, and a life-restoring force pulsing through its system too often have given up in frustration. Or with no other solution feasible or possible, they may consign a parent or relative to an inadequate nursing home, but with troubled conscience and feelings of guilt.*

Similar sentiments have been expressed regularly over the last 60 years by regulators (U.S. Government Accountability Office, 2003, 2007, 2009*a*,*b*, 2015, 2019), legislators (U.S. Senate, 1974, 1986, 2008), academics (Pillemer and Moore, 1989; Harrington et al., 2016), and the media (Duhigg, 2007; Bland, 2017; Whoriskey and Keating, 2018; Davies, 2018).[10] Regulators have taken numerous steps to improve quality of care that have been met with mixed success. These have included mandating minimum staffing levels, raising Medicare and Medicaid reimbursement rates, surveying facilities annually, and establishing ombudsman programs. In this paper, we consider a quality rating system implemented by CMS to help guide consumers to higher quality facilities and to induce facilities to compete more heavily on quality. We discuss this system below.

Five-Star Quality Rating System In an attempt to help prospective residents make informed decisions when choosing between nursing homes, CMS began publishing characteristics and health survey statistics for each facility online in October 1998. The tool was aptly titled "Nursing Home Compare" (www.medicare.gov/nursinghomecompare), as it allowed consumers the opportunity to compare facilities on key dimensions of quality. In June 2000, CMS added staffing data to their website, and between April 2002 and November

[9] Demand estimates from the nursing home literature indicate that residents are sensitive to varying degrees on observable measures of quality, such as nurse staffing levels (Gandhi, 2019; Hackmann, 2019; Rahman et al., 2014*a*,*b*).

[10] Media articles in the last few years include: "Overdoses, bedsores, broken bones: What happened when a private-equity firm sought to care for societys most vulnerable" in *The Washington Post* (dated November 25, 2018), "Corporate Americas Latest Target: Nursing Home Patients" in *HuffPost* (dated December 06, 2017), "Profit-hungry firms are gambling on social care. Are the stakes too high?" in *The Guardian* (dated February 28, 2018).

2004, other quality measures—including frequencies of infections, pain, pressure sores, loss of activities of daily living, use of physical restraints, and excessive weight loss—were introduced to the website as well. While these data were detailed and easily available online, estimates from previous studies suggest that these preliminary efforts to inform consumers had little impact on where they actually chose to receive care (Stevenson, 2006; Grabowski and Town, 2011; Werner et al., 2012).

One reason that the Nursing Home Compare website initially failed to steer consumers to higher quality facilities may have been that the provided information was too complex for many consumers to understand. On December 18, 2008, CMS introduced the "Five-Star Quality Rating System," (henceforth, "five-star system") which synthesized the quality of care data into a few easy-to-interpret measures. The five-star system assigned scores to each facility along a five-point scale in three domains—nurse staff hours per patient, results from health inspection surveys, and other quality measures—as well as a single overall score. This new presentation was significantly easier for consumers to digest, and Werner, Konetzka and Polsky (2016) found that the five-star system greatly increased the salience of these measures for consumers: "After the star-based rating system was released, 1-star facilities typically lost 8 percent of their market share and 5-star facilities gained over 6 percent of their market share." This shift in consumer elasticity of demand motivated many facilities to compete on these measures (Zhao, 2016). If PE-managed facilities are more attuned to the competitive pressures induced by consumer salience, then they should respond particularly aggressively to the introduction of the five-star system.

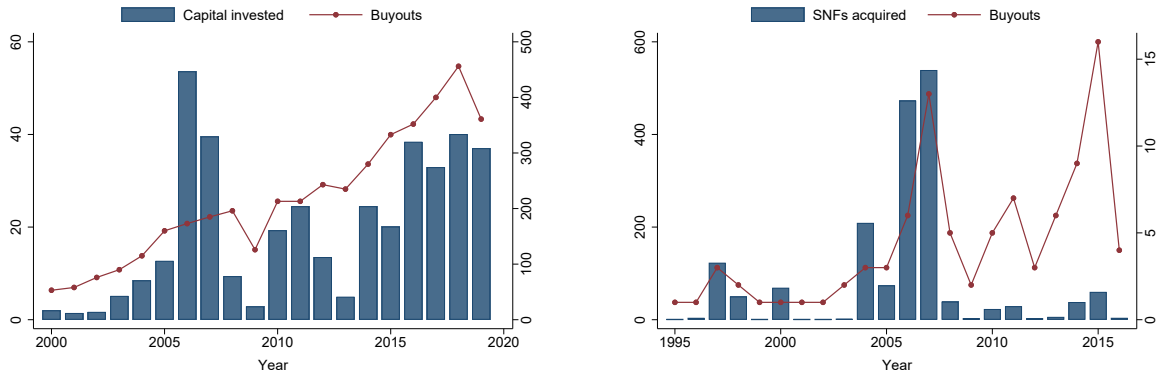
2.3 Private Equity Acquisitions

Private equity acquisitions in the healthcare industry have grown more prevalent and consequential in recent decades (Figure 1). In 1990, PE firms were investing just $356 million of capital in 10 US healthcare deals. By 2019, those figures had ballooned to $67.5 billion and 951 deals, respectively.[11] These 2019 deals represent 15.9% of PE capital investments, up from 8.5% in 1990. PE deals are now pervasive and extend to virtually all facets of the healthcare industry, including physician practices, dialysis clinics, pharmaceutical companies, medical device manufacturers, skilled nursing facilities, and home health care, to name a few.[12]

While PE deals regularly draw public scrutiny, their healthcare acquisitions have been particularly salient to regulators, academics, and the public due to their prevalence, size, and potential adverse effects on stakeholders. Nowhere are these concerns more clear than with PE acquisitions in the nursing home industry, owing to a public perception that PE firms are likely to exploit aging and infirm patients and provide low quality care financed by the government.

[11] These figures are computed from PitchBook and exclude deals classified as private investment in public equity (i.e., "PIPE").
[12] See, for example, Robbins, Rudsenske and Vaughan (2008) and Gondi and Song (2019).

Figure 1: Trends in private equity activity



(a) Number of PE deals in healthcare sector **(b) Number of PE deals in nursing home industry**

Note: The count of healthcare PE deals is computed using PitchBook. The count of nursing home deals are computed using a combination of PitchBook, Irving Levin, Preqin, Capital IQ, and SDC Platinum.

Scrutiny of such PE acquisitions accelerated during the mid-2000s, when buyout activity in the industry grew rapidly (Figure 1b). The most prominent of these LBO deals was The Carlyle Group's $6.3 billion acquisition of HCR ManorCare.[13] Less than three months after the deal was announced, *The New York Times* reported that previous PE investments in nursing home chains had led to significant cost-cutting at the expense of patient care. This report and the subsequent public outcry—including protests from Service Employees International Union, the nation's second-largest labor union—prompted both Congressional investigations and inquires by state regulators.[14]

It's worth noting these trends are not unique to the United States. For example, a very similar narrative took shape in Europe when Britain's largest nursing home chain, Southern Cross Healthcare, began facing financial troubles.[15]

[13] At the time of the deal, HCR ManorCare was the largest operator of nursing homes in the United States. In addition, the acquisition drew attention for succeeding leveraged buyouts of other large nursing home chains, including Genesis HealthCare in January of the same year and Beverly Enterprises in 2005.

[14] The original report published by *The New York Times* is entitled "At many homes, more profit and less nursing," dated September 23, 2007. For more information regarding the subsequent protesting of the acquisition, see "Union fights equity on nursing home buyout" in *Politico* (dated November 19, 2007) and "Scenes From the Private Equity Picket Line" in *The Wall Street Journal* (dated October 16, 2007). See also "Inquiries at Investor-Owned Nursing Homes" in *The New York Times* (dated October 24, 2007) regarding Congressional investigations of PE involvement in nursing homes.

[15] Blackstone acquired Southern Cross in September 2004 for $266 million as part of a leveraged buyout. Though Blackstone exited the investment in March 2007, they were widely seen as responsible for the nursing home operator's struggles in the years following its July 2006 IPO on the London Stock Exchange. In 2011, GMB—a labor union representing many Southern Cross staff—publicly criticized Blackstone's role and even called for a ban on private equity activity in healthcare and related industries. For more information, see "Union faults Blackstone for nursing home woes" in *The New York Times* (dated June 3, 2011) as well as GMB's 2011 report, "Southern Cross: The Cross We Have to Bear, the Greedy and the Gullible."

3 Data and Sample Construction

Our analysis spans the 1993 to 2017 period, and includes all CMS-certified skilled nursing facilities. Incorporating data from several sources, we construct a panel of nursing homes that combines information on facility-level organizational characteristics and private equity transactions. We obtain facility characteristics from annual surveys conducted at all CMS-certified nursing homes.[16] These administrative data reflect organizational characteristics including occupancy, bed size, ownership type, and chain affiliation, as well as staffing levels and aggregated resident demographics and characteristics.

Our paper takes a primary interest in understanding how PE managers interact with product market competition differently than non-PE managers. It is therefore important that we construct a measure that accurately reflects the competitive incentives faced by each facility. A large literature finds that patients demonstrate extremely strong preferences for nursing homes that are close to their home (Rahman et al., 2014*a*,*b*; Gandhi, 2019; Hackmann, 2019), suggesting that nursing homes compete primarily with other geographically proximate facilities. We therefore construct a Herfindahl-Hirschman Index using market shares in resident capacity within a 10-kilometer radius of each facility.

3.1 Identifying Private Equity Acquisitions

To identify PE deals in the nursing home industry, we perform targeted searches in Capital IQ, PitchBook, Preqin, and SDC Platinum.[17] These databases are frequently used by researchers and practitioners to identify private equity transactions. In addition, we supplement these sources with the Deal Search Online platform from Irving Levin Associates, which reports M&A deals in senior care and healthcare markets. In order to ensure at least one pre- and one post-acquisition year of data, we require that deals be completed between 1994 and 2016. We also perform independent searches to identify and exclude deals miscategorized as PE or corresponding to providers other than nursing homes (e.g. assisted living facilities). Most facilities are acquired by PE firms as part of larger chains, but some are acquired in standalone transactions or purchases

[16] Data from these surveys are stored in CMS' Certification and Survey Provider Enhanced Reporting ("CASPER") database and were formerly stored in the Online Survey Certification and Reporting ("OSCAR") database. Where possible, we utilize Brown University's LTC Focus, which cleans and augments the raw CMS files with statistics generated from administrative data on resident assessment surveys and claims data. LTC Focus is maintained by the Shaping Long-Term Care in America Project at Brown University funded in part by the National Institute on Aging (1P01AG027296).

[17] We employ the following criteria in our searches. When using Capital IQ, we screen for transactions that are identified as a "Going Private Transaction," "Leveraged Buyout (LBO)," "Management Buyout," or "Platform." We also require that a target's primary industry classification be "Nursing Homes," its geographical location be "USA," and its transaction status be either "closed" or "effective." In PitchBook, we employ a search criteria that filters for deal type as "Buyout/LBO," deal status as "Completed," headquarters location as "United States," and industry as "Elder and Disabled Care," with additional industry keywords for "skilled nursing facility" and "nursing home." From Preqin, we search for portfolio companies where the industry sector is "Nursing Homes and Assisted Living," the deal status is "Completed," and the location is "US." In SDC Platinum, we identify deals that are tagged as LBO, deals where the acquirer is listed as an LBO firm, and deals that are labelled as involving buyouts or financial sponsors. We identify whether the target operates nursing homes by checking its SIC code.

of several independent facilities at once. We match deals to the appropriate facilities in our sample using the facility and chain names provided during annual surveys. As target facilities sometimes experience multiple PE acquisitions during our sample period, we include only the first transaction per target facility. Applying these restrictions results in a sample of 95 deals.

3.2 Constructing the Matched Control Group

Our primary empirical strategy in Section 4 contrasts the evolution of quality in PE-acquired facilities with that of non-acquired ones using a difference-in-differences approach. One challenge to this approach is that private equity firms do not randomly choose which nursing homes to acquire. In fact, they are financially incentivized to strategically select their investment opportunities. This suggests that facilities targeted by PE firms may be systematically different than non-targeted facilities. Therefore, the full set of non-target facilities would be a poor control group for evaluating the impact of PE acquisitions. To mitigate these concerns, we compare acquired facilities to a control group of observably similar non-buyout facilities. This approach is shared by a number of recent papers in the PE literature (Boucly, Sraer and Thesmar, 2011; Bernstein, Lerner and Mezzanotti, 2019; Cohn, Nestoriak and Wardlaw, 2019; Fracassi, Previtero and Sheen, 2019).

We construct a control group by matching each target facility with up to five similar control facilities. A target's matches are its nearest neighbors from among the non-buyout facilities, based on observed similarity (Mahalanobis distance) in RN, LPN, and CNA hours of care per patient day in the year prior to buyout. We also require all matches to satisfy certain minimum standards. First, a control facility must be observed at least once prior to and after the LBO date of the associated target. This ensures that we can always measure the change surrounding the acquisition date for control facilities. Second, control facilities must be within a standard deviation of the target facility for all match variables. Finally, control facilities must be for-profit and fall within the same tercile of local market concentration as the target to which they are matched.[18]

Our matched sample includes 1451 target facilities from 77 PE deals and their corresponding 7213 matched control facilities. Of the 1451 PE-acquired facilities in our sample, we are able to pair 1429 (98.5%) with a full set of five matched controls.[19] Panel A of Table 1 reports summary statistics for these samples in the year of matching. Importantly, the PE and non-PE matched control facilities are remarkably similar along organizational characteristics, despite matching taking place only based upon measures of staffing. The average facility in our sample has 117 beds and approximately 72% occupancy. Staffing is predominantly provided by certified nursing aides (CNAs), at an average of 2 hours per resident per day, comprising nearly

[18] We exclude 31 targets for which we cannot find at least two satisfactory control facilities.

[19] Appendix Figure A.1 depicts the geographic locations of target and non-target facilities for both the full sample of facilities and our matched subsample.

65% of resident care hours. We do observe that target facilities tend to serve a slightly smaller share of Medicaid residents. Though statistically significant, this difference in means is only a small fraction of a standard deviation.

Panel B breaks these statistics out separately according to tercile of local market concentration. Of the 1451 buyout facilities in our sample, 484 belong to low-competition markets, 523 to mid-competition markets, and the remaining 444 are from high-competition markets. Within tercile of market competition, buyout and matched control facilities are again observably comparable, with Medicaid share a lone exception.

While it is ultimately infeasible to eliminate the possibility that buyout and control facilities are systematically different along unobserved dimensions, the observed similarity in our outcomes of interest in both the full sample and within concentration terciles should ease some concerns regarding potential endogeneity in our estimation approach. Furthermore, given our difference-in-difference approach, the ultimate validity of our estimators relies on our matched controls satisfying the parallel-trends assumption. We discuss this further and present supporting evidence in Sections 4.1 and 5.

Table 1: Comparing Buyout and Control Facility Characteristics Pre-LBO

Panel A: Buyout and Controls in Match Year

	PE sample			Matched sample			
	Mean	Median	SD	Mean	Median	SD	Diff.
Total beds	116.91	116.00	46.00	115.67	109.00	55.27	-1.24
Occupancy %	73.83	87.50	32.14	72.40	85.83	31.87	-1.43
RN hours	0.33	0.27	0.34	0.31	0.26	0.31	-0.02*
LPN hours	0.78	0.74	0.34	0.76	0.74	0.31	-0.01
CNA hours	2.02	1.95	0.59	2.01	1.95	0.56	-0.01
Acuity index	9.67	11.13	4.17	9.61	11.02	4.17	-0.06
Medicaid share	61.89	66.28	20.57	65.99	68.75	19.43	4.10***
10km HHI (beds)	0.23	0.17	0.17	0.23	0.18	0.18	0.01
Facilities	1451			7213			

Panel B: Comparison within Competition Subgroup

	High Competition			Mid Competition			Low Competition		
	PE	Non-PE	*t*-stat	PE	Non-PE	*t*-stat	PE	Non-PE	*t*-stat
Total beds	127.20	129.24	0.61	120.70	115.80	-2.11	103.39	103.13	-0.12
Occupancy %	71.43	71.44	0.01	77.24	74.86	-1.64	72.35	70.62	-1.10
RN hours	0.40	0.37	-1.31	0.32	0.31	-1.04	0.28	0.27	-0.87
LPN hours	0.80	0.78	-1.10	0.77	0.76	-0.57	0.76	0.75	-0.58
CNA hours	2.10	2.09	-0.40	2.00	2.00	-0.27	1.95	1.95	-0.09
Acuity index	9.49	9.34	-0.64	9.93	9.94	0.05	9.55	9.50	-0.22
Medicaid share	58.52	65.47	5.74	61.16	65.37	4.73	65.77	67.14	1.64
10km HHI (beds)	0.06	0.06	-1.05	0.17	0.18	3.79	0.44	0.45	2.05
Facilities	444	2202		523	2602		484	2407	

Note: This table summarizes facility characteristics for PE and non-PE nursing homes in the year prior to acquisition. The PE sample includes all targets that were successfully matched to at least two non-acquired facilities. Panel A presents facility characteristics broken by treatment group, and Panel B further divides the sample according to market concentration. The values shown in Panel B are means.

4 The Impact of Private Equity Ownership on Quality

In this section, we study the impact of private equity ownership on the quality of care provided by nursing homes. We pay particular attention to whether PE managers interact differently with local market competition than their non-PE counterparts. We find evidence that PE-owned facilities are more responsive to competitive incentives when investing in quality. Specifically, PE-owned facilities increase quality in highly competitive markets, while doing little or even decreasing quality in non-competitive ones.

4.1 Estimating the Average Impact of Private Equity Ownership

We use a matched difference-in-differences estimator to evaluate the effect of PE ownership on nursing home quality. In other words, we estimate the impact of PE-ownership by comparing changes in the quality of target facilities surrounding PE-acquisition to contemporaneous changes in the quality of control facilities. The following regression formalizes this intuition:

$$y_{ict} = \beta PE_{ict} + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}, \tag{1}$$

where i indexes facility, c indexes match cohort, and t indexes time. PE_{ict} is an indicator for whether facility i in cohort c is under PE ownership at time t. Since each matched cohort consists of one facility that was a PE target and up to five matched control facilities, PE_{ict} is nonzero only for the target facility on and after the buyout year.[20] Therefore, our coefficient of interest is β, which reflects the average impact of PE ownership on acquired facilities. In order to avoid bias from unobserved PE exits, we restrict our regression samples to four years before and after each acquisition. Accordingly, equation (1) identifies the difference in average facility quality in the four years before buyout and four years after. The estimate of β measures how this difference in quality compares in target and control facilities.

Our regression specification also includes a number of controls. First, X_{ict} is a vector of facility characteristics at time t that includes total beds, occupancy rate, and average patient acuity score. Second, α_{ct} is a cohort-year fixed effect that controls non-parametrically for common time series variation within each cohort. Importantly, unlike simple year fixed effects, cohort-year fixed effects can control for time-varying trends that differ across match cohorts.[21] For example, temporal variation in RN wages is likely to differentially affect facilities according to their levels of RN staffing. Insofar as our matching ensures similar RN staffing for all facilities within a match cohort, α_{ct} will control for this variation. Third, α_{ic} is a facility-cohort fixed

[20] As buyouts typically do not occur on January 1st, the year of LBO incorporates only partial treatment. We address this by excluding observations corresponding to the year of PE acquisition (for both target and associated match control facilities).

[21] Other papers employing cohort-time and firm-cohort fixed effects in a difference-in-differences regression include Gormley and Matsa (2011) and Fracassi, Previtero and Sheen (2019).

effect that controls for facility-level differences within each cohort.[22] This ensures that β is identified by comparing within-facility changes over time for the target facility to within-facility changes over time for its matched control facilities. Finally, we cluster our standard errors at the chain level since acquisitions frequently encompass entire chains.[23]

We use facility staffing measures as our dependent variables (y_{ict}). We measure staffing levels in hours of care provided per patient day for three key caregiver roles: registered nurses (RNs), licensed practical nurses (LPNs), and certified nursing assistants (CNAs).[24] Registered nurses are highly skilled nursing staff—RNs must both obtain a degree or diploma in nursing, typically requiring two to four years to complete, and must pass the licensing examination. Like RNs, LPNs must also receive a degree or diploma and pass an examination. LPN courses are significantly shorter, however, typically taking a year to complete. CNAs acquire the least training: typically just 1-3 months, depending on the state. The mean hourly wages for RNs, LPNs, and CNAs are \$37.24, \$23.32, and \$14.77, respectively.[25] In addition to separately analyzing RN, LPN, and CNA staffing levels, we also examine the share of total staffing a facility provides using RNs. We utilize this ratio, often called "staff mix" (Rantz et al., 2004) or "skill mix" (Kim, Harrington and Greene, 2009), as a measure of the degree to which a facility prioritizes high-skill care. While facilities employ significantly fewer RNs than LPNs or CNAs, policymakers and academics have both underscored high-skill RN care as a key measure of quality (Weech-Maldonado et al., 2004; Konetzka, Stearns and Park, 2008; Kim, Harrington and Greene, 2009). For example, CMS distinguishes RN hours from LPN and CNA hours in constructing staffing quality measures. (We discuss further in Section 5.) In fact, as we discuss below, CMS now also imposes severe rating penalties on nursing homes with gaps in RN staffing.

We emphasize staffing as a measure of quality for a number of reasons. Care provided at nursing homes is typically a mix of rehabilitative therapy, skilled nursing, and assistance with activities of daily living. This care is labor intensive, and as such, levels of staffing per patient day represent the clearest and most direct measure of the care that patients receive. CMS recently affirmed the role of staffing in its 2019 updates to the five-star system:[26]

> *Nurse staffing has the greatest impact on the quality of care nursing homes deliver, which is why CMS analyzed the relationship between staffing levels and outcomes. CMS found that as staffing levels increase, quality increases and is therefore assigning an automatic one-star rating when a*

[22] The benefits of facility-cohort fixed effects are more subtle than those of cohort-year fixed effects. By varying fixed effects with cohort, we allow the possibility that a facility in multiple match cohorts may have changed over time. This is especially plausible given that our sample covers more than two decades.

[23] Clustering at the facility level typically yields much smaller standard errors.

[24] We perform our analyses using levels of these staffing variables. Our results are also robust to using logs.

[25] Wages cited are for May 2019 and obtained from the Bureau of Labor Statistics through https://www.bls.gov/oes/current/oes_nat.htm.

[26] See "CMS Improving Nursing Home Compare in April 2019," (dated March 5, 2019) at CMS.gov. Available at: https://www.cms.gov/newsroom/press-releases/cms-improving-nursing-home-compare-april-2019.

Nursing Home facility reports "no registered nurse is onsite."

The importance of nurse staffing levels for patient health is also supported by a large literature (Institute of Medicine, 2004; Clarke and Donaldson, 2008; Castle and Anderson, 2011; Harrington et al., 2016). For example, Friedrich and Hackmann (2019) estimate that decreasing RN staffing by 1% yields a 1.9% (.15 percentage point) increase in mortality at Danish nursing homes. In addition, staffing also represents one of the largest expenses for nursing homes: the cost of RN, LPN, and CNA wages to provide the national average level of care in 2000 was $42.34 per patient day, or 37% of Medicaid's average reimbursement rate.[27] Even this measure likely understates staffing costs, as it excludes benefits, overtime, other staffing cost. Given the significant role of staffing costs on facilities' balance sheets, decisions about the number of direct care staff to employ represents one of the most important financial decisions made by a nursing home.

Practical considerations also lead us to prioritize staffing as our outcome of interest. Most importantly, staffing levels are directly adjustable by facility owners. Therefore, we feel confident that observed changes in staffing reflect decisions on the part of the facility owner, rather than random chance. While facilities may adjust their efforts to improve along other dimensions of quality—such as patient health outcomes—the actual realizations of these other measures are stochastic. A second practical consideration is that staffing data are available for our full sample period (1993-2017), while many other quality measures are available only from 2005 and onward. We consider other outcome measures in Appendix B, including other quality measures, health inspection outcomes, and patient composition.

Panel A of Table 2 presents the estimates of β from estimating equation (1). Our estimates suggest moderate reductions in LPN staffing and CNA staffing: 2.2% and 2.6% of the means for LPNs and CNAs, respectively. The estimates also indicate a substantial positive effect of PE ownership on RN staffing (11.5% of the mean), though with large standard errors. Correspondingly, the RN share of staffing increases on average by 12.5% of the mean. Taken together, these results suggest that PE ownership, on average, slightly reduces total staffing hours but predominantly substitutes higher skill RN staff for lower skill LPN and CNA staff. Another way of considering the effects of PE ownership is in the context of staffing expenditures. Using 2019 wage figures, the estimates suggest that PE-owned facilities spend an additional $0.21 per patient day.[28] Thus, while PE ownership is associated with a slight decrease in total staffing hours, this effect also represents a net increase in staffing expenditures. For the median PE-owned facility in our sample, this corresponds to an additional $7,785 per year.

[27] This figure is computed using the national average RN, LPN, and CNA staffing levels for 2000 in our data and multiplying by the nationwide hourly wages for each staffing role from the Occupational Employment Statistics program files at the Bureau of Labor Statistics. Harrington, Swan and Carrillo (2007) provides a nationwide average Medicaid reimbursement rate of $115 per day.

[28] This is according to an increase of $1.42 per patient day in RN staffing and decreases of $0.41 and $0.80 in LPN and CNA staffing respectively. The corresponding 2019 mean hourly wages for RNs, LPNs, and CNAs are $37.24, $23.32, and $14.77, from Bureau of Labor Statistics estimates.

Table 2: Changes in facility quality around PE acquisitions

	RN hours	LPN hours	CNA hours	RN share	Expenditure
Panel A: Specification 1					
PE_{ict}	0.0379*	-0.0175***	-0.0540***	0.0125**	0.204
	(0.0211)	(0.00564)	(0.0140)	(0.00552)	(0.724)
Panel B: Specification 2					
$PE_{ict} \times LowComp_c$	0.0169	-0.00648	-0.0625***	0.00691**	-0.450
	(0.0128)	(0.0102)	(0.0198)	(0.00289)	(0.593)
$PE_{ict} \times MidComp_c$	0.0247	-0.0335***	-0.0530**	0.0104*	-0.651
	(0.0192)	(0.00897)	(0.0241)	(0.00548)	(0.826)
$PE_{ict} \times HighComp_c$	0.0762**	-0.0103	-0.0461	0.0211**	1.931*
	(0.0320)	(0.0127)	(0.0332)	(0.00826)	(1.074)
Panel C: Specification 2 ($LowComp_c$ as baseline)					
PE_{ict}	0.0169	-0.00648	-0.0625***	0.00691**	-0.450
	(0.0128)	(0.0102)	(0.0198)	(0.00289)	(0.593)
$PE_{ict} \times MidComp_c$	0.00778	-0.0270*	0.00955	0.00346	-0.201
	(0.0149)	(0.0151)	(0.0313)	(0.00422)	(0.842)
$PE_{ict} \times HighComp_c$	0.0593**	-0.00380	0.0164	0.0142**	2.381**
	(0.0252)	(0.0157)	(0.0413)	(0.00627)	(1.063)
Controls	Yes	Yes	Yes	Yes	Yes
FE: SNF × match	Yes	Yes	Yes	Yes	Yes
FE: Year × match	Yes	Yes	Yes	Yes	Yes
N clusters	7,517	7,517	7,517	7,517	7,517
N observations	67,435	67,434	67,427	67,419	67,426
R^2	0.73	0.72	0.62	0.75	0.72
Mean	0.33	0.78	2.06	0.10	60.99
Std. Dev.	0.32	0.34	0.67	0.07	22.56

Note: The dependent variable *RN hours* represents the number of registered nurse hours of care that a facility provides per patient per day. Analogously, *LPN hours* and *CNA hours* measure licensed practical nurse and certified nursing assistant hours of care provided per patient per day. The dependent variable *RN share* is the fraction of total care hours provided by RNs, and *Expenditure* measures the approximate cost of providing the observed level of care (in $ per patient per day) based on 2019 hourly staff wages. Controls include a facility's occupancy rate, its number of total beds, and acuity index (a measure of the average intensity of care required by residents). All specifications include cohort-year fixed effects (controlling for common time series variation within each matched cohort) and cohort-facility fixed effects (controlling for facility-level differences within each matched cohort). Standard errors are provided in parentheses and are clustered by nursing home chain. The number of clusters indicates the number of chains in the analysis, where independent facilities not belonging to any chain are included as their own clusters. In each specification, an observation is a facility-year. Significance at the 10%, 5%, and 1% level are indicated using *, **, and ***, respectively.

4.2 Differential Response of PE Managers to Market Concentration

In addition to estimating average impacts, we also examine how private equity managed facilities interact differently with competitive incentives. To do this, we take advantage of spatial variation in local market concentration. As discussed in Section 3, we measure local market concentration using a Herfindahl-Hirschman Index (HHI) for each facility based on its competitors within a 10-kilometer radius. We then bin facilities into three terciles—high competition (low-HHI), mid competition (mid-HHI), and low competition (high-HHI)—and compare the impact of PE ownership of facilities in each of these terciles.

Most nursing home care is reimbursed by Medicare and Medicaid at fixed rates set unilaterally by the government. As a result, most theoretical models suggest that increased competition (decreased concentration) will incentivize nursing homes to improve their quality (see Gaynor (2006)). The intuition for this is straightforward: without the ability to compete on price, facilities must compete for patients on quality. This prediction is also borne out in empirical work that studies price-regulated markets across the healthcare industry (Kessler and McClellan, 2000; Tay, 2003).

A large literature has demonstrated that firms in many industries systematically under-adjust their pricing policies to spatial (Nakamura, 2008; Cavallo, 2017; DellaVigna and Gentzkow, 2019) and temporal (Gagnon and López-Salido, 2020; Arcidiacono et al., 2020) variation in local market competition. DellaVigna and Gentzkow (2019) highlight "managerial inertia"—encompassing agency and behavioral frictions—as the most important explanation for this phenomenon. In a setting like the nursing home industry, where prices are regulated, we may naturally expect such managerial inertia to manifest in under-adjustment of quality to local market competition.

In this section, we ask whether PE managers are better able to adjust quality based on local market competition. There are several reasons we might expect this to be the case. First, PE managers may possess greater operational experience and aptitude that allows them to overcome managerial inertia. Second, newly appointed outside managers—PE or otherwise—may be more willing or able to overcome prevailing frictions. For example, they may be more amenable to renegotiating contracts, reassessing personnel, and implementing other major changes necessary to adjust quality locally. Finally, PE managers may have different objectives than non-PE managers.

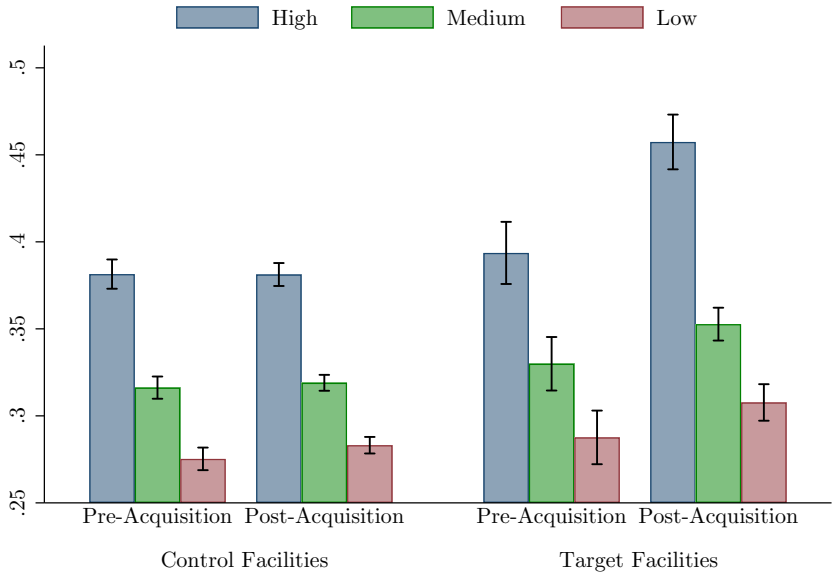
A large literature has shown that even for-profit firms in the healthcare industry are not necessarily profit-maximizing (Arrow, 1963; McGuire, 2000; Godager and Wiesen, 2013).[29] For example, non-PE managers may target a level of quality they deem appropriate, even if it deviates from the profit-maximizing ideal. Note that this need not imply that non-PE facilities always over-provide quality. In particular, if non-PE

[29] Deviations of this type are often termed "altruism" in the healthcare context. While most of the literature focuses on physician altruism and the hospital setting, the same intuition extends to nursing homes as well.

managers overlook the policies of their competition, they may *under*-provide quality relative to the profit-maximizing levels in markets with strong competition.[30] PE managers' greater focus on profits may reflect either different preferences or higher powered incentives: leveraged, scaling (and skewing) equity-holder gains to facility profitability.

If PE managers are indeed more responsive to competitive incentives, then PE-owned facilities should be more sensitive to market concentration (than non-PE facilities) in setting staffing levels. Consequently, we expect quality changes in PE-owned facilities to better reflect the alternatives available to potential patients and therefore the impact of PE ownership to vary based on local market concentration.

Figure 2: Mean RN Staffing Before and After Acquisition Year, by Level of Local Market Competition



Note: Figure shows mean RN staffing hours per patient day before and after acquisition year by level of local market competition. Local market competition is measured by tercile of HHI distribution. Bars denote 95% confidence intervals.

Figure 2 presents mean RN staffing levels for target and control facilities in the years before and after acquisition by level of local market competition. On average, control facilities change very little at all levels of competition, while targets appear to increase RN staffing after acquisition. More importantly, the change in RN staffing at targets is significantly more pronounced in highly competitive markets. If PE managers were similarly responsive to local market competition as non-PE managers, then we would expect the changes after PE acquisition to be similar at all levels of local market competition. That PE managers appear to adjust staffing in a way that increases the disparity in staffing between high-, medium-, and low-competition

[30] This may be especially plausible given the theoretical consensus that competition under price regulation (provided price exceeds marginal cost) leads to an over-provision of quality (Gaynor, 2006).

markets suggests that PE managers are more sensitive to local market competition when setting staffing levels than their non-PE counterparts.

We formalize this approach by estimating the following difference-in-difference-in-differences ("triple-difference") regression:[31]

$$\begin{aligned} y_{ict} = \beta_L(PE_{ict} \times LowComp_c) + \beta_M(PE_{ict} \times MidComp_c) \\ + \beta_H(PE_{ict} \times HighComp_c) + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}. \end{aligned} \tag{2}$$

The coefficient β_L gives a difference-in-differences estimate of the impact of private equity ownership on acquired facilities in markets with low competition. Similarly, the coefficients β_M and β_H are respectively difference-in-differences estimates of the impact of PE ownership in mid- and high-competition markets.

Since we are interested in how PE managers respond to differently to competition than non-PE managers, we focus on the *differences* between these difference-in-difference estimates (i.e., the "triple-differences"). These differences represent how the impact of PE ownership varies depending on level of local market competition. For example, $\beta^H - \beta^L$ measures how much greater the impact of PE ownership is on the quality of acquired facilities in highly competitive markets than those in non-competitive ones. If PE managers respond similarly to competition, we would expect the estimated impact of PE ownership to be similar at all levels of competition. In other words, we would expect $\beta^H - \beta^L$, $\beta^H - \beta^M$, and $\beta^M - \beta^L$ to be zero. If these differences are non-zero, then private equity managers interact differentially with competitive incentives than non-PE managers. Moreover, insofar as the differential impact of PE ownership widens the gap in quality between facilities in more and less competitive markets, we infer that PE owners are more responsive to local market competition.

Panel B of Table 2 presents the estimates from regression (2).[32] We find that the effects of PE ownership do indeed vary by level of local market concentration. Consistent with our results in Panel A of Table 2, Panel B suggests increases in RN staffing and decreases in LPN and CNA staffing. However, the relative prominence of these effects varies substantially by level of local market competition. Most noticeably, PE ownership increases RN staffing most strongly in highly competitive markets. This effect is particularly pronounced, with PE-ownership increasing RN staffing by 23% of the mean relative to non-PE facilities in highly competitive markets. In contrast, the point-estimate for the increase in low-competition markets is just 5%. The difference in estimated impacts between low- and high-competition markets is statistically significant at the 5%-level. We find that LPNs and CNAs decrease at all levels of competition, with the

[31] Note that we exclude $LowComp_c, MidComp_c$, and $HighComp_c$, as well as their interactions with an indicator for post-acquisition, because they are absorbed by fixed effects α_{ct}.

[32] Panel C of Table 2 presents the estimates when modifying regression (2) to use low-competition as the baseline. This regression allows us to directly estimate and compute standard errors for $\beta^H - \beta^L$ and $\beta^M - \beta^L$.

reduction in CNAs being slightly more prominent in low-competition markets, and the reduction in LPNs being most prominent in medium-competition markets. Taken together, these results suggest that PE ownership shifts the skill-mix of staffing towards RNs and LPNs at all levels of competition. This shift is most prominent in high-competition markets, where RN share of staffing increases by 21%. By comparison, this shift is more than three times larger than in low-competition markets, and the distinction between high and low competition markets is statistically significant at the 5% level.

In assessing the relative value of increasing RN staffing to decreasing LPN and CNA staffing, it is helpful to consider the labor costs associated with each type of staffing. Owing to the wage premium garnered by RNs, a reallocation of hours towards RNs can increase overall expenditure even when total hours are reduced. The regression estimates suggest that overall staffing expenditures decline following LBOs in both low- and mid-competition (-$0.43 and -$0.63, respectively) markets. On the other hand, PE ownership is associated with a large *increase* in total expenditure in high-competition markets. We find that following acquisition, total expenditure rises by $1.90 per patient day. This additional expenditure would be $72,501 annually—approximately the cost of one additional full-time RN staff member—for the median PE-owned facility in a highly competitive market.[33] This is in stark contrast to the effect in low- and mid-competition markets, where spending falls by $18,604 in annualized terms.

Consequently, the effect of PE ownership on total staffing expenditure is mixed: expenditure on staffing decreased in low- and mid-competition markets, but increased substantially in high-competition markets. These results suggest that whether PE is ultimately beneficial or harmful for facility quality may depend significantly on the concentration of the market in which the acquired facility is located.

4.3 Identification

The key identifying assumption of equation (1) is parallel trends between treatment and control groups. In other words, we assume that absent PE investment, staffing levels in acquired and non-acquired facilities would have evolved similarly. We test the plausibility of this assumption by examining treatment and control facilities evolved similarly in the pre-period. We accomplish this by estimating the treatment effect of being a target facility in each year before and after the acquisition:

$$y_{ict} = \beta_{t-\tau_c} Target_{ic} + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}, \tag{3}$$

where $Target_{ic}$ denotes that facility i in match group c was a PE target, and τ_c is the year of acquisition for the target facility in match cohort c. Thus, $\beta_{t-\tau_c}$ is the estimated impact of being a PE target $t - \tau_c$ years

[33] The median annual wage of RNs was $73,300 in 2019.

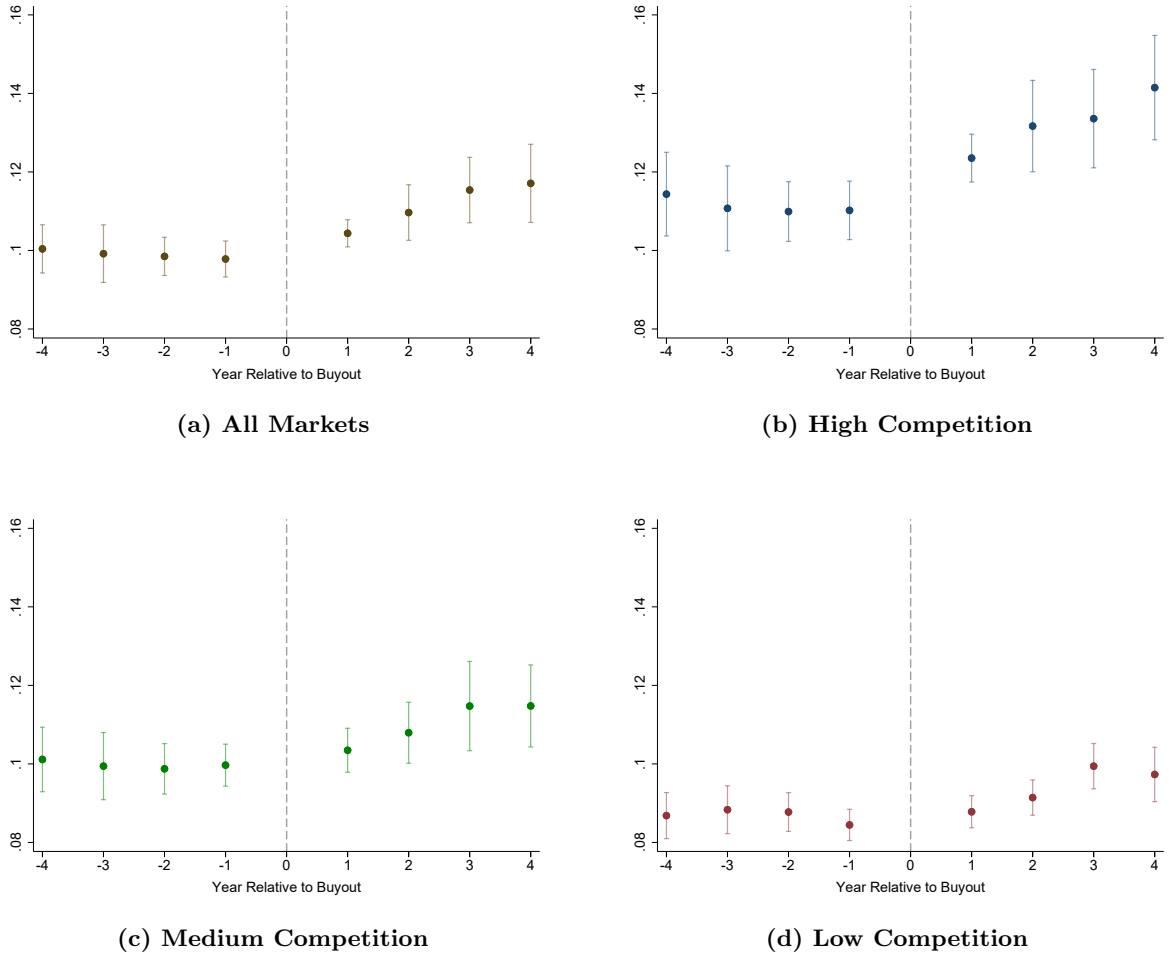
after acquisition. We inspect $\{\beta_{t-\tau_c}\}$ in the pre-acquisition period (i.e., when $t < \tau_c$) to assess whether there is a difference in pre-trends for target and control facilities.

The analogous identifying assumption for β^L, β^M, and β^H in equation (2) is parallel trends between target and control facilities within each tercile of local market competition. We therefore estimate the following regression analogous to equation (3):

$$\begin{aligned} y_{ict} = &\beta^L_{t-\tau_c} Target_{ic} \times LowComp_c + \beta^M_{t-\tau_c} Target_{ic} \times MidComp_c \\ &+ \beta^H_{t-\tau_c} Target_{ic} \times HighComp_c + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}. \end{aligned} \tag{4}$$

We inspect $\{\beta^L_{t-\tau_c}\}$, $\{\beta^M_{t-\tau_c}\}$, and $\{\beta^H_{t-\tau_c}\}$ for differential pre-trends between target and control facilities in each tercile of competition.

Figure 3: Changes in RN share of staffing around buyouts



(a) All Markets **(b) High Competition**

(c) Medium Competition **(d) Low Competition**

Note: These figures present the estimates of $\{\beta^L_{t-\tau_c}\}$, $\{\beta^M_{t-\tau_c}\}$, and $\{\beta^H_{t-\tau_c}\}$ from (4). The values have been shifted up by the match-year mean of the dependent variable to provide scale.

Figure 3a plots $\{\beta_{t-\tau_c}\}$ from (3) for RN share of staffing. These represent the estimated impact of being

a PE ownership for each of four years before and after acquisition. The remaining panels of Figure 3 plot $\{\beta^L_{t-\tau_c}\}$, $\{\beta^M_{t-\tau_c}\}$, and $\{\beta^H_{t-\tau_c}\}$. These are the estimated impacts of PE ownership by year relative to buyout for low-, mid-, and high-competition markets, respectively.[34] In each instance, we observe no evidence of a treatment effect prior to buyout. Both this absence of differential pre-trends and the distinct after the acquisition event suggest that the effects on staffing can be plausibly attributed to PE ownership. While the RN share of hours trends upward in both competitive and non-competitive markets after acquisition, the trend is markedly stronger in highly competitive markets. These estimates are consistent with those from Panel B of Table 2.[35]

The assumptions required to identify the difference in impact of PE ownership at varying levels of local market competition (e.g. $\beta^H - \beta^L$) are weaker. In particular, we need only be concerned with sources of bias that differentially affect our estimates of β^H, β^M, and β^L. This gives us particular confidence in our results that regard the distinction between the impacts of PE ownership in markets of different levels of concentration. Consider as an example the possibility that PE targets are selected based on unobservable factors inadequately addressed by our matching. If these factors indicate an anticipated change in staffing regardless of PE ownership, then our estimates of β^L, β^M, and β^H will be biased. However, unless this selection bias differs for different markets, our estimates of $\beta^H - \beta^L$, $\beta^H - \beta^M$, and $\beta^M - \beta^L$ will not suffer from bias. Such differential bias is particularly implausible given that buyouts are typically at the chain level and encompass multiple facilities with varying levels of local market competition. We are therefore most confident in our results regarding the difference in impact of PE ownership depending on local market competition.

5 Impact of Five-Star Quality Rating System on Private Equity

Section 4 demonstrates that PE-owned facilities are more responsive to local market competition than non-PE-owned facilities. This suggests that regulators and policymakers concerned about the impact of PE on consumer stakeholders should pay careful attention to whether PE targets are in concentrated or non-concentrated markets.

In this section, we explore another implication of PE's heightened sensitivity to competitive incentives: that pro-competitive policies and regulations are actually *more* effective at encouraging quality improvements in PE-owned establishments than in non-PE ones. Specifically, we examine how CMS' implementation of the Five-Star Quality Rating System differentially affected PE-owned facilities. The policy was designed

[34] Analogous graphs for all other outcomes are in Appendix A. For all regressions except those pertaining to RNs, there is relatively low statistical precision for the yearly estimates.

[35] In fact, since our estimates suggest that the staffing changes enacted by PE owners take place over a few years, our estimates in Sections 4.1 and 4.2 may underestimate the impact of PE ownership.

to incentivize quality competition by increasing the salience of facility quality among consumers. We find that PE managers were significantly more aggressive in responding to the system's incentives than non-PE managers.

In Section 5.1, we describe the strategic incentives induced by the five-star system. To better motivate how the policy elicited different responses from PE and non-PE managers, Section 5.2 describes the evolution of staffing levels at facilities operated by a large PE-acquired chain, HCR ManorCare. Section 5.3 presents our estimation strategy and our findings. These results demonstrate how PE ownership can amplify pro-competitive policies and their benefits to consumers.

5.1 Strategic Incentives from the Five-Star Quality Rating System

In December 2008, the Centers for Medicare & Medicaid Services implemented the Five-Star Quality Rating System. This five-star system presented consumers with easy-to-understand measures of quality according to a 1-5 star scale. In doing so, CMS hoped to help guide consumers to higher quality facilities and to spur competition between facilities on quality. The five-star system summarized a nursing home's quality along three dimensions: staffing, health inspections, and outcomes-based quality measures. Appendix C describes each of these measures in detail; as in Section 4.1 however, we focus on facility staffing as a primary measure of facility quality.

The five-star staffing rating evaluates each facility based on its level of nurse staffing, relative to what CMS anticipates as necessary given the facility's typical "case mix," or composition of patients.[36] Facility staffing ratings consist of two components: registered nurse (RN) hours per resident day, and total staffing hours per resident day (comprised of RN, LPN, and CNA hours). Facilities are rated from 1 to 5 on each component, and the two measures are given equal weight. A total staffing score, ranging from 1 to 5, is then assigned according to the combination of the two component staffing ratings.

There are two important features of this rating system. First, long-standing concerns regarding levels of highly skilled nurse staff led CMS to heavily emphasize RNs in designing the rating system. Importantly, hiring an RN raises staffing levels for both component measures: RN staffing and total staffing. In contrast, hiring an LPN or CNA raises only the latter. In this way, RN hours are credited with double the incentive of other types of staffing. As RN hours are privileged over LPN and CNA hours, managers paying significant attention to their five-star rating may increase the facility's RN staffing or shift the composition of staff towards greater RNs. As RNs are the most expensive type of nursing staff however, we would not expect facilities to shift entirely to providing care using RNs in order to maximize their five-star rating.

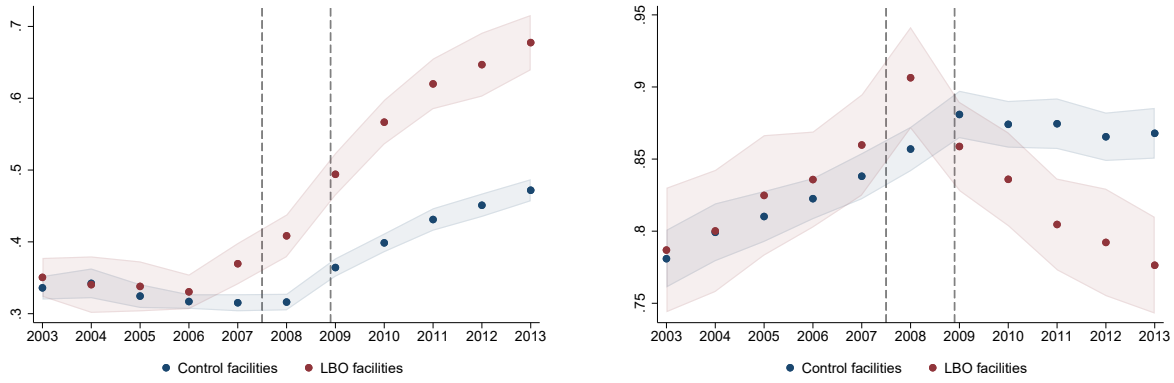
[36] Because the composition of a facility's residents naturally influences the level and type of care required, we include the acuity index—a measure of the severity of care demanded by a facility's residents—as a control variable in all regressions.

A second, more subtle, implication of the rating design is based on the equal treatment of LPN and CNA staffing. As the total staffing component does not distinguish between types of staffing—instead considering RN, LPN, and CNA hours altogether—care provided by LPNs and CNAs are recognized equivalently. In spite of this, LPNs are more costly than CNAs ($23.32 per hour vs. $14.77 per hour). Savvy managers who recognize this may therefore try to shift away from LPN staffing to reduce expenditures or reallocate resources. Insofar as a facility adjusts their marginal non-RN staff in order to maximize its five-star rating, we expect LPNs to be less cost effective than CNAs.

Overall, the introduction of the five-star system should increase facility incentives for RN staffing and make LPN staffing relatively less attractive. As a result, cost-efficient facilities may optimize by increasing RN staff and decreasing LPN staff.

5.2 A Motivating Example: HCR ManorCare

Figure 4: Historical staffing trends at HCR ManorCare facilities



(a) RN hours per patient day

(b) LPN hours per patient day

Note: The vertical lines correspond to the acquisition announcement date (July 2007) and the implementation of the five-star system (December 2008).

To illustrate how the five-star system may have differentially impacted the staffing behavior of PE-owned facilities, we consider The Carlyle Group's acquisition of HCR ManorCare. The 2007 buyout of the nation's largest nursing home chain grabbed headlines and sparked protests. This increased scrutiny centered around concerns that Carlyle would reduce quality of care at HCR ManorCare facilities. Several years after the acquisition, CMS introduced the new five-star system to encourage quality competition between nursing homes. To assess the staffing response to both PE ownership as well as the five-star system, we examine the evolution of staffing at both HCR ManorCare facilities and their associated matched controls. Figure 4 plots the mean RN and LPN hours of care at these facilities between 2003 and 2013. The first dashed line

indicates the Carlyle buyout, while the second dashed line indicates the introduction of the five-star rating system.

We observe that HCR ManorCare facilities increased both RN and LPN staffing beginning in 2007. In the case of RN staffing, this increase signals a divergence from the prevailing trend in corresponding non-PE facilities. Perhaps most striking however, is the clear shift in staffing behavior that both sets of nursing homes exhibit around 2009. The five-star system was designed to encourage higher overall staffing levels, but emphasized RN staffing in particular, giving equal weight to RN hours as total staffing hours. Notably, we observe that while all facilities increased RN staffing, HCR ManorCare facilities responded much more strongly in doing so. This may suggest a differential response to the rating system incentives by PE and non-PE facilities. Though the five-star system underscored RN staffing, they rewarded facilities equally for all other types of staffing. Due to the higher costs associated with LPN staffing, we might expect facilities to reduce LPN hours, either to substitute for less expensive CNAs or the more highly privileged RNs. We observe that while non-PE facilities keep LPN hours steady, HCR ManorCare facilities reduce LPN staffing. These trends once again highlight the distinct responses of PE and non-PE managers to the new five-star system.

5.3 Empirical Strategy and Results

In Section 4.2, we examined the interaction between local market concentration and PE ownership by comparing the estimated impacts of PE ownership for targets with different levels of local market concentration. In this section, we use a similar approach to examine how PE-owned facilities responded differently to the introduction of the five-star system. Specifically, we compare the impact of PE ownership before and after the five-star system was implemented.

We first study the impact of the five-star system on targets already under PE ownership when the five-star system was initially introduced. In particular, we compare how these PE-owned facilities responded to the five-star system in relation to the contemporaneous responses of their matched controls. To do this, we restrict our sample to include only the 902 targets acquired between 2005 and 2007 and their 4,492 matched controls. Recall that we restrict observations to include only four years before and after acquisition. Accordingly, the post-acquisition period for each of the deals in this subsample—such as HCR ManorCare—includes at least one year before and after the five-star rating system was introduced.

We estimate the following regression model on this subsample:

$$y_{ict} = \beta PE_{ict} + \beta^{5\star} PE_{ict} \mathbf{1}\{t \geq 2009\} + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}. \tag{5}$$

Table 3: Quality effects of LBOs around five-star system (2005-2007 deals)

	RN hours	LPN hours	CNA hours	RN share	Expenditure
PE_{ict}	0.0292	0.0000557	-0.0497***	0.00844	0.355
	(0.0197)	(0.00753)	(0.0170)	(0.00530)	(0.816)
$PE_{ict} \times Post2009_t$	0.0651***	-0.0352***	-0.00311	0.0183***	1.558***
	(0.0105)	(0.0135)	(0.0203)	(0.00328)	(0.432)
Controls	Yes	Yes	Yes	Yes	Yes
FE: SNF × Cohort	Yes	Yes	Yes	Yes	Yes
FE: Year × Cohort	Yes	Yes	Yes	Yes	Yes
N clusters	4,630	4,630	4,630	4,630	4,630
N observations	42,568	42,568	42,568	42,568	42,568
R^2	0.72	0.73	0.59	0.73	0.71
Mean	0.32	0.79	2.05	0.10	60.63
Std. Dev.	0.27	0.31	0.65	0.06	18.92

Note: The dependent variable *RN hours* represents the number of registered nurse hours of care that a facility provides per patient per day. Analogously, *LPN hours* and *CNA hours* measure licensed practical nurse and certified nursing assistant hours of care provided per patient per day. The dependent variable *RN share* is the fraction of total care hours provided by RNs, and *Expenditure* measures the approximate cost of providing the observed level of care (in $ per patient per day) based on 2019 hourly staff wages. Controls include a facility's occupancy rate, its number of total beds, and acuity index (a measure of the average intensity of care required by residents). All specifications include cohort-year fixed effects (controlling for common time series variation within each matched cohort) and cohort-facility fixed effects (controlling for facility-level differences within each matched cohort). Standard errors are provided in parentheses and are clustered by nursing home chain. The number of clusters indicates the number of chains in the analysis, where independent facilities not belonging to any chain are included as their own clusters. In each specification, an observation is a facility-year. Significance at the 10%, 5%, and 1% level are indicated using *, **, and ***, respectively.

The coefficient β is the impact of PE ownership for these facilities prior to the implementation of the five-star system. More importantly, $\beta^{5\star}$ measures the change in quality of PE-owned facilities around the introduction of the five-star policy relative to the change experienced by the matched control facilities. In other words, $\beta^{5\star}$ measures the degree to which the five-star policy had a greater (or lesser) impact on PE-owned facilities than comparable non-PE facilities. This approach is similar to the methodology employed by Bernstein, Lerner and Mezzanotti (2019), with the notable difference that we match targets to controls pre-acquisition and directly control for the baseline effect of PE ownership, whereas Bernstein, Lerner and Mezzanotti (2019) match targets to controls post-acquisition on the year prior to the policy change.

Table 3 presents the estimates from regression (5). We identify large and significant shifts in the staffing choices at PE-owned facilities following the introduction of the five-star rating system. Relative to non-PE facilities, PE-owned facilities dramatically increased RN staffing by 0.07 (20.3% of the mean) and decreased LPN staffing by 0.04 (4.5% of the mean). On average, PE ownership increased total direct care hours for these facilities by 0.03 (0.85% of the mean) in response to the five-star rating system. This shift away from LPN staffing and towards RN staffing is consistent with PE firms responding more aggressively to the incentives of the five-star system. While the change in direct care hours is small, the shift towards RN staffing is costly due to the wage premium demanded by RNs. In total, the staffing changes implemented

by PE managers constitute an additional annual expenditure of $57,742 for the median PE target in our subsample.

Regression (5) also identifies a baseline effect of PE ownership for these acquisitions prior to the implementation of the five-star system. Our results estimates indicate a .03 (9.1% of the mean) increase in RN staffing—though not statistically significant—and a .05 decrease (2.4% of the mean) in CNA staffing. On average, PE owners did not discernibly change LPN staffing. Taken together, these suggest that PE owners slightly shifted away from CNA staffing and towards RN staffing. This change would cost $13,147 per year at the median target in the subsample.

An important limitation of the aforementioned baseline estimates is that they apply only to acquisitions made between 2005 and 2007. Moreover, we may also be concerned that the impact of these acquisitions were affected by the heightened public and regulatory scrutiny of PE acquisitions brought on by The Carlyle Group's acquisition of HCR ManorCare in 2007. As a result, PE owners may have been especially careful not to risk drawing further ire by reducing quality. *The New York Times* wrote of HCR ManorCare's attempt to assuage residents' and regulators' concerns about its acquisition by The Carlyle Group:[37]

> *To counter such criticisms, Manor Care began sending letters to regulators and officials in the 32 states where its facilities are located, pledging to maintain staff levels and other quality standards. The company has also sent letters to residents and their families criticizing the article in The Times and the union's efforts.*

If HCR ManorCare and other targets during this period avoided reducing quality due to heightened scrutiny, then our estimate of β from (5) would capture this effect in addition to the unadulterated impact of PE ownership. In order to disentangle the effect of heightened scrutiny from the baseline effect of PE ownership, we use the full sample of PE deals and control directly for the heightened scrutiny of PE deals following the 2007 acquisition of HCR ManorCare:

$$y_{ict} = \beta PE_{ict} + \beta^S PE_{ict}\mathbf{1}\{t \geq 2007\} + \beta^{5\star} PE_{ict}\mathbf{1}\{t \geq 2009\} + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}. \tag{6}$$

Here, β gives the baseline estimate of the impact of PE ownership, β^S gives the impact of heightened scrutiny on the effect of PE ownership, and $\beta^{5\star}$ once again measures the effect of the five-star rating system on the impact of PE ownership.

Table 4 presents our estimates of regression (6). We find that after expanding the sample and controlling for heightened scrutiny, the impact of PE ownership on quality prior to the five-star system is distinctly worse. We estimate that prior to heightened scrutiny and the five-star system, PE ownership is associated

[37] See "Inquiries at Investor-Owned Nursing Homes," dated October 24, 2007.

Table 4: Quality effects of LBOs around five-star system (all deals)

	RN hours	LPN hours	CNA hours	RN share	Expenditure
PE_{ict}	-0.0214	-0.0198**	-0.0585**	0.000495	-2.123**
	(0.0140)	(0.0100)	(0.0272)	(0.00276)	(0.925)
$PE_{ict} \times Post2007_t$	0.0348*	0.0186	-0.00182	0.00428	1.703
	(0.0181)	(0.0115)	(0.0300)	(0.00408)	(1.065)
$PE_{ict} \times Post2009_t$	0.0668***	-0.0252*	0.0121	0.0180***	2.078***
	(0.0124)	(0.0148)	(0.0216)	(0.00358)	(0.575)
Controls	Yes	Yes	Yes	Yes	Yes
FE: SNF × match	Yes	Yes	Yes	Yes	Yes
FE: Year × match	Yes	Yes	Yes	Yes	Yes
N clusters	7,517	7,517	7,517	7,517	7,517
N observations	67,435	67,434	67,427	67,419	67,426
R^2	0.73	0.72	0.62	0.75	0.72
Mean	0.33	0.78	2.06	0.10	60.99
Std. Dev.	0.32	0.34	0.67	0.07	22.56

Note: The dependent variable *RN hours* represents the number of registered nurse hours of care that a facility provides per patient per day. Analogously, *LPN hours* and *CNA hours* measure licensed practical nurse and certified nursing assistant hours of care provided per patient per day. The dependent variable *RN share* is the fraction of total care hours provided by RNs, and *Expenditure* measures the approximate cost of providing the observed level of care (in $ per patient per day) based on 2019 hourly staff wages. Controls include a facility's occupancy rate, its number of total beds, and acuity index (a measure of the average intensity of care required by residents). All specifications include cohort-year fixed effects (controlling for common time series variation within each matched cohort) and cohort-facility fixed effects (controlling for facility-level differences within each matched cohort). Standard errors are provided in parentheses and are clustered by nursing home chain. The number of clusters indicates the number of chains in the analysis, where independent facilities not belonging to any chain are included as their own clusters. In each specification, an observation is a facility-year. Significance at the 10%, 5%, and 1% level are indicated using *, **, and ***, respectively.

with lower RN, LPN, and CNA staffing. These reductions are respectively .02 (6.48% of the mean), .02 (2.54% of the mean), and .06 (2.84% of the mean) hours per patient day. Only the reduction in RN staffing is not statistically significant at the 5% level. Taken together, these staffing reductions account for $2.12 of patient care per day, or $78,695 per year for the average facility.

As anticipated, we find that the heightened scrutiny of PE acquisitions following the acquisition of HCR ManorCare resulted in greater expenditure on staffing. This is most notable in a statistically significant increase of .03 RN hours relative to the baseline impact of PE ownership. Overall, the estimated staffing changes induced by heightened scrutiny cost approximately $1.70 per patient day ($63,129 annually).

Finally, our estimates of $\beta^{5\star}$ are similar to those Table 3. Even having expanded our sample and controlled for heightened scrutiny, we still find that PE-owned facilities increase RN staffing and decrease LPN staffing more than their non-PE controls in response to the five-star system. The magnitude of these effects are substantial: RN staffing increases by .07 hours per patient day (20.24% of the mean), and LPN staffing decreases by .03 (3.23% of the mean). In total, the five-star system induced PE owners to increase expenditure on staffing at levels of $77,063 annually for the average PE target. This corresponds to hiring an additional 1.05 RNs, 1.62 LPNs, or 2.60 CNAs full-time.

An important implication of our estimates in this section is that the impact of PE ownership has changed over time due to heightened public scrutiny and variation in competitive incentives from the five-star rating system. Our estimates from Section 4.1 must therefore be carefully interpreted as an average impact of PE ownership on acquired facilities over time. Similarly, our estimates in this section must be considered as being an average over markets with differing levels of market concentration. To disentangle the effects of these two forces, Table 5 re-estimates regression (6) while allowing for heterogeneity across differing levels of market concentration:

$$\begin{aligned} y_{ict} = PE_{ict} Comp_c \left(\beta^{pre} \mathbf{1}\{t < 2009\} + \beta^{post} \mathbf{1}\{t \geq 2009\}\right) \\ + \beta^{S} PE_{ict} \mathbf{1}\{t \geq 2007\} + \gamma X_{ict} + \alpha_{ic} + \alpha_{ct} + \epsilon_{ict}. \end{aligned} \tag{7}$$

$$Comp_c := \begin{bmatrix} LowComp_c \\ MidComp_c \\ HighComp_c \end{bmatrix}' ; \quad \beta^{pre} := \begin{bmatrix} \beta^{pre}_{low} \\ \beta^{pre}_{mid} \\ \beta^{pre}_{high} \end{bmatrix} ; \quad \beta^{post} := \begin{bmatrix} \beta^{post}_{low} \\ \beta^{post}_{mid} \\ \beta^{post}_{high} \end{bmatrix}. \tag{8}$$

where $Comp_c$ indicates $LowComp_c$, $MidComp_c$, or $HighComp_c$ according to the local market concentration.[38] Though the regression asks much from the data, the results are broadly consistent with our findings on market concentration and the five-star system.

[38] In Appendix Table B.1, we analogously re-estimate regression (5) to vary according to local market concentration.

Table 5: Interacting market concentration and five-star system (all deals)

	RN hours	LPN hours	CNA hours	RN share	Expenditure
Scrutiny					
$PE_{ict} \times Post2007_t$	0.0356**	0.0192	-0.00222	0.00445	1.738
	(0.0176)	(0.0118)	(0.0300)	(0.00391)	(1.057)
Pre-Policy Estimates					
$PE_{ict} \times LowComp_c$	-0.0264*	-0.00430	-0.0726**	-0.00108	-2.156**
	(0.0150)	(0.0118)	(0.0283)	(0.00293)	(0.875)
$PE_{ict} \times MidComp_c$	-0.0388**	-0.0428***	-0.0410	-0.00333	-3.051**
	(0.0177)	(0.0144)	(0.0368)	(0.00354)	(1.205)
$PE_{ict} \times HighComp_c$	0.00326	-0.0112	-0.0623*	0.00646	-1.055
	(0.0228)	(0.0165)	(0.0362)	(0.00530)	(1.337)
Post-Policy Estimates					
$PE_{ict} \times LowComp_c$	0.00835	-0.0415*	-0.0467	0.00890***	-1.358
	(0.0162)	(0.0216)	(0.0363)	(0.00339)	(1.042)
$PE_{ict} \times MidComp_c$	0.0337**	-0.0547***	-0.0619	0.0175***	-0.947
	(0.0171)	(0.0168)	(0.0490)	(0.00497)	(1.225)
$PE_{ict} \times HighComp_c$	0.0940***	-0.0389	-0.0266	0.0287***	2.224*
	(0.0230)	(0.0249)	(0.0495)	(0.00626)	(1.252)
Controls	Yes	Yes	Yes	Yes	Yes
FE: SNF × Cohort	Yes	Yes	Yes	Yes	Yes
FE: Year × Cohort	Yes	Yes	Yes	Yes	Yes
N clusters	7,517	7,517	7,517	7,517	7,517
N observations	67,435	67,434	67,427	67,419	67,426
R^2	0.73	0.72	0.62	0.75	0.72
Mean	0.33	0.78	2.06	0.10	60.99
Std. Dev.	0.32	0.34	0.67	0.07	22.56

Note: The dependent variable *RN hours* represents the number of registered nurse hours of care that a facility provides per patient per day. Analogously, *LPN hours* and *CNA hours* measure licensed practical nurse and certified nursing assistant hours of care provided per patient per day. The dependent variable *RN share* is the fraction of total care hours provided by RNs, and *Expenditure* measures the approximate cost of providing the observed level of care (in $ per patient per day) based on 2019 hourly staff wages. Controls include a facility's occupancy rate, its number of total beds, and acuity index (a measure of the average intensity of care required by residents). All specifications include cohort-year fixed effects (controlling for common time series variation within each matched cohort) and cohort-facility fixed effects (controlling for facility-level differences within each matched cohort). Standard errors are provided in parentheses and are clustered by nursing home chain. The number of clusters indicates the number of chains in the analysis, where independent facilities not belonging to any chain are included as their own clusters. In each specification, an observation is a facility-year. Significance at the 10%, 5%, and 1% level are indicated using *, **, and ***, respectively.

We find that the differential impact of the five-star incentives on PE-owned facilities is most clearly concentrated in highly competitive markets, where we would expect the gains from quality to be highest. For example, prior to the five-star system, PE ownership is associated with a decrease in RN staffing in low- (-0.03 hours) and mid-competition (-0.04 hours) markets, but not highly competitive ones. In contrast, PE ownership increases RN staffing in all markets following the five-star system introduction, though the effect is increasing in level of competition. Though the policy mitigates the detrimental effects of PE ownership in low- (now 0.01 hours) and mid-competition (now 0.03 hours) markets, the effects are both strongest and most significant in very competitive markets. Under high competition, PE owners increased RN staffing by 0.09 hours per patient day (28.5% of the mean). The associated changes in expenditure brought about by PE ownership in high-competition markets is particularly noticeable: PE owners reduced expenditure by $1.06 per patient day ($38,192 annually) before the policy, but increased expenditure by $2.22 ($80,512 annually) afterward.

To fully appreciate the role of competitive incentives in mediating PE behavior, consider the contrast in PE ownership effects in the weakest incentive setting (low-competition market, before five-star system) and the strongest one (high-competition market, after five-star system). We find that PE owners in highly competitive markets under the five-star system increase staffing expenditure by 3.6% of the mean, or enough to raise RN staffing by 15% of the mean. On the other hand, acquisitions in less competitive markets prior to the introduction of the five-star system lowered staffing expenditure by 4.3% of the mean, cost-equivalent to reducing RN staffing by 21% of the mean. Taken together, our results underscore the substantial impact of market concentration and pro-competition policies on PE behavior in the nursing home industry.

5.4 Identification

Lastly, we examine the empirical validity of estimating equations (5) and (6). As we previously described in the discussion of results in Section 4.3, causal interpretation of difference-in-differences estimates is based on the parallel trends assumption. In both regressions (5) and (6), properly identifying β—the baseline effect of PE ownership—requires that the target and control facilities would have evolved similarly in the absence of acquisition. Stated alternatively, we should find no evidence of PE ownership impacting staffing prior to the acquisition itself. This is the identical criterion we considered for equation (1). In Section 4, we verified that staffing levels change in a parallel fashion in the pre-LBO period, as we observe no treatment effects until after acquisition.

There is, however, a potential concern regarding the identification of $\beta^{5\star}$. Namely, if PE firms implement changes in staffing policy slowly over time, we may misattribute the progressive nature of treatment to the

effect of the five-star system introduction in 2009. An analogous concern could likewise bias the estimate of β^S as well. PE firms that acquire facilities several years prior to 2007 or 2009 may simply require more time to implement changes stemming from their initial takeover. Our key finding of a shift toward RN staffing is robust to specifications controlling for this concern.[39]

6 Conclusion

Policymakers, academics, and the public have long expressed concerns about the impact of private equity acquisitions on stakeholders such as consumers. These concerns are perhaps most pronounced in the health-care industry given its economic importance, the high degree of public subsidy, and a consumer population that is typically ill and vulnerable to exploitation. We study the impact of PE investments in nursing homes, a clear instance where these factors are significant.

Our findings highlight a significant heterogeneity in the effect of PE ownership based on competitive incentives. We first examine PE ownership effects based on local market concentration, and determine that PE managers are more sensitive to competitive incentives than non-PE managers: PE-owned facilities increase the value of care provided in highly competitive markets, while reducing the value of care in less competitive markets. We also consider whether PE managers are more responsive to shocks in competition over time. Following the introduction of the Five-Star Quality Rating System, a salience policy intended to spur quality competition, PE-owned facilities were more aggressive in shifting their staffing composition towards higher-skilled nurses, and increased the overall value of care provided by more than their non-PE counterparts. The effects of market concentration and pro-competition policies are especially significant when considered jointly. In highly competitive markets under the five-star system, PE managers spend enough to raise RN levels by 18.1% of the mean, while acquisitions in less competitive markets prior to the five-star system led to spending cuts amounting to RN reductions of 21.3%. Our results demonstrate that competitive incentives are pivotal to understanding PE behavior, as these forces may ultimately determine whether PE acquisitions benefit or harm consumers.

[39] When including controls for differential policy impacts in each year separately, we lose statistical precision for the LPN decline around 2009.

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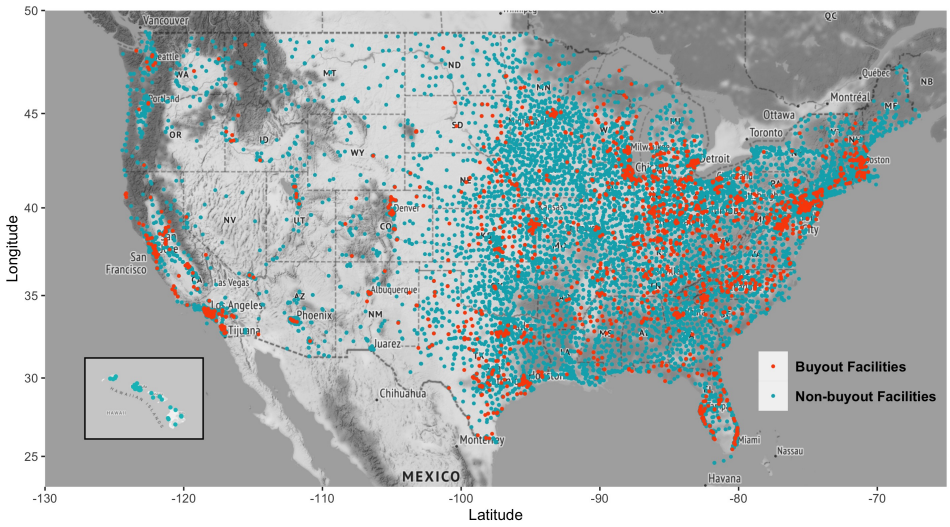
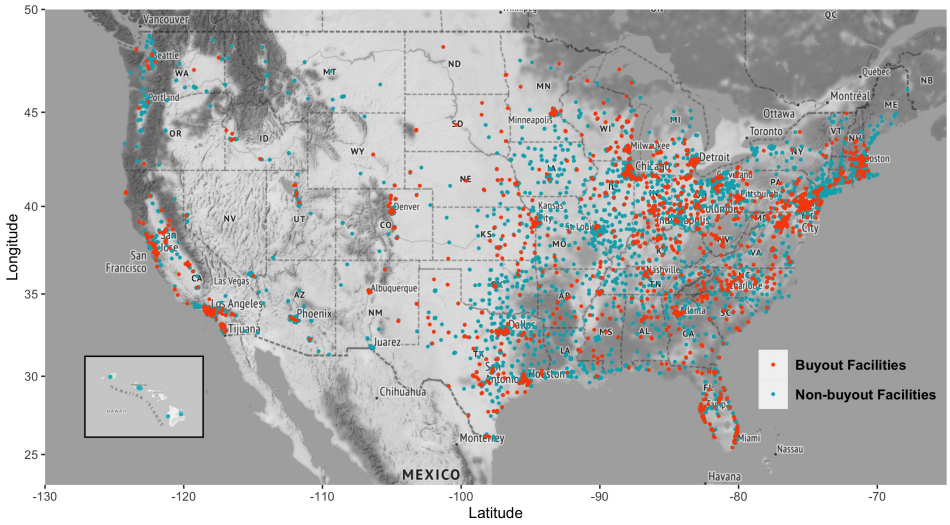
A Additional Figures

Figure A.1: Facility Locations



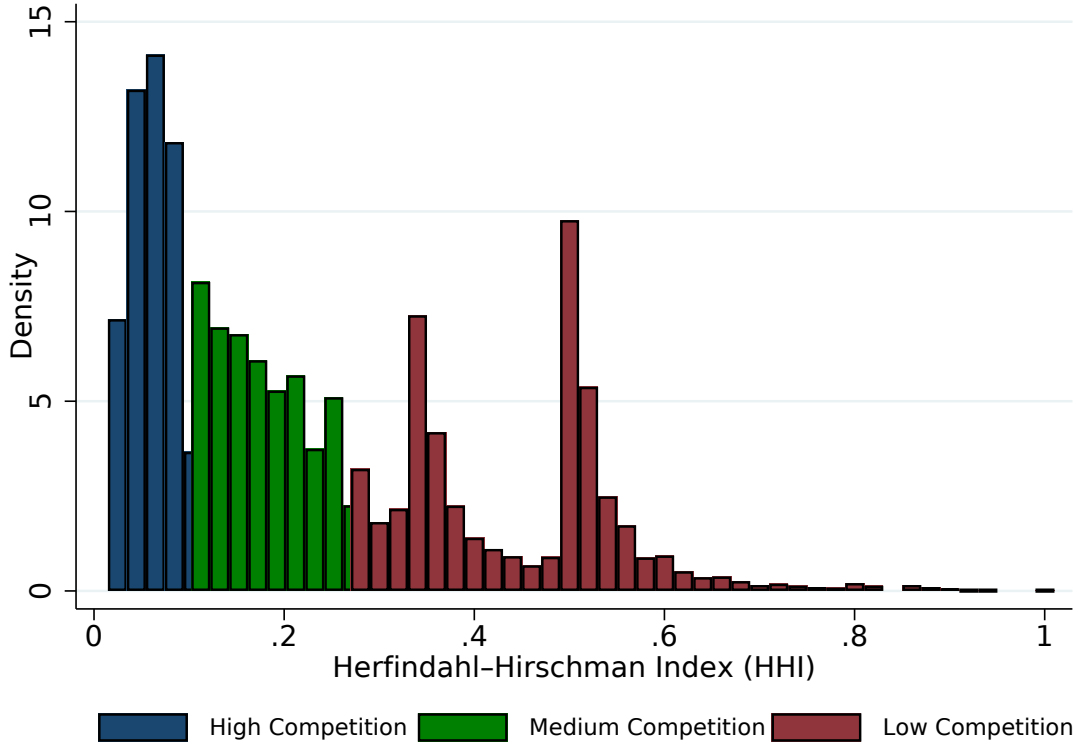
(a) All Facilities



(b) Matched Sample

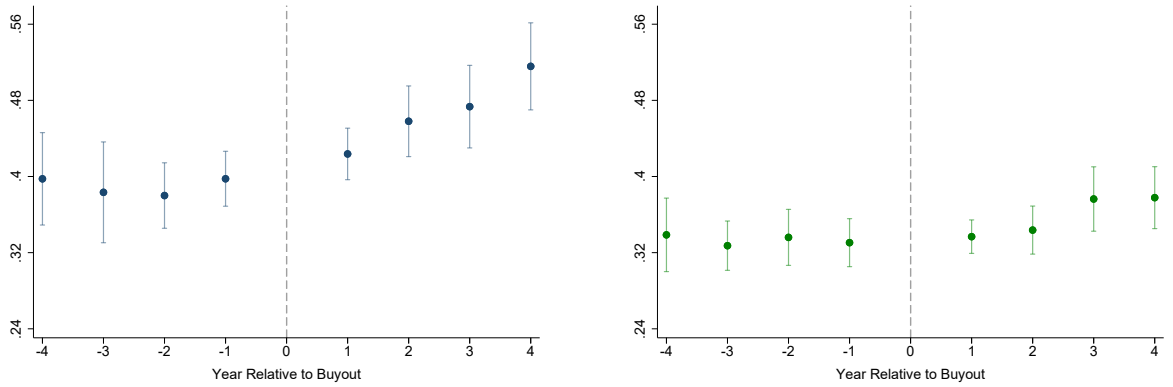
Notes: Maps display geographic location of target and non-target facilities in the full and matched samples.

Figure A.2: HHI Distributions for Matched Samples: Match in Year Before Acquisition



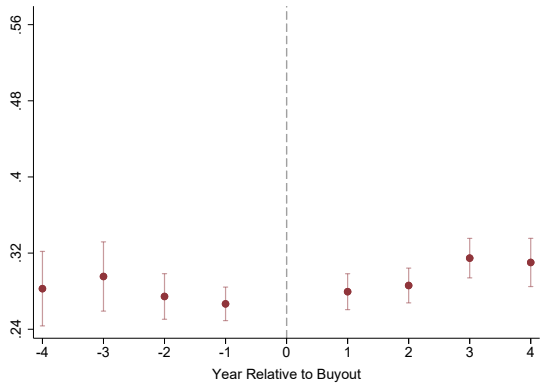
Notes: These reflect HHIs computed using bed capacity within a 10km radius.

Figure A.3: Changes in RN hours per patient day around buyouts

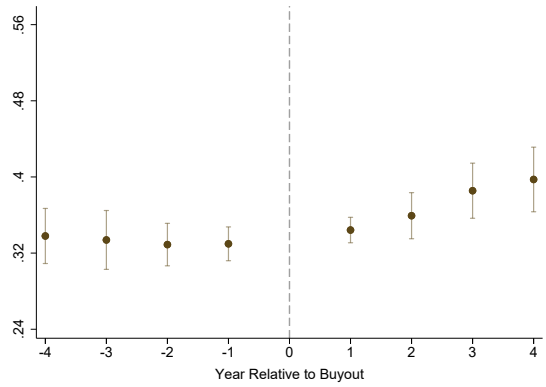


(a) High Competition

(b) Medium Competition



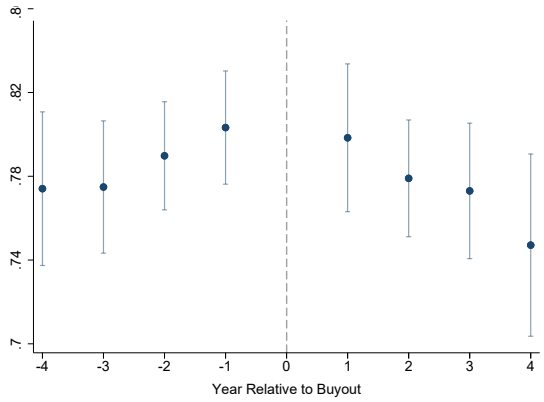
(c) Low Competition



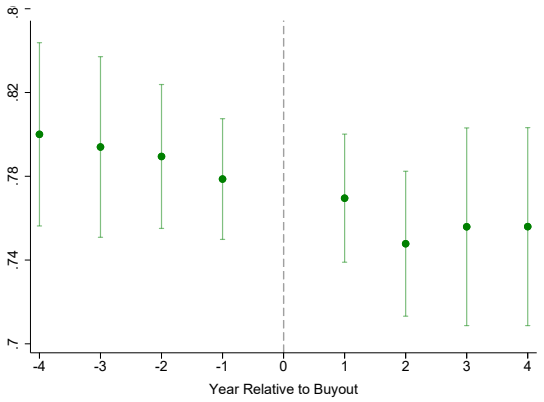
(d) All Markets

Notes: These figures present the estimates of $\{\beta^L_{t-\tau_c}\}$, $\{\beta^M_{t-\tau_c}\}$, and $\{\beta^H_{t-\tau_c}\}$ from (4). The values have been shifted up by the match-year mean of the dependent variable to provide scale.

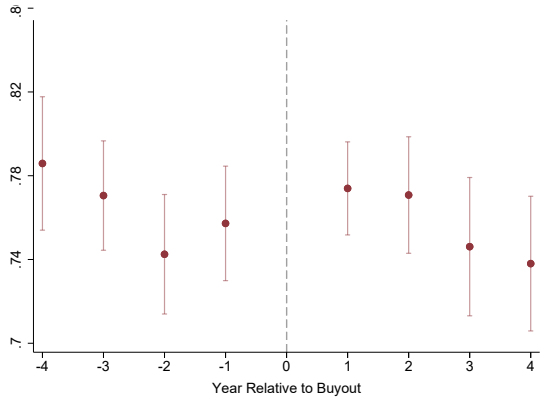
Figure A.4: Changes in LPN hours per patient day around buyouts



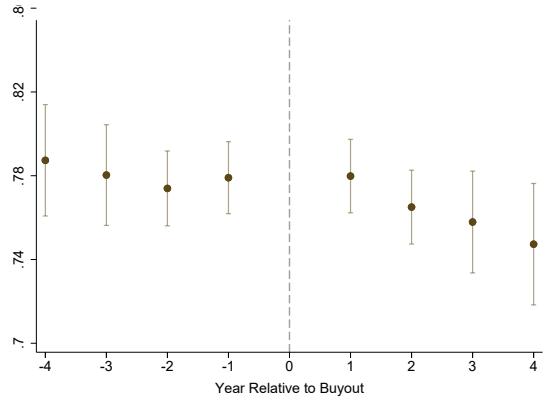
(a) High Competition



(b) Medium Competition



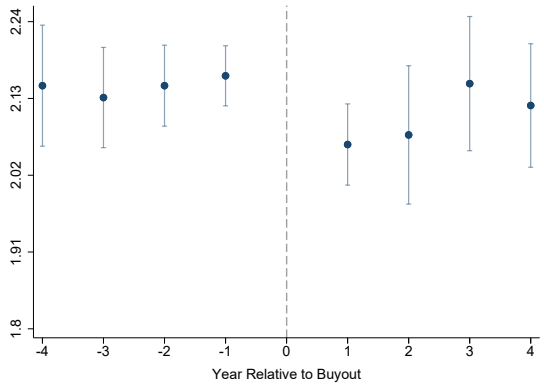
(c) Low Competition



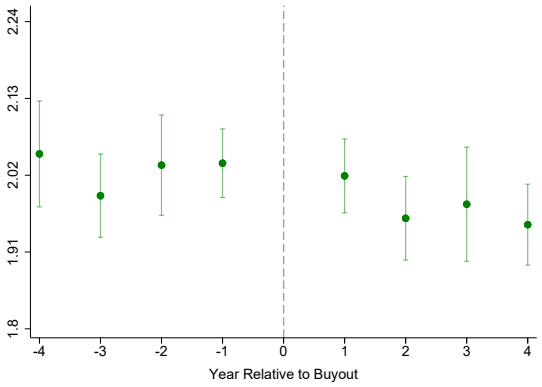
(d) All Markets

Notes: These figures present the estimates of $\{\beta^L_{t-\tau_c}\}$, $\{\beta^M_{t-\tau_c}\}$, and $\{\beta^H_{t-\tau_c}\}$ from (4). The values have been shifted up by the match-year mean of the dependent variable to provide scale.

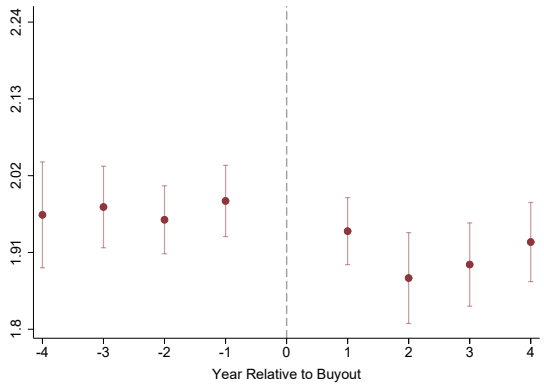
Figure A.5: Changes in CNA hours per patient day around buyouts



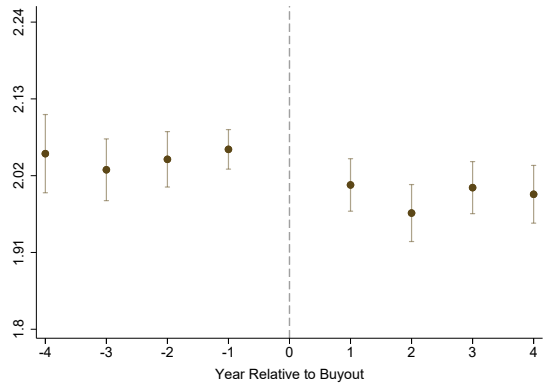
(a) High Competition



(b) Medium Competition



(c) Low Competition



(d) All Markets

Notes: These figures present the estimates of $\{\beta^L_{t-\tau_c}\}$, $\{\beta^M_{t-\tau_c}\}$, and $\{\beta^H_{t-\tau_c}\}$ from (4). The values have been shifted up by the match-year mean of the dependent variable to provide scale.

B Additional Tables

Table B.1: Interacting market concentration and five-star system (2005-2007 deals)

	RN hours	LPN hours	CNA hours	RN share	Expenditure
Pre-Policy Estimates					
$PE_{ict} \times LowComp_c$	0.0127	0.0184**	-0.0661***	0.00434	-0.0759
	(0.0131)	(0.00863)	(0.0218)	(0.00285)	(0.683)
$PE_{ict} \times MidComp_c$	0.0243*	-0.0293***	-0.0437*	0.00865**	-0.424
	(0.0129)	(0.0112)	(0.0263)	(0.00430)	(0.765)
$PE_{ict} \times HighComp_c$	0.0514	0.0147	-0.0395	0.0123	1.676
	(0.0336)	(0.0152)	(0.0388)	(0.00895)	(1.307)
Post-Policy Estimates					
$PE_{ict} \times LowComp_c$	0.0341**	-0.0460**	0.00544	0.0110***	0.276
	(0.0138)	(0.0209)	(0.0278)	(0.00399)	(0.569)
$PE_{ict} \times MidComp_c$	0.0582***	-0.0184	-0.0347	0.0179***	1.224
	(0.0132)	(0.0127)	(0.0395)	(0.00424)	(0.772)
$PE_{ict} \times HighComp_c$	0.0999***	-0.0432*	0.0218	0.0252***	3.034***
	(0.0123)	(0.0234)	(0.0348)	(0.00393)	(1.164)
Controls	Yes	Yes	Yes	Yes	Yes
FE: SNF × Cohort	Yes	Yes	Yes	Yes	Yes
FE: Year × Cohort	Yes	Yes	Yes	Yes	Yes
N clusters	4,630	4,630	4,630	4,630	4,630
N observations	42,568	42,568	42,568	42,568	42,568
R^2	0.72	0.73	0.59	0.73	0.71
Mean	0.32	0.79	2.05	0.10	60.63
Std. Dev.	0.27	0.31	0.65	0.06	18.92

Table B.2: Changes in deficiencies around PE acquisitions

	Total Deficiencies			Standard Deficiencies			Complaint Deficiencies		
	ln(Points)	ln(Pts/beds)	Pts/beds	ln(Points)	ln(Pts/beds)	Pts/beds	ln(Points)	ln(Pts/beds)	Pts/beds
Panel A: Specification 1									
PE_{ict}	0.0122	0.0141	-0.00141	-0.0204	-0.0186	-0.0139	0.182**	0.362***	0.0168
	(0.0238)	(0.0267)	(0.0156)	(0.0214)	(0.0257)	(0.0115)	(0.0741)	(0.121)	(0.0174)
Panel B: Specification 2									
$PE_{ict} \times LowComp_c$	0.0411	0.0317	0.0228	0.000694	-0.00465	-0.0113	0.236*	0.424*	0.0437
	(0.0439)	(0.0503)	(0.0364)	(0.0396)	(0.0467)	(0.0261)	(0.140)	(0.245)	(0.0440)
$PE_{ict} \times MidComp_c$	0.00437	0.00967	0.0111	-0.0356	-0.0321	0.00116	0.286**	0.529**	0.0356
	(0.0374)	(0.0435)	(0.0268)	(0.0382)	(0.0463)	(0.0183)	(0.139)	(0.226)	(0.0251)
$PE_{ict} \times HighComp_c$	-0.0104	-0.0000311	-0.0442*	-0.0252	-0.0174	-0.0355*	0.0190	0.121	-0.0278*
	(0.0440)	(0.0464)	(0.0254)	(0.0418)	(0.0472)	(0.0186)	(0.0868)	(0.147)	(0.0167)
Panel C: Specification 2 ($LowComp_c$ as baseline)									
PE_{ict}	0.0411	0.0317	0.0228	0.000694	-0.00465	-0.0113	0.236*	0.424*	0.0437
	(0.0439)	(0.0503)	(0.0364)	(0.0396)	(0.0467)	(0.0261)	(0.140)	(0.245)	(0.0440)
$PE_{ict} \times MidComp_c$	-0.0368	-0.0220	-0.0117	-0.0363	-0.0274	0.0125	0.0507	0.104	-0.00812
	(0.0575)	(0.0673)	(0.0499)	(0.0575)	(0.0691)	(0.0324)	(0.199)	(0.336)	(0.0528)
$PE_{ict} \times HighComp_c$	-0.0515	-0.0317	-0.0670	-0.0259	-0.0127	-0.0242	-0.217	-0.304	-0.0715
	(0.0620)	(0.0682)	(0.0498)	(0.0639)	(0.0718)	(0.0344)	(0.186)	(0.320)	(0.0504)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: SNF × Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: Year × Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N clusters	6,648	6,648	6,648	6,648	6,648	6,648	4,399	4,399	4,399
N observations	60,217	60,217	60,217	60,217	60,217	60,217	33,031	33,031	33,031
R^2	0.55	0.54	0.51	0.53	0.52	0.53	0.55	0.53	0.46
Mean	3.57	-1.17	0.57	3.42	-1.34	0.47	1.48	-4.40	0.16
Std. Dev.	1.08	1.31	0.69	1.05	1.31	0.55	1.68	2.67	0.37

Table B.3: Changes in quality metrics around PE acquisitions

	QM Points	Long-Stay Points	Short-Stay Points
Panel A: Specification 1			
PE_{ict}	-0.110	-0.0924	-0.0174
	(1.011)	(0.961)	(0.335)
Panel B: Specification 2			
$PE_{ict} \times LowComp_c$	-0.709	-0.471	-0.238
	(2.126)	(1.626)	(0.610)
$PE_{ict} \times MidComp_c$	0.110	-0.0966	0.206
	(1.123)	(1.135)	(0.369)
$PE_{ict} \times HighComp_c$	0.225	0.287	-0.0619
	(1.091)	(1.265)	(0.346)
Panel C: Specification 2 ($LowComp_c$ as baseline)			
PE_{ict}	-0.709	-0.471	-0.238
	(2.126)	(1.626)	(0.610)
$PE_{ict} \times MidComp_c$	0.818	0.374	0.444
	(1.939)	(1.607)	(0.574)
$PE_{ict} \times HighComp_c$	0.934	0.758	0.176
	(2.453)	(2.042)	(0.623)
Controls	Yes	Yes	Yes
FE: SNF × match	Yes	Yes	Yes
FE: Year × match	Yes	Yes	Yes
N clusters	4,829	4,829	4,829
N observations	39,453	39,453	39,453
R^2	0.68	0.70	0.62
Mean	71.87	51.31	20.56
Std. Dev.	17.88	15.33	6.81

Table B.4: Changes in miscellaneous metrics around PE acquisitions

	Of Residents					Of Admitted			
	Rehosp.	Hosp./yr	Restraints	% DNR	% DNR	% from hosp.	% from home	Avg. ADL	Avg. CMI
Panel A: Specification 1									
PE_{ict}	0.240	0.0161	0.707	1.858	2.354	-0.432	-0.235	-0.111	-0.00396
	(0.268)	(0.0179)	(0.500)	(1.371)	(2.057)	(0.381)	(0.416)	(0.141)	(0.00610)
Panel B: Specification 2									
$PE_{ict} \times LowComp_c$	-0.0445	-0.00831	1.060	1.762*	1.840	-0.666	0.150	-0.171	-0.00893
	(0.295)	(0.0152)	(0.666)	(0.968)	(1.208)	(0.534)	(0.610)	(0.118)	(0.00637)
$PE_{ict} \times MidComp_c$	0.610***	0.0247	0.887*	2.584	2.878	-0.494	-0.196	-0.105	-0.00244
	(0.235)	(0.0190)	(0.535)	(1.588)	(2.588)	(0.543)	(0.799)	(0.122)	(0.00523)
$PE_{ict} \times HighComp_c$	0.0453	0.0327	0.0862	1.014	2.306	-0.0961	-0.949**	-0.0525	-0.000227
	(0.416)	(0.0261)	(0.515)	(2.176)	(2.874)	(0.537)	(0.436)	(0.251)	(0.00920)
Panel C: Specification 2 ($LowComp_c$ as baseline)									
PE_{ict}	-0.0445	-0.00831	1.060	1.762*	1.840	-0.666	0.150	-0.171	-0.00893
	(0.295)	(0.0152)	(0.666)	(0.968)	(1.208)	(0.534)	(0.610)	(0.118)	(0.00637)
$PE_{ict} \times MidComp_c$	0.654**	0.0331*	-0.173	0.823	1.038	0.172	-0.346	0.0664	0.00649**
	(0.298)	(0.0177)	(0.599)	(1.374)	(2.059)	(0.634)	(1.146)	(0.0959)	(0.00327)
$PE_{ict} \times HighComp_c$	0.0898	0.0410	-0.974	-0.748	0.465	0.570	-1.099	0.118	0.00870
	(0.377)	(0.0255)	(0.716)	(1.773)	(2.279)	(0.665)	(0.767)	(0.217)	(0.00698)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: SNF × Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: Year × Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N clusters	4,170	6,487	6,686	5,454	5,371	6,447	3,957	5,856	5,855
N observations	34,918	58,977	60,825	49,040	47,248	58,110	26,782	52,931	52,913
R^2	0.73	0.77	0.62	0.89	0.85	0.81	0.83	0.84	0.81
Mean	20.74	0.98	6.32	56.19	38.14	77.58	13.76	15.90	1.04
Std. Dev.	6.31	0.57	8.17	20.84	20.10	16.38	10.42	2.99	0.11

Table B.5: Changes in patient composition around PE acquisitions

	Discharges			Admissions			Length of Stay		
	Medicare	Medicaid	Total	Medicare	Medicaid	Total	Medicare	Medicaid	Total
Panel A: Specification 1									
PE_{ict}	-21.78***	-0.523	4.720	-22.54***	-0.989	-7.394	14.26***	52.87	-8.012
	(8.378)	(6.073)	(15.31)	(6.393)	(4.969)	(14.84)	(5.119)	(44.90)	(15.26)
Panel B: Specification 2									
$PE_{ict} \times LowComp_c$	-9.949	8.613	21.78	-11.83**	1.103	-7.483	11.26**	71.81	-5.527
	(6.609)	(11.50)	(33.47)	(6.005)	(6.212)	(13.25)	(5.732)	(67.14)	(22.81)
$PE_{ict} \times MidComp_c$	-20.50**	-1.408	-2.325	-20.48***	2.173	3.007	18.54**	61.06	-2.706
	(9.370)	(4.941)	(21.76)	(6.582)	(4.726)	(18.76)	(7.215)	(50.18)	(14.41)
$PE_{ict} \times HighComp_c$	-36.55***	-9.666	-5.801	-37.03***	-7.169	-19.93	12.40	21.73	-17.24
	(12.20)	(7.560)	(19.78)	(10.29)	(7.296)	(17.49)	(13.37)	(40.02)	(13.51)
Panel C: Specification 2 ($LowComp_c$ as baseline)									
PE_{ict}	-9.949	8.613	21.78	-11.83**	1.103	-7.483	11.26**	71.81	-5.527
	(6.609)	(11.50)	(33.47)	(6.005)	(6.212)	(13.25)	(5.732)	(67.14)	(22.81)
$PE_{ict} \times MidComp_c$	-10.55	-10.02	-24.11	-8.647	1.070	10.49	7.273	-10.75	2.821
	(7.783)	(10.21)	(36.82)	(7.447)	(4.411)	(9.905)	(6.897)	(50.07)	(15.06)
$PE_{ict} \times HighComp_c$	-26.60**	-18.28	-27.58	-25.20**	-8.272	-12.45	1.139	-50.08	-11.71
	(12.62)	(11.98)	(39.10)	(11.23)	(6.648)	(12.18)	(15.65)	(59.56)	(15.65)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: SNF × Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: Year × Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N clusters	5,975	5,975	5,975	5,975	5,975	5,975	5,975	5,975	5,975
N observations	54,416	54,416	54,416	54,416	54,416	54,416	54,416	54,416	54,416
R^2	0.86	0.55	0.45	0.89	0.49	0.85	0.42	0.45	0.56
Mean	162.18	63.52	339.60	184.89	50.11	331.64	64.40	454.17	204.93
Std. Dev.	184.78	147.77	713.10	193.15	110.91	345.43	148.25	1,025.07	255.74

C Details on the Five-Star Quality Rating System

In this section, we provide additional detail regarding the Five-Star Quality Rating System that was introduced by CMS in December 2008. The policy aimed to provide patients with easily digestible information about quality to aid them in choosing higher quality facilities. The system rated facilities on three key dimensions: staffing, health inspections, and an aggregation of quality measures (QMs) computed from Minimum Data Set (MDS) resident assessments. These ratings were displayed prominently on the Nursing Home Compare website (Figure C.1) that CMS encouraged prospective residents to consult when choosing a nursing home. The following sections detail the five star system in its first year based on documentation from CMS' October 2009 technical users' guide. The general structure of the system remains unchange to date, however some changes have been implemented sine 2009, such as adjusting ratings thresholds, changing featured MDS measures, and more heavily penalizing inadequate RN staffing.

C.1 Staffing

Staffing ratings were computed based on a combination of two ratings: RN staffing and total staffing (RN + LPN + CNA staffing). CMS sourced staffing levels and resident counts from the form CMS-671. These forms, recorded in OSCAR/CASPER and underlying LTCFocus, are also the source of the staffing data used in our study. CMS translated these measures in to hours per patient day using counts of resident census from form CMS-672. These forms are also the source of facility census counts used in our study. CMS additionally normalizes their staffing measures by an estimate of the care intensity required by a facility's patients based on the MDS resident assessments.[40]

In computing an overall staffing rating, RN staffing and total staffing were given equal weight. First, CMS computed separate five-star ratings for each measure based on percentile thresholds from 2008 (see Table C.1).

The RN and total staffing measures are then combined into a singular measure according to the following table:

[40] Formally, rather than using the number of hours of care provided, CMS uses

$$Hours_{adjusted} := \frac{Hours_{reported}}{Hours_{Expected}} Hours_{NationalAverage},$$

where $Hours_{reported}$ is staffing reported on CMS-671 and $Hours_{NationalAverage}$ is a lagged national unadjusted mean staffing measure. This measure was computed based on .63989 RN hours per patient day and 3.83862 total care hours per patient day for the first two years of the rating system. $Hours_{Expected}$ is the expected hours of care required for a facility's patients based on their resource utilization group (RUG) as reported in the MDS, where each RUG is assumed to require a particular number of hours per care.

Table C.1: Scoring Method and Thresholds for Staffing Measures

Rating	Definition	Range (adjusted hours per resident day) RN	Total
1	$< 25^{th}$-percentile of distribution for freestanding facilities	<0.221	<2.998
2	at least 25^{th}-percentile but less than median of the distribution for freestanding facilities	$\geq$ 0.221 - <0.298	$\geq$ 2.998 - <3.376
3	greater than or equal to the median but less the 75^{th}-percentile of the distribution for freestanding facilities	$\geq$ 0.298 - <0.402	$\geq$ 3.376 - <3.842
4	greater than or equal to the 75^{th} percentile of the distribution for freestanding facilities but less than the CMS staffing study threshold	$\geq$ 0.402 - <0.550	$\geq$ 3.842 - <4.080
5	at or exceeding the thresholds identified in the CMS staffing study	$\geq$ 0.550	$\geq$ 4.080

Notes: The cut points are based on data reported to CMS as of 11/4/2008 and are being maintained at that fixed baseline level for two years.

Note that the 0.55 RN threshold was identified for potentially avoidable hospitalizations (short-stay measures); the 4.08 threshold is the sum of the NA (2.78) and licensed staff (1.30) threshold for long-stay measures.

Source: Centers for Medicare & Medicaid Services "Design for *Nursing Home Compare* Five-Star Quality Rating System: Technical Users' Guide" (October 2009).

Table C.2: Computing Overall Staffing Rating

		Total Staffing Rating				
RN Rating		**1-star**	**2-stars**	**3-stars**	**4-stars**	**5-stars**
	1-star	1-star	1-star	2-stars	2-stars	3-stars
	2-stars	1-star	2-stars	3-stars	3-stars	4-stars
	3-stars	2-stars	3-stars	4-stars	4-stars	4-stars
	4-stars	2-stars	3-stars	4-stars	4-stars	4-stars
	5-stars	3-stars	4-stars	4-stars	4-stars	5-stars

Source: Centers for Medicare & Medicaid Services "Design for *Nursing Home Compare* Five-Star Quality Rating System: Technical Users' Guide" (October 2009).

C.2 Health Inspections

The health inspection score is computed using information from the prior three health inspection surveys and the three most recent years of complaint deficiencies and survey revisits. For each of the three most recent health inspection surveys, points for each citation are allocated depending on the severity and scope of the deficiency (see Table C.3)

The health inspection domain score is calculated by aggregating the three weighted time period scores. The most recent survey is given 1/2 weight, the second most recent 1/3 weight, and the third most recent 1/6 weight. When providers require more than one revisit to correct a deficiency, additional penalties are assigned for the number of required revisits: 50% if two, 70% if three, 85% if four. If facilities have missing

Table C.3: Health Inspection Score: Weights for Different Types of Deficiencies

Severity	Scope		
	Isolated	Pattern	Widespread
Immediate jeopardy to resident health or safety	**J** 50 points* (75 points)	**K** 100 points* (125 points)	**L** 150 points* (175 points)
Actual harm that is not immediate jeopardy	**G** 20 points	**H** 35 points (40 points)	**I** 45 points (50 points)
No actual harm with potential for more than minimal harm that is not immediate jeopardy	**D** 4 points	**E** 8 points	**F** 16 points (20 points)
No actual harm with potential for minimal harm	**A** 0 points	**B** 0 points	**C** 0 points

Notes: Figures in parentheses indicate points for deficiencies that are for substandard quality of care.

Shaded cells denote deficiency scope/severity levels that constitute substandard quality of care if the requirement which is not met is one that falls under the following federal regulations: 42 CFR 483.13 resident behavior and nursing home practices; 42 CFR 483.15 quality of life; 42 CFR 483.25 quality of care.

*If the status of the deficiency is past non-compliance and the severity is Immediate Jeopardy, then points associated with a G-level deficiency (i.e. 20 points) are assigned.

Source: Centers for Medicare & Medicaid Services "Design for *Nursing Home Compare* Five-Star Quality Rating System: Technical Users' Guide" (October 2009).

data for one inspection cycle, the health inspection scores are the weighted composite of the two most recent inspections, with the most recent survey given 60% weight and the piror period 40% weight.

Deficiencies attributed to complaints also accrue to a facility's health inspection score and are weighted depending on the number of years since the complaint survey, with most recent complaint surveys weighing the heaviest.

Since health inspections are overseen at the state level, deficiency ratings are computed based on within-state comparisons. The 10% of facilities within each state with the lowest score received five stars. The 20% of facilities with the highest score received just one star. The 70% in the middle are spilt into terciles and assigned two to four stars.

C.3 Quality Measures

Quality measures were initially computed based on 7 long-stay and 3 short-stay measures from the Minimum Data Set. The Long-Stay measures were:

- Percent of residents whose need for help with daily activities has increased
- Percent of residents whose ability to move in and around their room got worse
- Percent of high risk residents with pressure sores
- Percent of residents who had a catheter inserted and left in their bladder
- Percent of residents who were physically restrained

Table C.4: Star Cut Points for MDS Quality Measure Summary Score (1-05-2009)

1 star	2 stars		3 stars		4 stars		5 stars
	lower	upper	lower	upper	lower	upper	
≤ 48	49	63	64	77	78	97	≥ 98

Note: Cutpoints for MDS Quality Measure Scores (which have a 0-136 point range) are set to achieve this distribution:

- 5 stars: $\geq 90^{\text{th}}$percentile;
- 4 stars: $< 90^{\text{th}}$percentile and $\geq 66.67^{\text{th}}$ percentile
- 3 stars: $< 66.67^{\text{th}}$percentile and $\geq 43.33^{\text{th}}$percentile
- 2 stars: $< 43.33^{\text{th}}$percentile and $\geq 20^{\text{th}}$percentile
- 1 star: $< 20^{\text{th}}$percentile

Source: Centers for Medicare & Medicaid Services "Design for *Nursing Home Compare* Five-Star Quality Rating System: Technical Users' Guide" (October 2009).

- Percent of residents with urinary tract infection
- Percent of residents who have moderate to severe pain

The short-stay measures were:

- Percent of residents with pressure ulcers (sores)
- Percent of residents who had moderate to severe pain
- Percent of residents with delirium

The 5-star QM domain scores are calculated using the adjusted QM values of the three most recent quarterly QM ratings.[41] Except for the two ADL-related measures, points for each QMs are assigned based on facility quintile of national distribution. The two ADL-related measures are weighted 1.6667 times higher than others and are based on within-State quintile distribution, because of their greater importance to nursing home residents and sensitivity to State specific Medicaid policies. It is also likely that some facilities with insufficient number of residents have missing data for one or more QM. Depending on number of missing QMs in short-stay and long-stay categories, the QM ratings are imputed by state average and re-scaled.

Summing the points across the ten measures creates a total score for each facility, and the 5-star QM scores are assigned based on the thresholds listed in Table C.4.

[41] The adjusted three-quarter QM values are computed as

$$QM_{3Quarters} := \frac{QM_{Q1} * D_{Q1} + QM_{Q2} * D_{Q2} + QM_{Q3} * D_{Q3}}{D_{Q1} + D_{Q2} + D_{Q3}}$$

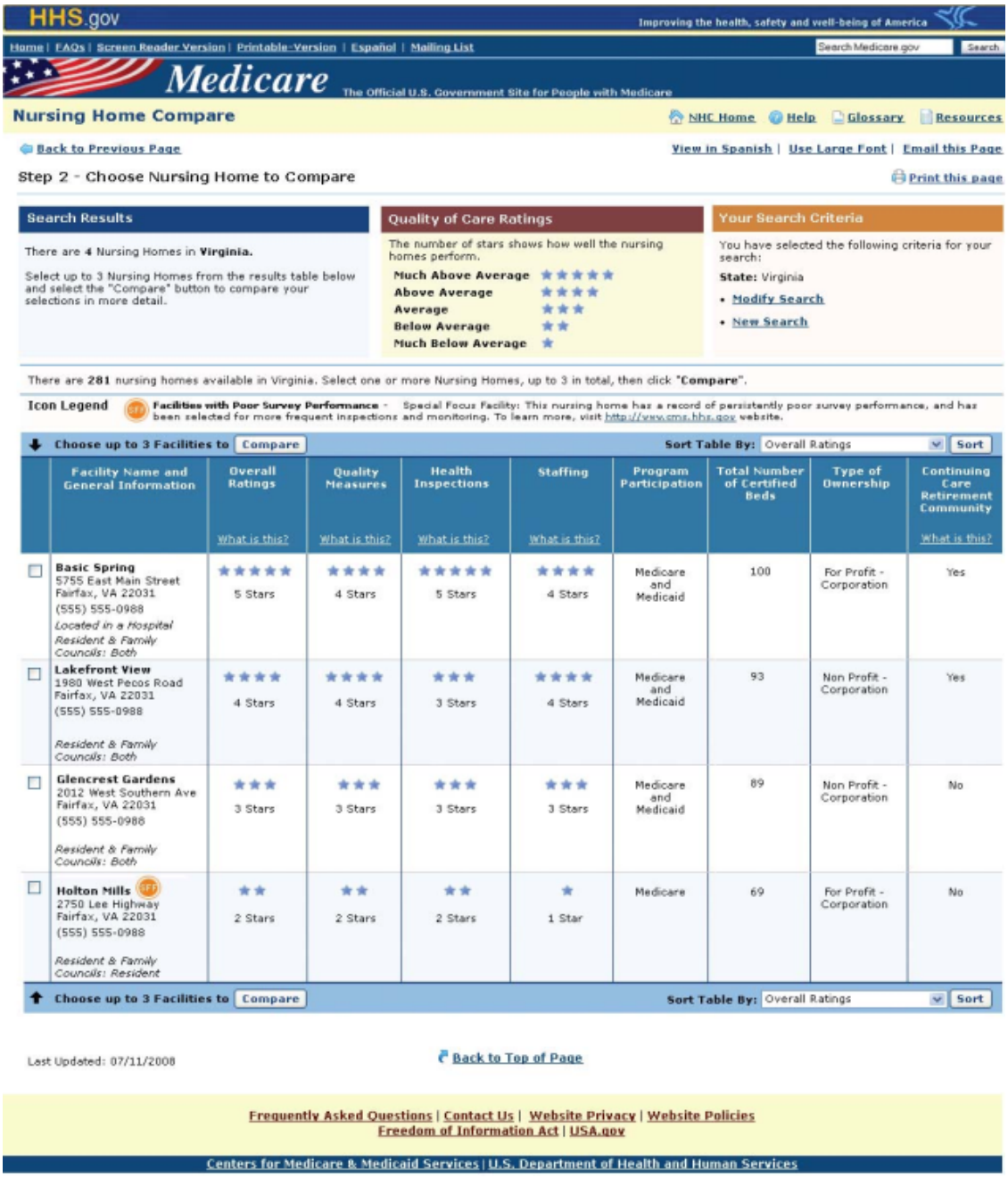
, where D_{Q1}, D_{Q3} and D_{Q3} are the number of eligible residents in the corresponding quarter

C.4 Aggregation

The three scores were aggregated in steps. First one starts with the health inspection rating and adds a star if the staffing rating is a 4 or a 5 and greater than the health inspection rating. If staffing rating is a one, subtracts a star. Then a star is added to facilities with a 5 star QM rating and subtracted from facilities with a 1 star QM rating. Facilities that received a 1 star health rating could not receive an overall rating above 2 stars.[42]

[42] Additionally Special Focus Facilities were limited to 3 stars overall.

Figure C.1: Snapshot of Early Nursing Home Compare Website



Notes: This snapshot depicts an early version of how five-star ratings were displayed on the Nursing Home Compare website.

Source: Centers for Medicare & Medicaid Services "Design for *Nursing Home Compare* Five-Star Quality Rating System: Technical Users' Guide" (October 2009).