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Competition, Quality Choices and Vertical Differentiation: Applications to the Nursing Home Industry

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ABSTRACT

Competition, Quality Choices and Vertical Differentiation:

Applications to the Nursing Home Industry

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This dissertation contains three essays that investigate various factors affecting firms' choice of quality in the context of nursing homes.

The first essay examines how strategic interactions with competitors affect quality levels selected by nursing homes. I explore nursing homes' responses to minimum nurse staffing standards imposed in two large states: California and Ohio. I compare the response to the standards of nursing homes with different initial levels of quality, and the response by high-end nursing homes in a given market to increases in quality by low-end homes in the same market. I find that minimum staffing standards increase nursing homes' total nurse staffing hours per patient day by 5% (0.14 hours) on average. This increase in quality largely comes from nursing homes initially positioned close to the minimum standards level. I also find that nursing homes tend to substitute cheaper labor inputs for more expensive ones to meet the minimum standards. Finally, consistent with vertical differentiation theory, if high-end nursing homes do increase quality, it occurs in the markets where they have the strongest incentive to vertically differentiate

from their low-end competitors.

The second essay considers how market structure affects the choice of product levels. I analyze whether nursing home residents in more concentrated markets enjoy higher levels of quality as measured by total nursing hours per patient day. In order to address the potential endogeneity of market structure, I exploit shocks to the Herfindahl-Hirschman Index (HHI) caused by statewide exists of chain-affiliated nursing homes. Using these exists as an instrument for changes in HHI, I find that a one standard deviation increase in HHI increases total nursing inputs by 80% of total nurse staffing Hours Per Patient Day (HPPD). Among markets with positive change of HHI, total HPPD increase 40%. By comparison, the estimates are insignificant at conventional levels using fixed effects OLS regression, implying that changes in market structure are endogenous to quality choices.

The last essay investigates the role of market competition in shaping nursing home ownership choice and the dynamic effects of ownership conversions on nursing home performances. I find that competition leads to more conversion to for-profit from non-profit or government status but less conversion to non-profit from other status. I also find that facilities converting from for-profit to nonprofit exhibited significant increase in total nurse staffing inputs starting from two years after the conversions. There is no significant change in other dimensions of performance such as size, capacity and patient composition for both pre and after conversion periods. Neither do I find significant changes in performance from nursing homes converting from nonprofit to for-profit status.

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1 Introduction

An important topic for industrial organization economists is firms' choice of quality levels. Such choice affects not only consumers' welfare, but it may also soften product market competition and enable firms to raise prices in imperfectly competitive markets. Added to this, government interventions on product quality levels may not be necessarily beneficial. The dissertation provides an empirical study of these important issues in the context of nursing homes.

Despite the long-standing theoretical interest in and policy relevance of product quality levels selected by firms, relevant empirical work is rather limited, largely due to the difficulty in measuring quality level and the unavailability of firm specific data. Nursing homes provide an ideal setting to study firms' choice of quality levels, not only because quality of care is of serious concern, but also because an important aspect of quality, nurse staffing levels, can be observed and measured.

The purpose of the dissertation is to derive implications from the theoretical literature and select suitable empirical methods to investigate the role of competition, of organizational form and of strategic interaction in quality level decision. With the help of a most comprehensive nursing home level panel dataset, this dissertation examines various theoretical predictions and makes it possible to describe the consequences and evaluate the effectiveness of government intervention in the nursing home markets.

The dissertation consists of three essays.

The first essay has the title "Minimum Quality Standards and Strategic Vertical Differentiation: An Empirical Study of Nursing Homes". This paper examines how strategic interactions with competitors affect quality levels selected by nursing homes. I do so by exploring responses to minimum quality standards imposed in two large states: California and Ohio. I compare the response to the standards by nursing homes with different initial levels of quality, and the response by high-end homes in a given market to increases in quality by low-end homes in the same market. I find that minimum staffing standards increase nursing homes' total nurse staffing hours per patient day by 5% (0.14 hours) on average. This increase in quality largely comes from nursing homes initially positioned close to the minimum standards level. I also find that nursing homes tend to rely on cheaper labor inputs to meet the minimum standards. Finally, consistent with vertical differentiation theory, high-end nursing homes increase quality only where they have the strongest incentive to differentiate themselves from their low-end competitors.

The second essay is titled as "The Impact of Market Structure on Nursing Home Quality". This paper considers how market structure affects the choice of product levels. Although the impact of competition on quality has long been of interest to both industrial organization economists and regulators, there is surprisingly little evidence, especially along non-price dimensions. The empirical challenges lie in measuring quality and addressing the endogeneity of market structure. In this paper I examine how market structure affects the choice of product

quality levels in the nursing home industry. Specifically, I analyze whether nursing home residents in more concentrated markets enjoy higher levels of quality, as measure by total nursing hours Per Patient Day. In order to addresses the potential endogeneity of market structure, I exploit shocks to the Herfindahl-Hirschman Index (HHI) caused by statewide exists of chain-affiliated nursing homes. Using these exists as an instrument for changes in HHI, I find that a one standard deviation increase in HHI increases total nursing inputs by 80% of total nurse staffing Hours Per Patient Day (HPPD). Among markets with positive change of HHI, total HPPD increase 40%. By comparison, the estimates are insignificant at conventional levels using fixed effects OLS regression, implying that changes in market structure are endogenous to quality choices.

The last essay is titled “To Profit or Not to Profit: An Empirical Study of Competition, Ownership Conversions and Nursing Home Performance.” The paper investigates the role of competition in nursing home ownership choice and the dynamic effects of ownership status on nursing home performances. I find that competition leads to more conversion to for-profit from non-profit or government status but less conversion to non-profit from other status. I also find that facilities converting from for-profit to nonprofit exhibited significant increase in total nurse staffing inputs starting from two years after the conversions. This increase in nursing input comes from the increase in Licensed Vocational Nurses (LVNs) and Certified Nurse Assistants (CNAs), but not the most highly skilled Registered Nurses (RNs). There is no significant change in other dimensions of performance such as size, capacity and patient composition for both pre

and after conversion periods. Neither do I find significant changes in performance from nursing homes converting from nonprofit to for-profit status.

2 Minimum Quality Standards and Strategic Vertical Differentiation: An Empirical Study of Nursing Homes

2.1. Introduction

Governmental use of Minimum Quality Standards (MQS) to boost quality is widespread. They set a lower bound of quality for firms to enter and remain in the market. For example, buildings and toys must meet some minimum safety standards before consumers can use them; professionals such as brokers, lawyers and financial advisors have to pass minimum licensing requirements in order to practice. In insurance markets, there are mandated minimum benefits in the Medigap market that provide private insurance for the elderly, and in labor intensive industries such as child care and nursing homes there are minimum staffing standards.

One rationale for MQS is the existence of asymmetric information between seller and buyer. When buyers cannot distinguish the relative qualities of products as sellers do, this information asymmetry can lead to the under-provision of product quality and market degeneration, e.g. "lemons" in the used car market (Akerlof 1970) and "quacks" among doctors (Leland 1979). MQS can serve as a simple screening device to help eliminate the lemons and the quacks when it is too costly to improve consumer information. Paternalism or externality concerns may also motivate government to regulate the free-market qualities. Examples include regulations that set

minimum fuel-economy standards. The government prefers that consumers drive more fuel-efficient cars to cut down on air pollution and foreign oil dependency. Consumers' preferences may not provide automobile manufacturers enough incentives to produce such vehicles so the government uses the simple regulatory tool to help correct the market failure. Other examples include minimum standards on safety products such as cyclists' helmet and smoke detectors. The not-internalized negative externality exerted on others appears to be one of the main rationales for the government to regulate the minimum quality level.

Theoretically, the effect of MQS on quality produced and consumed varies depending on different assumptions about the market environment. Leland (1979) and Shapiro (1983) study the consequences of imposing an MQS in perfectly competitive markets with incomplete information. They show that consumers whose purchases already satisfy the minimum standards in the absence of regulation will not change their consumption decisions. This creates a spike in quality distribution around the minimum standard level. The rest of the quality distribution remains unchanged. Ronnen (1991) and Crampes and Hollander (1995), however, investigate the effects of MQS in imperfectly competitive markets in which firms compete in both quality and price. Based on the standard vertical differentiation model, they argue that in response to the adoption of the MQS policy, not only do low-quality suppliers raise their qualities to meet the standard, but the high-quality sellers also further increase qualities in order to vertically differentiate themselves from their improved low quality rivals. As a result, the whole quality distribution in a given market shifts to the right.

Given the prevalence of MQS and the ambiguous theoretical predictions on the change of product quality distribution, there is surprisingly little convincing empirical studies that clearly identifying the impact of MQS on the whole quality distribution and the strategic interactions among firms. This paper asks three empirical questions: first, what are the effects of MQS on average quality; second, do firms at different points on the quality distribution respond differently to the MQS; third, are there any strategic interactions in firms' quality choice? I examine these questions in the context of health care markets, in particular, the nursing home industry. Nursing homes provide an ideal setting to study quality competition and vertical differentiation, not only because quality of care varies tremendously across homes, but also because it can be observed and measured by nurse staffing levels.

I clearly identify a natural experiment in the nursing home industry, i.e. the minimum nurse staffing hour regulation imposed on California and Ohio in 2000 and 2002, respectively. Using a set of carefully selected controls and a detailed firm level data set maintained by Center of Medicare and Medicaid Services, I estimate the short term, intermediate term and long term effects of MQS on all U.S. nursing homes that are certified by Medicare and/or Medicaid programs from 1997 to 2005. I estimate the effect of MQS to be the difference in trends of nurse staffing levels after the imposition of MQS in California and Ohio relative to the difference in trends in control states. I find robust evidence that minimum staffing standards increase nursing homes' total nursing hours per patient day by 5% (0.14 hours) on average. This increase in quality largely comes from nursing homes initially positioned close to the minimum standards

level. I also find that nursing homes adjust their labor inputs and substitute less skilled nursing assistants for more skilled licensed nurses to meet the minimum standards.

To identify the strategic interactions among nursing homes, I construct an index to measure the market-level impact of the MQS for each local market and I compare high-end nursing homes' responses across such local markets. I find that in markets where the MQS have a potentially big impact, all high-end homes which are not directly affected by the MQS significantly increase their staffing; in markets where MQS have a small impact, none of the high-end homes show a significant increase in nurse staffing and in markets with medium impact, only nursing homes which were initially a little above MQS improve quality. In other words, high-end nursing homes increase their staffing level only in markets where they are likely to face quality upgrading from their low-end rivals.

This study contributes to the existing empirical studies on MQS (e.g. Chipty and Witte (1997); Hotz and Xiao (2005)); Mueller et al (2006)). Most existing studies in this literature suffer from identification problems and none of them explicitly consider the differential response of firms on the different points of the quality distribution and the strategic interactions among firms in quality choices. The primary contribution of this paper is that it is able to identify the change in the whole quality distribution and the strategic interactions of nursing homes' quality choices in response to MQS. This paper also designs a test to detect firms' vertical differentiation incentives in imperfectly competitive markets. The instrumental variable idea underlying the identification strategy, which uses a mandated regulation as an instrument for changes in rivals'

behavior and identifies firms' behavior change in response to their rivals' change, can be applied in other settings, especially in studying strategic interactions. Moreover, the lengthy study period (1997-2005) and detailed firm level information helps me overcome some of the data limitations experienced by prior researchers. The study also complements theoretical and recent empirical research on competition and quality differentiation (e.g. Ellickson (2000); Mazzeo (2002); Jin (2005)).

The rest of the paper is organized as follows. Section 2.2 reviews the relevant theoretical and empirical literature. Section 2.3 introduces industry background and the minimum nurse staffing regulations. After describing the data and the empirical specifications in section 2.4, I present some preliminary analysis results in section 2.5 and section 2.6 concludes.

2.2. Literature Review

This study draws from three related streams of literature: studies of product quality differentiation, theories about the effect of minimum quality standards under different assumptions about the market environment and empirical studies of the impact of MQS. This paper uses insights from these literatures and aims to contribute to each of them.

2.2.1. Product Quality Differentiation

The theoretical literature on vertical differentiation has been well-developed since

Gabszewicz and Thiesse (1980) and Shaked and Sutton (1982). Assuming consumers agree on the preference ordering of product, the critical insight from this research is that firms have incentives to strategically vertical differentiate to relax price competition (see Tirole (1988) in *The Theory of Industrial Organization* for an excellent review). However, the theoretical predictions on the changes of quality distribution with competition are ambiguous. Competition may increase or decrease quality depending on how to model competition and the choice variable is strategic complements or substitutes.

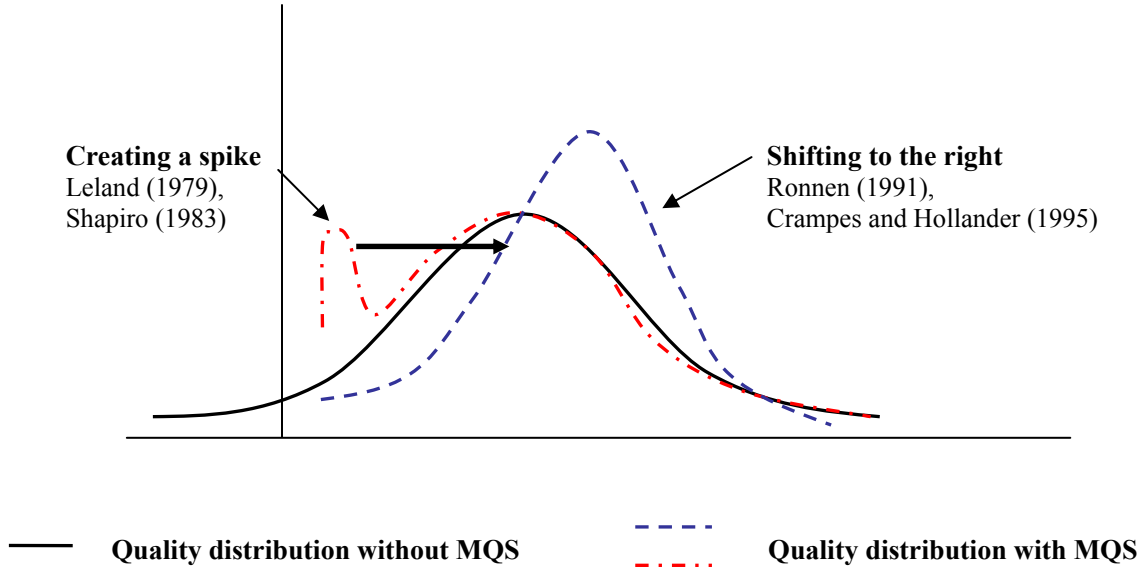
Empirical papers have documented evidence of product differentiation across various settings. Mazzeo (2002) studies entry of motels in isolated markets and finds that motels have strong incentives to differentiate in quality. Ellickson (2000) looks at the supermarket industry, and finds supermarkets located in the same market tend to choose similar service quality, which suggests quality choices are strategic complements. In a more recent paper, Jin (2005) examines Health Maintenance Organizations' (HMOs) voluntary disclosure of product quality and finds that HMOs use voluntary disclosure to differentiate from competitors, with lower disclosure rates in more highly competitive markets. These different conclusions drawn from the studies in different context hint the ambiguous theoretical predictions on product differentiation and strategic interaction.

2.2.2. Theories and Testable Implications about the effect of MQS

Theoretically, the effect of MQS on the quality produced and consumed varies depending

on different assumptions about the market environment. Leland (1979) and Shapiro (1983) study the consequences of imposing an MQS in perfectly competitive markets with incomplete information. Leland (1979) was based on a similar model as that of Akerlof (1970), where the various qualities are exogenously given, and sellers only decide whether or not to supply. Shapiro (1983) extends the analysis to include heterogeneous consumers and allows sellers to choose quality. Both Leland (1979) and Shapiro (1983) argue that imposing minimum quality standards deters entry and causes low-quality sellers to exit the market. Prices are expected to go up because of the increased costs of producing higher quality and the decreased market competitiveness due to low-quality firms' exit. They also show that consumers whose purchases already satisfy the minimum standards in the absence of regulation will not change their consumption decisions. However, consumers whose preferred quality is below the MQS may find the utility of not buying is higher than buying the mandated minimum quality level. As a result, they may decide not to purchase at all and are worse off. Assuming the MQS is strictly enforced, low-quality firms are forced to either raise their quality to meet the standards or exit, and high-quality firms will stay at their initial position. As figure 2.1 illustrates, this creates a spike in the quality distribution around the minimum standard level, and the rest of the quality distribution remains unchanged.

Figure 2.1. Theoretical Implications for Quality Distribution



Adapted from Hotz and Xiao (2005)

Notes: This figure shows the change in quality distribution after the imposition of Minimum Quality Standards under different theory predictions. The solid line represents quality distribution in a given market before MQS comes into place.

Ronnen (1991) and Crampes and Hollander (1995) investigate the effects of MQS in imperfectly competitive markets in which firms compete in both quality and price and consumers have perfect information about product quality. Based on the standard vertical differentiation model (Gabszewicz and Thiesse (1980) and Shaked and Sutton (1982)), they show that in response to the adoption of the MQS policy, low-quality suppliers raise their qualities to meet the standard and thus become closer substitutes for the high-quality suppliers. To alleviate the intensified price competition caused by the shrinkage in the quality range, the high-quality sellers

also raise quality in an effort to vertically differentiate themselves from their improved low quality rivals. Their work points to a different set of theoretical predictions about quality distribution changes and provides different welfare implications as opposed to models assuming perfect competition and incomplete information. First, the whole quality distribution in a given market would shift to the right (see figure 2.1) and the specific shape of the distribution of quality available to consumers may depend on the extent of competition in the market. Second, since MQS limit the range in which firms can differentiate their qualities, price competition still intensifies despite high-quality firms' efforts to relax it. Quality adjusted prices will fall. Third, the combination of better qualities and lower hedonic prices leads to increased consumers' participation and will cause all participating consumers to select higher qualities. As a result, all participating consumers are strictly better off for an appropriately chosen MQS. This strongly contrasts with the welfare implications derived from Leland (1979) and Shapiro (1983), which both demonstrated that a group of consumers would be worse off either because their preferred qualities are no longer supplied or because the prices after MQS are increased.

2.2.3. Empirical Studies on MQS

There are empirical studies examining the impact of MQS in insurance markets (Finkelstein (2001)), child care markets (Chipty and Witte (1997), Hotz and Xiao (2005)), and nursing homes (Mueller et al (2006)), but none of them explicitly address strategic interaction in firms' choice of quality levels. Finkelstein (2001)) examines the state minimum benefits regulations for

non-group Medigap policies implemented in the 1970s and 1980s, and finds that the strongly enforced minimum standards lead to substantial decline in insurance coverage in both mandated and non-mandated benefits. The results are argued to be most consistent with a model of the private insurance market with adverse selection. Sufficiently high minimum standards may require low risk consumers to purchase an amount of insurance above their incentive compatible amount and destroy the separating equilibrium where high risk individuals purchase full insurance coverage while low risk individuals purchase less than full insurance. This may produce an unraveling of the market for the non-mandated benefits and generate even larger declines in non-mandated benefits than Leland (1979) and Shapiro (1983) predict.

Among the abundant literature investigating minimum standards regulations in the child care industry, Chipty and Witte (1997) and Hotz and Xiao (2005) are the most relevant to this paper. They study all kinds of minimum quality standards imposed on child care centers such as age-specific staff-child ratio, age-specific group size limitations, and staff education requirements. Chipty and White (1997) find that more stringent minimum standards are associated with higher probability for firms to exit and have mixed effects on the average and maximum quality in the market. However, using a limited cross-sectional sample of approximately 1000 child centers, this study suffers from identification problems. If some unobserved state or facility characteristics are correlated with the presence and stringency of a minimum quality standard, their estimates will be biased. Hotz and Xiao (2005) address this problem by using a panel data set and including state-specific and time-specific fixed effects in

order to mitigate the biases associated with policy endogeneity. They find the effects of MQS specifying the labor intensives of child care services differ remarkably from those specifying staff qualifications. Higher staff-child ratio requirements are associated with fewer operating child care establishments, and existing establishments are more likely to receive accreditation and less likely to exit. By contrast, higher staff-qualification requirements are not associated with fewer establishments, but they discourage accreditation and lead to a higher probability of exit. However, since many of these minimum standards are highly correlated with each other in the child care market, it is impossible for these studies to separately identify the effects of each individual minimum quality standard. Mueller et al (2006) examine the relationships among state staffing standards and actual nursing staffing for all the states in the U.S. and find that facilities in states with high staffing standards had higher staffing than states with no standards or low standards, whereas states with low standards were not significantly different from that in states with no standards. These effects are also identified purely from the cross sectional variation of existing staffing legislature status at the state level and suffer from policy endogeneity.

All of these papers suggest the stringency of MQS affect firms' quality choice, but the results are mixed. Most of them suffer from identification problems either because only cross sectional data is available or because of the impossibility of separating each individual MQS. My study contributes to this literature by clearly identifying the exact time of minimum staffing regulation incidence and estimating the difference-in-difference change in actual nurse staffing before and after the staffing policy takes effect. By controlling for facility, state and year fixed

effects, and testing to see if there is a different pre-trend in staffing between experiment and control states, I clearly establish the causal link between staffing standards and nursing homes' quality choices.

In summary, the main contributions of this study lie in clearly identifying a natural experiment for studying the strategic interaction of nursing homes' choice of quality in response to the minimum quality standards. This paper also designs a test to detect firms' vertical differentiation incentives in imperfectly competitive markets. In the process of doing so, it also sheds light on the effect of MQS and, in particular, provides guidance to policy makers in terms of the effectiveness of such policy. Thus, my study contributes to the literatures on firms' strategic interaction, the economic consequences of policy regulation and health economics. In addition, the idea underlying the identification strategy, which uses a mandated regulation as an instrument for changes in rivals' behavior and identifies firms' behavior change in response to their rivals' change, can be applied in other settings, especially in studying strategic interactions. Thus, my paper contributes to applied econometrics as well.

2.3. Background

2.3.1. The Nursing Home Industry

The nursing home industry is not only the largest and most expensive component of long term care but also one of the major sectors of the whole U.S. economy. Nursing home costs

represent about 70 percent of long-term care expenditures and the industry accounts for about 1% of total U.S. GDP. According to Kemper and Murtaugh (1991), four out of every ten people turning age 65 will use a nursing home at some point in their lives. As the population ages and average life expectancy becomes longer, the need for high quality nursing home care is projected to increase substantially in the coming years, particularly for women. Data from the National Health Care Expenditure Survey estimates payments for nursing home care in 2004 were 115 billion, which is a little more than spending on consumer electronics, and will reach 210 billion by 2016.

Besides the importance in its own right, the nursing home industry provides an ideal setting for studying quality competition and vertical differentiation. This is not only because quality of care is of serious concern, but also because an important aspect of quality, which is nurse staffing levels, can be observed and measured. Nursing homes are labor intensive and their quality rests almost entirely in the hands of nursing staff. The positive relationship between nurse staffing and patient outcomes in nursing homes has been documented in a number of studies reported by the Institute of Medicine (Wunderlich et al, 2001 and IOM 2003 for example). Higher staffing hours per patient day, particularly RN hours, have been consistently and significantly associated with overall quality of care including: improved resident survival rates, functional status, and incontinence care; fewer pressure sores and infections; less physical restraint, catheter and antibiotic use; less weight loss, dehydration, et cetera (CMS Report to Congress Phase I and Phase II, Schnelle, et al, 2004 among others.) Besides medical evidence, surveys also show that

consumers perceive nurse staffing as a key indicator of quality. Moreover, nurse staffing levels are more easily observed by consumers compared to other nursing home attributes. Weisbrod (1988) divides nursing home quality-oriented attributes into easy-to-assess type I and costly-to-assess type II attributes, and nurse staffing level is considered to be one of the easiest observable attributes. All nursing homes have time cards and assignment sheets that specify nurse staffing levels and assignments for each shift every day. Some display their time cards on the front desk and consumers can see the information immediately after they step into the nursing home; others show the time cards upon requests. Consumer Reports Nursing Home Quality Monitor (the former Consumer Reports Watch List) also uses nurse staffing as one of the main quality measures to help consumers identify nursing homes with better-quality care.

2.3.2. Minimum Nurse Staffing Standards

In response to heightened public concern over quality of care in nursing homes, most states introduced legislation to establish or increase minimum staffing standards in recent years. Some legislation passed, other measures stalled or failed (see Department of Health Services report 2003)[1,2]. Besides improving quality of care, another related motive for passing nurse staffing

[1]In 1987, the Nursing Home Reform Act (i.e. the Omnibus Budget Reconciliation Act (OBRA)) established the federal staffing standard for nursing homes participating in Medicare and Medicaid and has not updated since then. It requires that each nursing home must provide twenty-four hour licensed nursing services that are sufficient to meet the nursing needs of its residents and does not mandate a specific staff-to-resident ratio or hours per patient day. States without their own minimum standards follow the federal guidelines.

[2]The state level standards for minimum nurse staffing vary a lot both across states and over time. By 2007, 37 states have established their own staffing standards as a part of their state nursing facility licensing

legislation is to reduce the work load of nursing staff, lower the turn over rate and increase the nurse (especially Registered Nurse) supply to alleviate the nationwide nurse shortage. State affiliates of the American Nurse Association (ANA) and other major unions representing nurses such as the Service Employees International Union (SEIU) actively lobby for minimum staffing levels to be established not only in nursing homes but also in hospitals. The final passage of the legislation and the minimum staffing level specified are determined to some extent by the bargaining between these nurse unions and other organizations that vigorously oppose the establishment of a minimum staffing level. The overall political environment may also matter. For example, the legislation in California was a key component of the "Aging with Dignity Initiative" sponsored by Governor Gray Davis to improve services to the elderly and to implement significant nursing home reform.

Amongst the states with recently passed legislation, I choose California and Ohio as my experiment states. The reasons for choosing these two states are the following. Firstly, their state level regulations took effect between 1999 and 2002, which is within my data range (1997 to 2005) and allows for a long enough pre and after period. Secondly, they are relatively "clean" in the sense that previous regulations governing nurse staffing were implemented a long time ago, and there are no other potential complications such as a Medicaid payment scheme change. Chapter 502, Statutes of 1990, set in place minimum nurse staffing requirements for California

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requirements. Among them, thirteen states established their current standards in the year 2000 or later. The complete summary of these standards is lengthy and not presented here, but it is available from the author upon request.

nursing homes that remained unchanged for about 10 years[3]. Regulations to increase the minimum nurse staffing standards to 3.2 hours of direct patient care per day were established in January 2000[4]. In Ohio, regulations established in October 2001[5] increase the minimum total direct care hours to 2.75 following the previous regulation effective in 1974 and amended in 1992[6]. However, the state inspectors did not start enforcing the compliance until January 2002; therefore, I code the effective date as 2002.

The direct care hours as specified in the regulations is the sum of working hours from three types of nursing staff: Registered Nurses (RNs), Licensed Practical Nurses (LPNs) or Licensed Vocational Nurses (LVNs) and Certified nursing assistant (CNAs). Among them, RNs have the widest scope of practice and are often assigned a supervisory role to oversee tasks performed by LPNs and CNAs. To be qualified for an RN, it usually takes three to four years of training in addition to an Associateate or a Bachelor degree of Science in Nursing. LPNs (LVNs) can perform some complex medical procedures but not to the extent of RNs. They must at least be high school graduates and usually have twelve months to two years of training in approved nursing programs. CNAs make the bulk of the direct care workforce, who perform routine tasks such as bathing, dressing, transferring and feeding. The training and qualifications to obtain CNA certification vary across states, but the minimum mandates specified by the Nursing Home Reform Act (1987) are 75 hours of training, among which 16 hours must be supervised clinical

[3]In 1999, 97 percent of CA SNFs met the then-current 3.0 staffing standard, which allowed for doubling the hours of licensed nurse (see CA DHS report 2001).
[4]Specifics of the regulation can be found in Assembly Bill 1731, Shelley (Chapter 451, Statutes of 2000).
[5]See Ohio H.B.No.78 for specifics of the regulation.
[6]The minimum hour per patient day specified in the previous regulation is 1.6 and not binding as well.

training.

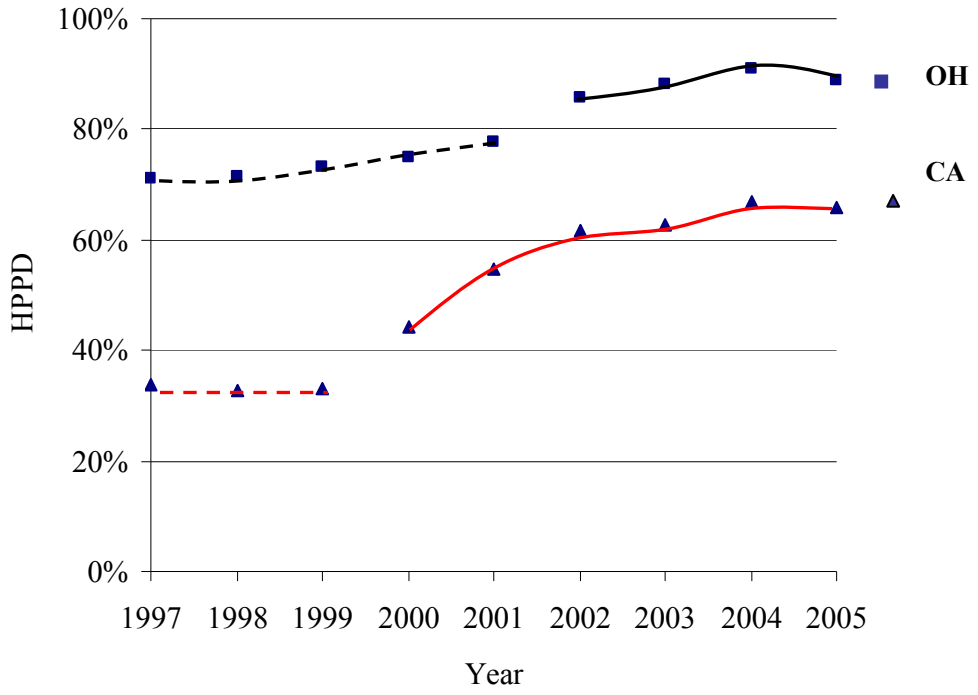
My set of seven control states was chosen based on the following criteria: these states have no newly established nurse staffing regulations or any changes in such regulations during the periods we study, and they had to have similar trends in staffing as they did in the pre-period. For California, the control states used are New York, New Hampshire, Virginia and Washington. For Ohio, the controls are Alabama, Kentucky and Nebraska. The assignment of the control states follows the logic that control states should have a similar trend of changes in nurse staffing as their corresponding experiment state did before the regulation took effect. This being said, in the section of robustness checks, I show neither in significance nor in magnitude do main results change if I pool all the controls together instead of the specified control states assignments.

2.3.3. Costs of Compliance and Non-Compliance

The cost to a nursing home of complying with the minimum standards depends on two factors: the extent of compliance before the regulation and the composition of the nurse skill mix. Figure 2.2 shows the trends of compliance rate over time for California and Ohio respectively. The percentage of nursing homes complying with the minimum standards in CA is quite stable at around 35% from 1997 to 1999, and increases abruptly to 45% in 2000, and keeps increasing to almost double at 70% in 2004 and 2005. This is consistent with the findings using a limited sample of 111 nursing homes in the California Department of Health Services' report to the legislature. In Ohio, since the standard is less stringent, more than 70% nursing homes met the

requirement prior to the regulation, but still the compliance rate increases about 20% to 90% from 2001 to 2002 and persists at this higher rate since then.

Figure 2.2. Percentage of Minimum Standards Compliance



Notes: The dashed line represents pre-regulation periods and the solid line represents post-regulation periods.

According to the 1999 survey by the Bureau of Labor Statistics, the average hourly wages for RN, LPN and CNA are 19, 14 and 8 dollars respectively. To increase 1 hour of direct care nursing to meet the standard, a typical nursing home with 100 patients needs to pay 292,000 in wages if all they hire are CNAs; the total additional wage costs will accrue to 594,000 if all they

hire are RNs. Using the On-line Survey, Certification and Reporting Database, I estimate the total additional annual wage cost to meet the minimum nurse staffing standards would be 202 and 24.4 million dollars in California and Ohio respectively.

States generally monitor facility staffing during the annual survey as a licensing and certification process. The common practice is that surveyors randomly choose two weeks of time cards and assignment sheets and calculate the hours per patient day, in which staff time spent on administrative tasks, in training or orientation, vacation time, and sick-leave hours are excluded. Staffing levels are also investigated when any complaints about poor quality of care that may be related to insufficient staffing occur. Nursing facilities that are not in compliance with the minimum level receive a deficiency citation and must submit a plan of correction. If the harm is serious or the problem persistent, they may be subject to fines ranging from $1,000 to $100,000 per incident and restrictions on new admissions depending on the severity of the violation. Nurse interest groups and the general public criticize the enforcement of minimum nurse staffing standards as being too weak and the information regarding states' use of the penalties has not being adequately disseminated.

2.4. Data

2.4.1 Data Sources

The data used in this study is drawn from three sources. The primary data source is from the

On-line Survey, Certification, and Reporting Database (known as OSCAR), which is updated continuously and maintained by the Center of Medicare and Medicaid Services (CMS). OSCAR is the most comprehensive source of facility level information on the operations, patient census and regulatory compliance of nursing facilities. Every nursing home that is certified to receive Medicare or Medicaid payments is required to be surveyed at least once during a 15-month period, usually once a year[7], to determine their eligibility for maintaining certification status. Since approximately 96% of nursing homes are certified by Medicare and/or Medicaid (Gruber et al 2006 and Strahan 1997), OSCAR covers almost the entire universe of nursing homes.

Based on concerns that facilities could mask certain deficiencies, such as routinely having too few staff to care for residents, if they could predict the survey timing, Health Care Financing Administration (HCFA)[8] directed states in 1999 to (1) avoid scheduling a home's survey for the same month of the year as the home's previous standard survey and (2) conduct at least 10 percent of standard surveys outside the normal work day (either on weekends, early in the morning, or late in the evening).

OSCAR staffing variables are reported in full time equivalents (FTEs) for full-time, part-time and contract labor for each type of nursing staff (e.g. RN, LVN and CNA) based on a 35 hour work week over a two week period. I first sum up all the FTEs within each type of nursing staff, I then convert the summed FTE to direct care hours per patient day (HPPD) according to following formula:

[7]The statewide average interval for these surveys must not exceed 12 months.
[8]HCFA has been renamed the Centers for Medicare and Medicaid Services (CMS) since 2001.

$\text{HPPD} = \frac{35 * \text{FTE}}{7 * \text{totres}}$, where totres is the corresponding reported total number of residents in the nursing home at the same time period.

The second data source is the state rules and regulations for nursing home staffing standards I collected from the nursing literature (Harrison (2001), Mueller, et al (2006) and et cetera), the National Citizens' Coalition for Nursing Home Reform's 1999 report titled *Federal and State Minimum Staffing Requirements*, and government policy reports. Whenever there is contradiction, ambiguity or missing information, I turned to each state's government website and checked the relevant state codes and senate/assembly bills. I also made additional contact with state licensing and certification offices and ombudsman programs to make sure the accuracy of the regulations' implementation date and specifics.

The third data source is the Dartmouth Atlas (2001). It provides Hospital Service Areas (HSAs) boundary files, which I use to define market. Dartmouth Atlas (2001) is matched with OSCAR by zip code.

2.4.2 Data Description and Raw Data Patterns

This study uses data for a total of 4,304 Medicare and/or Medicaid certified nursing homes located in 9 states[9] over 9 years, with a total 29,429 observations. The number of nursing homes in each year decreases from 3,413 in 1996 to 3,185 in 2005. Table 2.1 presents summary statistics of total direct care hours per patient day (total HPPD). Even in the raw data, there

[9]See section 2.3.2 for reasons to only choose these nine states to study.

appears to be an increase in the mean total HPPD starting from the year of regulation in CA and OH.

Table 2.1. Summary Statistics for Total Direct Care HPPD

	Mean Total HPPD									N	
	1997	1998	1999	2000	2001	2002	2003	2004	2005	1997	2005
CA	3.28 [1.32]	3.24 [1.28]	3.26 [1.34]	3.43 [1.32]	3.46 [1.28]	3.53 [1.15]	3.46 [1.39]	3.51 [1.38]	3.47 [1.40]	1000	885
Controls for CA											
NY	2.99 [0.80]	3.03 [0.82]	3.04 [0.79]	3.03 [0.83]	3.02 [0.82]	3.28 [0.80]	3.13 [0.98]	3.25 [0.75]	3.31 [0.82]	511	580
NH	3.49 [1.12]	3.28 [1.26]	3.48 [1.43]	3.33 [1.39]	3.45 [1.45]	3.56 [1.36]	3.42 [1.54]	3.39 [1.48]	3.42 [1.76]	74	64
VA	3.12 [0.91]	3.26 [1.28]	3.24 [1.15]	3.21 [1.27]	3.29 [1.16]	3.33 [1.19]	3.12 [0.99]	3.26 [1.08]	3.27 [1.00]	217	185
WA	3.64 [1.23]	3.61 [1.18]	3.59 [1.11]	3.55 [1.11]	3.54 [1.08]	3.62 [1.07]	3.49 [1.44]	3.52 [1.00]	3.61 [1.31]	250	219
OH	3.15 [0.85]	3.12 [0.70]	3.20 [0.83]	3.18 [0.75]	3.25 [0.81]	3.36 [0.72]	3.39 [0.80]	3.43 [0.77]	3.40 [0.90]	781	683
Controls for OH											
AL	3.49 [0.62]	3.66 [0.76]	3.54 [0.75]	3.51 [0.73]	3.50 [0.74]	3.65 [0.94]	3.53 [0.99]	3.70 [0.78]	3.71 [0.77]	172	144
KY	3.23 [1.44]	3.12 [1.23]	3.19 [1.27]	3.14 [1.17]	3.35 [1.47]	3.34 [1.22]	3.32 [1.22]	3.41 [1.26]	3.25 [1.41]	195	246
NE	2.76 [1.00]	2.72 [0.96]	2.84 [0.96]	2.86 [1.06]	2.90 [1.16]	2.88 [1.00]	2.92 [1.03]	2.98 [1.11]	2.93 [1.01]	213	179

Notes: Shading refers to post MQS regulation periods.

Table 2.2. Summary Statistics for Other Key Variables

	California	Controls for CA	Ohio	Controls for OH
Number of Beds	98.26 [61.39]	143.93 [108.00]	107.74 [55.11]	93.43 [48.27]
Total Number of Residents	84.26 [52.05]	132.71 [103.15]	89.08 [47.07]	84.08 [44.34]
Occupancy Rate	0.86 [0.11]	0.91 [0.11]	0.83 [0.14]	0.90 [0.10]
Acuity Index	10.95 [2.27]	10.60 [1.43]	10.18 [1.21]	10.50 [1.59]
Hospital-Based	0.11 [0.31]	0.10 [0.30]	0.01 [0.11]	0.11 [0.31]
Chain-Owned	0.59 [0.49]	0.37 [0.48]	0.57 [0.50]	0.57 [0.50]
Ownership Type				
Percentage For-Profit	0.80 [0.40]	0.56 [0.50]	0.79 [0.41]	0.65 [0.48]
Percentage Non-Profit	0.17 [0.37]	0.36 [0.48]	0.18 [0.39]	0.24 [0.43]
Percentage Government	0.04 [0.18]	0.08 [0.27]	0.03 [0.16]	0.11 [0.31]
Certification Status				
Medicaid and Medicare Dually Certified	0.93 [0.26]	0.95 [0.23]	0.89 [0.31]	0.91 [0.28]
Medicaid Certified Only	0.07 [0.26]	0.05 [0.23]	0.11 [0.31]	0.09 [0.28]
Residents by Payer Source				
% of Medicaid Residents	0.66 [0.25]	0.68 [0.20]	0.68 [0.17]	0.66 [0.20]
% of Medicare Residents	0.10 [0.15]	0.12 [0.12]	0.09 [0.08]	0.10 [0.11]
% of Other Residents	0.23 [0.21]	0.21 [0.16]	0.23 [0.15]	0.24 [0.19]
N (Pooled over 9 Years)	8,128	9,284	6,624	5,393

Notes: Unit of observations is nursing home-year. Numbers in square brackets are standard deviations. For CA, the control states used are NY, NH, VA and WA. For OH, the controls are AL, KY and NE. Percentages may not add up to 1 due to rounding. See appendix A for definition of acuity index.

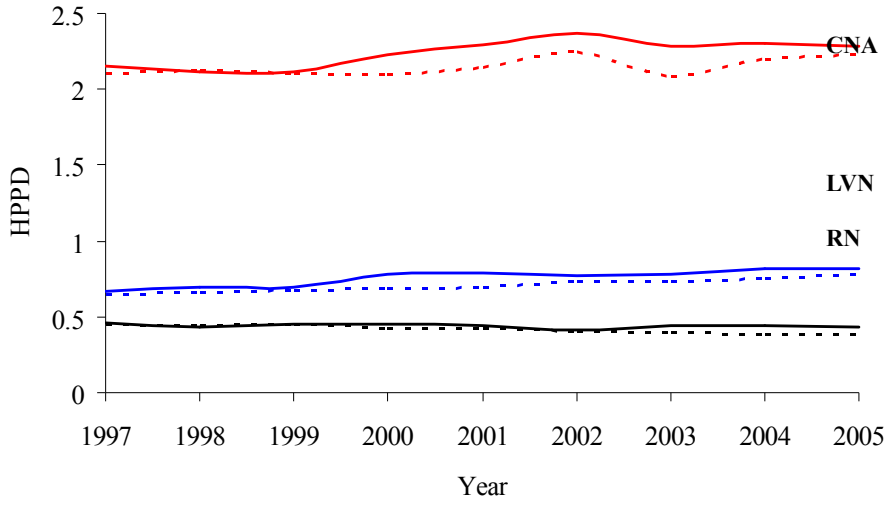
Table 2.2 presents descriptive statistics of other key variables used in the specifications.

There are not many striking differences across different groups of states: the certification status, acuity index and resident payer composition are very similar for the experiment and control states. The experimental states have slightly lower occupancy rates and different sizes of nursing homes (as shown by the number of beds and total number of residents). These differences are controlled in the estimation either by directly including them as covariates or by using the facility fixed effect.

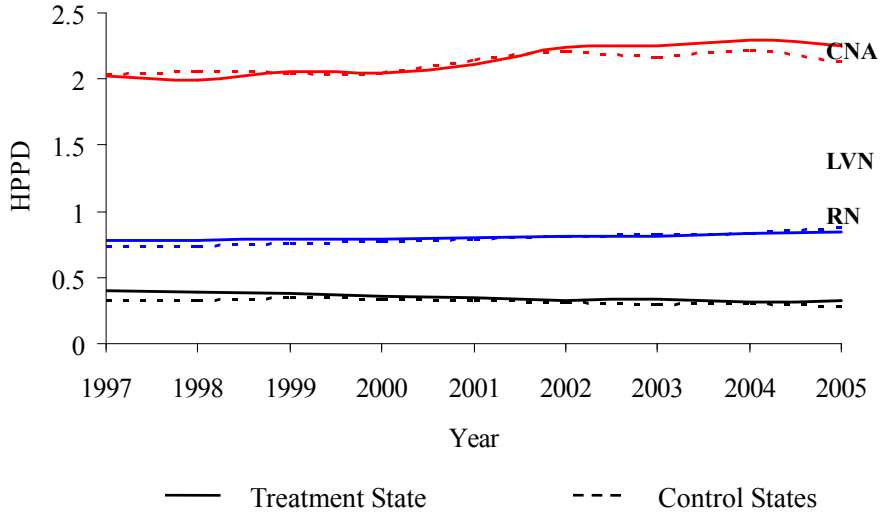
Figure 2.3 shows the time trends of nurse staffing by staff type. Figure 2.3.A pertains to nursing homes in California and its control states. Clearly, trends for all three types of nursing staff for California and its controls overlap in the three years before the regulation. Starting from 2000, there is an evident increase in Hours Per Patient Day of Certified Nurse Assistants (the least skilled and least paid type) in California compared to its controls. There is also some increase in HPPD of Licensed Vocational Nurses, but not as much as in CNA HPPD, and the increase in HPPD of Registered Nurses (the most highly skilled and highly paid type) is even smaller. This difference in time trends before and after the regulation is also present in figure 2.3.B, which pertains to Ohio and its control states, but less pronounced. Compared to control states, CNA HPPD in Ohio increases after regulation, but there is not much change in LVN and RN HPPD.

Figure 2.3. Time Trends of Nurse Staffing, 1997-2005

A. CA and its controls



B. OH and its controls



I exclude Medicare-certified-only facilities, which account for 2 percent of the total nursing

home certified beds, because they specialize in serving post-acute patients requiring much higher staffing levels than Medicaid-only and dually-certified nursing homes and are not affected by mandated minimum staffing standards. I also exclude nursing homes that appear in the bottom one and top two percentiles[10] of the distribution of total HPPD in order to exclude extreme values due to misreporting. To examine the effect of MQS, I restrict attention to those nursing homes that existed before the regulations took effect. The empirical results are nonetheless robust in spite of these sample restrictions.

2.5. Econometric Specifications and Results

2.5.1. Average Responses

(a) Model

As a first step, I study the average effect of minimum nurse staffing standards on the total direct nursing hours per patient day. To achieve this goal, I employ the following basic specification.

(1) $\text{TOTHPPD}_{jst} = \alpha + X_{jst}\beta + \lambda \text{MQS}_{st} + \text{YEAR}_t + \text{FIRM}_j + \varepsilon_{jst}$

The key independent variable MQS_{st} is an indicator variable that equals 1 if nursing facility j in state s and year t is subject to minimum staffing standards and 0 otherwise. If nursing homes

[10]These figures are chosen following some existing literature (e.g. Harrington, et al (2006)) in order to compare results. The findings nonetheless remain the same if excluding top and bottom 1 percentile or top and bottom 2 percentiles of the distribution of total HPPD.

do respond to the MQS on average, we expect $\beta_0 > 0$. X is a vector of covariates including certification status, ownership, size, occupancy rate, patient acuity index, et cetera (see summary statistics in table 2.2). It controls for observable nursing home characteristics.

YEAR and FIRM are fixed effects that control respectively for yearly trends related to nurse staffing that are common across states, and the unobserved, time-invariant differences across nursing homes such as the hiring patterns and working environments. Once these effects are included in the model, λ is identified by the relationship between within-facility variations over time in total nurse staffing hours per patient day and the variation of minimum staffing regulations across states. State fixed effects are omitted from the specification because they become redundant once finer facility fixed effects are included. I estimate equation (1) with and without facility fixed effects and the results are reported separately in section 2.5.1(b) that follows.

The underlying identifying assumption for estimating equation (1) is that, absent the MQS regulation, TOTHPPD would have similar trends in the treatment and control states. If this assumption does not hold, i.e., if, for example, nursing homes anticipate the implementation of the regulations or the regulations come into place when nursing intensity is increasing anyway, then the coefficient of MQS I estimated would be biased. I conduct a partial test of this identifying assumption by examining if experiment states have significant differences in changes of TOTHPPD in the periods prior to the regulation. To do that, I enrich the basic specification (1) by adding leads. $MQS_{st,-2}$ is an indicator variable equal to 1 if it is two years prior to the

regulation enforcement and $MQS_{st,-3}$ is an indicator variable equal to 1 if it is three or more years prior to the enforcement. To examine the timing and persistence of the response to MQS, I break the post period into short-term (the year or one year post), intermediate-term (two years post) and long-term (three and more years post), which are indicated by dummy variables $MQS_{st,1}$, $MQS_{st,2}$ and $MQS_{st,3}$ respectively. The enriched specification is as below and the omitted reference category is the year prior to the regulation (period -1).

$$(2)\quad \begin{aligned} TOTHPPD_{jst} &= \alpha + X_{jst}\beta + \lambda_{-3}MQS_{st,-3} + \lambda_{-2}MQS_{st,-2} \\ &\quad + \lambda_1 MQS_{st,1} + \lambda_2 MQS_{st,2} + \lambda_3 MQS_{st,3} + YEAR_t + FIRM_j + \varepsilon_{jst} \end{aligned}$$

I also replace the dependent variable TOTHPPD using hours per patient day of RN, LVN and CNA, and run separate regressions using specification (2) for each type of nursing staff. This allows me to look at how nursing homes change their composition of staff skill mix in response to the MQS.

(b) Results

Table 2.3 presents the estimated results by OLS.

Table 2.3. Effect of Minimum Quality Standards on Total Direct Care

	Dependent Variable: Total HPPD		
	(1)	**(2)**	**(3)**
MQS_T (All Post Years)	0.135***	0.141***	
	(0.021)	(0.022)	
$MQS_{t,-3}$ (3 or More Years Prior to Regulation)			0.027
			(0.028)
$MQS_{t,-2}$ (2 Years Prior to Regulation)			-0.012
			(0.029)
$MQS_{t,1}$ (The Year of Regulation or Post 1 Year)			0.141***
			(0.024)
$MQS_{t,2}$ (Post 2 Years)			0.182***
			(0.036)
$MQS_{t,3}$ (Post 3 or More Years)			0.135***
			(0.033)
Facility Characteristics	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Facility Fixed Effect	N	Y	Y
R-squared	0.294	0.660	0.661
N	29,429	29,429	29,429

Notes: Robust standard errors clustered by state-year are reported in parentheses.

***signifies p<.001, ** signifies p<.05 and * signifies p<.1.

Column (1) and (2) report the results of estimating equation (1) without and with facility fixed effect respectively. They indicate that the MQS regulation is associated with a 0.135 to 0.141 increase in direct care hours per patient day. It translates into about a 5% increase given that the mean total HPPD before regulation is around 3.2. This effect is statistically significant at the 0.1 percent level and is not sensitive in either magnitude or significance to the inclusion of facility fixed effect.

Column (3) reports the difference-in-differences estimates of the change in total HPPD in

the treatment states relative to the change in total HPPD in the control states using the specification in equation (2). The estimated effect of the MQS is the biggest post 2 years after the regulation and persists after it has been in place for 3 or more years. MQS is associated with a 0.141 increase in total HPPD during the first year and one year after the regulation, a 0.182 increase after 2 years, and a 0.135 point increase after 3 or more years. All of these estimates are statistically significant at the 0.1 percent level. Standard errors in this table and all the tables that follow except table 2.8 are clustered by state-year group[11] to allow for an arbitrary covariance matrix within the clusters.

The insignificance of the lead coefficients shows that there is no significant difference in changes of total direct care hours per patient day between treatment and control states prior to the regulation relative to period -1 (the year right before the regulation). This provides partial support for the identifying assumption that, absent the MQS regulation, the treatment and control states would follow the same trend in total HPPD.

Table 2.4 shows the effect of MQS on nursing staff skill mix.

[11]Standard errors in table 2.8 are clustered by market-year group.

Table 2.4. Effect of Minimum Quality Standards on Nursing Staff Skill Mix

Dependent Variable	RN HPPD	LVN HPPD	CNA HPPD
	(1)	**(2)**	**(3)**
$MQS_{t,-3}$ (3 or More Years Prior to Regulation)	0.028**	0.002	-0.003
	(0.011)	(0.011)	(0.019)
$MQS_{t,-2}$ (2 Years Prior to Regulation)	-0.0005	-0.013	0.001
	(0.008)	(0.011)	(0.017)
$MQS_{t,1}$ (The Year of Regulation or Post 1 Year)	0.003	0.032***	0.107***
	(0.006)	(0.010)	(0.015)
$MQS_{t,2}$ (Post 2 Years)	-0.003	0.034**	0.151***
	(0.009)	(0.013)	(0.020)
$MQS_{t,3}$ (Post 3 or More Years)	0.019	0.033**	0.083***
	(0.012)	(0.011)	(0.025)
Facility Characteristics	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Facility Fixed Effect	Y	Y	Y
R-squared	0.819	0.657	0.474
N	29,429	29,429	29,429

Notes: Robust standard errors clustered by state-year are reported in parentheses.

***signifies p<.001, ** signifies p<.05 and * signifies p<.1.

Columns (1), (2) and (3) report results of estimating specification (2) using hours per patient day from Registered Nurse, Licensed Vocational Nurse and Certified Nurse Assistant as dependent variables respectively. All the lag coefficients in column (1) are trivial, which suggests no effect of MQS on RN HPPD. There is a significant increase in LVN HPPD in treatment states relative to control states as indicated in column (2), but the magnitude is very small. Column (3) shows there is a significant positive effect of MQS on CNA HPPD. When compared with column (3) in table 2.4, it is evident that about 80% of the increase of total HPPD after MQS comes from the change of hours per patient day from CNAs, while change in direct care hours of RN and LVN together only account for a very small portion of it. Since the training and qualification

requirements of CNA are considerably lower than LVN and RN, and their wages are the lowest among the three types of nurses, the results suggest that, to minimize cost, nursing homes tend to hire more CNAs than RNs and LVNs to fulfill the minimum total direct care hour requirements.

2.5.2. Differential Response to MQS by Initial Quality Position

(a) Model

Having shown that the average total hours per patient day increases after MQS, next, I explore from whom this increase comes. I first order nursing homes by their initial relative distance from the minimum standards level. A nursing home j is coded as very low quality if its initial total HPPD is less than 70% of the specified minimum standard level, it is coded as low quality if its initial total HPPD is less than 90% but greater than 70% of the specified minimum standard level, and it is coded as a little below MQS if its initial total HPPD is less than the specified minimum standard level but greater than 90% of the MQS level. The rest is defined symmetrically as follows.

$$
\begin{aligned}
&DIST = 1 \quad \text{Very Low Quality}: && medHPPDpre_j < 0.8 * MQShppd \\
&DIST = 2 \quad \text{Low Quality}: && medHPPDpre_j \in [0.8 * MQShppd,\ 0.9 * MQShppd) \\
&DIST = 3 \quad \text{A Little Below MQS}: && medHPPDpre_j \in [0.9 * MQShppd,\ 1.0 * MQShppd) \\
&DIST = 4 \quad \text{A Little Above MQS}: && medHPPDpre_j \in [1.0 * MQShppd,\ 1.1 * MQShppd) \\
&DIST = 5 \quad \text{High Quality}: && medHPPDpre_j \in [1.1 * MQShppd,\ 1.3 * MQShppd) \\
&DIST = 6 \quad \text{Very High Quality}: && medHPPDpre_j \geq 1.3 * MQShppd
\end{aligned}
$$

$medHPPDpre_j$ is the median total HPPD of nursing home j over the years before the MQS

implemented. MQShppd is the mandated minimum direct care hours in market m, i.e. 3.2 hours per patient day for California and 2.75 for Ohio. I use the median total HPPD before MQS was implemented instead of the total HPPD in the year right before the regulation took effect or the mean total HPPD before MQS in order to reduce noisiness in measurement. Compared to the mean or the number reported in the last survey prior to MQS, median[12] is less affected by potential extreme values caused by misreporting or random fluctuations in nurse staffing pattern.

I then interact MQS with indicators of nursing homes' initial quality I(DIST) to see how the response in total HPPD to the MQS differs by nursing homes' distance to the mandated minimum level. The econometric specification is as below:

$$\text{TOTHPPD}_{jst} = \alpha + X_{jst}\beta + \sum_{DIST=1}^{6} \lambda_{DIST}\, I(DIST)_j * POST_t + \sum_{DIST=1}^{6} \delta_{I,\,DIST}\, I(DIST)_j * MQS_{st} + YEAR_t + FACILITY_j + \varepsilon_{jst} \quad (3)$$

POST is a dummy variable, which equals 1 for both treatment and control states in all the years after the regulation and 0 otherwise. By interacting POST with DIST, this specification allows TOTHPPD to trend differently for nursing homes with different initial quality positions.

The key variable of interest is I(DIST)*MQS. A causal interpretation of the estimated coefficients $\delta_{I,DIST}$ as measuring the differential response to MQS by nursing homes' initial quality position requires the identifying assumption that, absent MQS, TOTHPPD would have followed similar trend for nursing homes within the same distance category in the treatment and

[12]I checked robustness by using the mean total HPPD of nursing home j over the years before the MQS implemented, and total HPPD in the last survey before MQS implemented. The results do not change.

corresponding control states. I conduct a partial test of this identifying assumption by examining whether nursing homes within the same distance category have similar trend in TOTHPPD prior to the regulation in treatment and control states. As in section 2.5.1(a), I enrich specification (3) by including leads. There are two ways to run this set of regressions: either run a separate regression for each distance category or put them together in one single regression. The results are comparable. The coefficients of leads are all statistically insignificant for two years prior to the regulation. Thus, I fail to reject the null hypothesis that nursing homes within the same distance category have the same trend in TOTHPPD prior to the regulation in treatment and control states, and the identifying assumption is partially supported.

I reestimate specification (3) for HPPD of RN, LVN and CNA respectively to examine the effects of MQS on the composition of nurse skill mix and how the effects differ by nursing homes' initial staffing position.

(b) Results

Table 2.5. Effect of Minimum Quality Standards on Total Direct Care Hours: By Distance from Minimum Standards

	Dependent Variable: Total HPPD		
	(1)	**(2)**	**(3)**
	Full Sample	**CA & Its Controls**	**OH & Its Controls**
<0.8	0.127*	0.070	0.490**
	(0.070)	(0.080)	(0.135)
[0.8, 0.9)	0.273***	0.258***	0.360**
	(0.036)	(0.037)	(0.132)
[0.9, 1.0)	0.168***	0.124**	0.233***
	(0.038)	(0.041)	(0.060)
[1.0, 1.1)	0.208***	0.120**	0.199***
	(0.046)	(0.053)	(0.044)
[1.1, 1.3)	0.093**	-0.031	0.065
	(0.041)	(0.070)	(0.042)
≥1.3	0.024	0.123	-0.045
	(0.066)	(0.102)	(0.073)
R-squared	0.670	0.683	0.645
N	29,429	17,412	12, 017

Notes: All regressions include observable facility characteristics, year and facility fixed effects. Robust standard errors clustered by state-year are reported in parentheses.

***signifies p<.001, ** signifies p<.05 and * signifies p<.1

Table 2.5 indicates that the effect of MQS on staffing hours is not uniform across nursing homes[13]. Not only do the nursing homes that fell short of the MQS increase their staffing, those with a little above the MQS but not far above also increase their total HPPD. The very high-end nursing homes' total HPPD, however, remains unchanged. Interestingly, contrary to what might have been expected, nursing homes initially with the lowest nurse staffing hours do not have the biggest increase. One possible explanation is that these most poorly staffed nursing homes

[13]The results reported are from a single regression. For the sake of parsimony and degrees of freedom, I exclude the leads and lags. The complete set of results is available upon request.

mostly locate in rural areas, which face a serious nursing staff shortage. Thus, they may have been granted a waiver by the regulators. Another possible explanation is that realizing the difficulty of meeting the standards, the lowest quality nursing homes may have prepared to exit and given up making an effort to increase nurse staffing.

Column (1) reports estimates from using the full sample. Columns (2) and (3) report estimates from using sub-samples of California with its controls and Ohio with its controls respectively. The estimates display similar patterns in both California and Ohio, which assures us that the results are not solely driven by one of the treatment states.

Appendix B provides the mean total HPPD and the number of nursing homes prior to MQS in each distance category. The mean total HPPD for treatment and its corresponding control states are comparable for each distance category. Compared to the estimates in table 2.5, nursing homes in distance category <0.8, [0.9, 1.0) and [1.0, 1.1) all increase their total HPPD by 6% or so after MQS, nursing homes in range [0.9, 1.0) increases total HPPD by about 10% and nursing homes falling in the top two categories do not have much change in total HPPD. The number of nursing homes reported shows there are enough observations in each distance category.

Table 2.6. Effect of Minimum Quality Standards on Nursing Staff Skill Mix: By Distance from Minimum Standards

Dependent Variable	RN HPPD	LVN HPPD	CNA HPPD
	(1)	**(2)**	**(3)**
<0.8	-0.022	-0.010	0.159***
	(0.016)	(0.021)	(0.045)
[0.8, 0.9)	0.016	0.079***	0.179***
	(0.011)	(0.014)	(0.039)
[0.9, 1.0)	0.0003	0.038**	0.130***
	(0.011)	(0.011)	(0.039)
[1.0, 1.1)	0.006	0.032**	0.170**
	(0.013)	(0.015)	(0.052)
[1.1, 1.3)	-0.015	0.026*	0.082**
	(0.014)	(0.014)	(0.038)
≥ 1.3	0.006	0.054*	-0.035
	(0.025)	(0.031)	(0.056)
R-squared	0.820	0.659	0.485
N	29,429	29,429	29,429

Notes: All regressions include observable facility characteristics, year and facility fixed effects. Robust standard errors clustered by state-year are reported in parentheses.

***signifies p<.001, ** signifies p<.05 and * signifies p<.1.

Table 2.6 shows the results of re-estimating equation (3) using HPPD of RN, LVN, and CNA as dependent variable respectively. The same results pattern as table 2.5 prevails. In general, nursing homes that were initially positioned not too far away from the standards are associated with an increase in direct care hours while the very top nursing homes do not increase their staffing. Moreover, the results reconfirm that the change in the direct care hours of CNAs account for most of the change of total HPPD as was pointed out in section 2.5.1(b).

2.5.3. Competitive Reactions

(a) Model

The specifications described thus far examine how a nursing home's total HPPD change on average after the imposition of MQS and how this quality change would differ by the pre-regulation positioning of the nursing home. In this section, I take the market competitive environment into consideration and study the strategic interaction in nursing homes' choice of quality. To detect whether high-end nursing homes strategically further increase their quality to differentiate from their improved low-end competitors, I take advantage of the exogenous shock on low-end nursing homes' quality imposed by the minimum nurse staffing standards.

I first construct an index $BITE_m = \sum_{j=1}^{N} S_{jm} * \Delta_j$ using the market share weighted distance to the mandated minimum staffing levels to capture the extent of the exogenous effect of MQS in market m. S_{jm} is nursing home j's median share of patients in market m before MQS is implemented. Define $\Delta_j = MQShppd_m - medHPPDpre_j$. Let $\Delta_j = 0$ if $medHPPDpre_j \geq MQShppd_m$. I then restrict the sample to high quality nursing homes, which are defined as having the median total HPPD before MQS equal or surpass the mandated minimum levels, i.e., nursing homes which fall in DIST categories 4, 5 and 6.

I shall use a simple example to briefly illustrate the idea of such an index. Consider two markets A and B; each has four nursing homes with the same number of patients. The imposed MQShppd = 3 for both markets. Each nursing home's initial quality level, its distance to the

minimum standards level, the total share of patients affected and the computed BITE for each market are listed in the following table.

Table 2.7. Illustration of BITE

Market	**A**	**B**
medHPPDpre	1, 2, 3, 4	2, 3, 4, 5
Δ	2, 1, 0, 0	1, 0, 0, 0
Total Market Share Affected	50%	25%
BITE	25%*2+25%*1=0.75	25%*1=0.25

In market A, two nursing homes are directly affected by the MQS which accounts for 50% of the market share. One of them needs to increase 2 HPPD to meet the standards and another needs to increase 1 HPPD. The computed BITE value is equal to 0.75. In market B, only one nursing home falls short of the minimum standards level and has to increase 1 HPPD to meet the standards. The computed BITE is 0.25.

Now focus on nursing homes whose initial quality level is equal or above MQS. First look at nursing homes with medHPPDpre = 3. In market A, 50% of total market share are low-end competitors who are subject to the MQS enforcement; in market B, only 25% market share has to increase 1 hppd. If strategic vertical differentiation incentives are present in these high-end nursing homes' quality choice, we should see the nursing home located in market A increase its quality levels more relative to those located in market B after MQS (if there's any increase in market B at all). This is because the markets with higher BITE are expected to be more directly

affected by the mandated minimum levels and therefore the quality spread should shrink more due to low-end competitors' compliance. Similarly, for nursing homes with medHPPDpre = 4, there ought to be a greater increase in total HPPD after MQS for the nursing home located in market A relative to that located in market B. Moreover, should vertical differentiation incentive exist, in both market A and B, nursing homes with an initial quality level equal to 3 would have a bigger increase in total HPPD than nursing homes with an initial quality level of 4. This is because the former type were positioned closer to their rivals initially and therefore face more direct threats from their improved competitors and hence have more incentive to differentiate.

The empirical model which captures the idea illustrated by the example is as follows:

$$\begin{aligned} TOTHPPD_{jmt} &= \lambda_s MQS_{mt} * I(SmallBITE)_m + \lambda_m MQS_{mt} * I(MediumlBITE)_m \\ &+ \lambda_b MQS_{mt} * I(SmallBITE)_m + \alpha + X_{jmt}\beta \\ &+ YEAR_t + FIRM_j + \eta_{jmt} \end{aligned} \tag{4}$$

I group the continuous variable BITE into three categories: SmallBITE, MedianBITE, and BigBITE, and interact indicators of each category with MQS. The key coefficients of interest λ_s, λ_m and λ_b thus capture high-end nursing homes' change in total HPPD in response to MQS when they belong to markets with different extent of "bite".

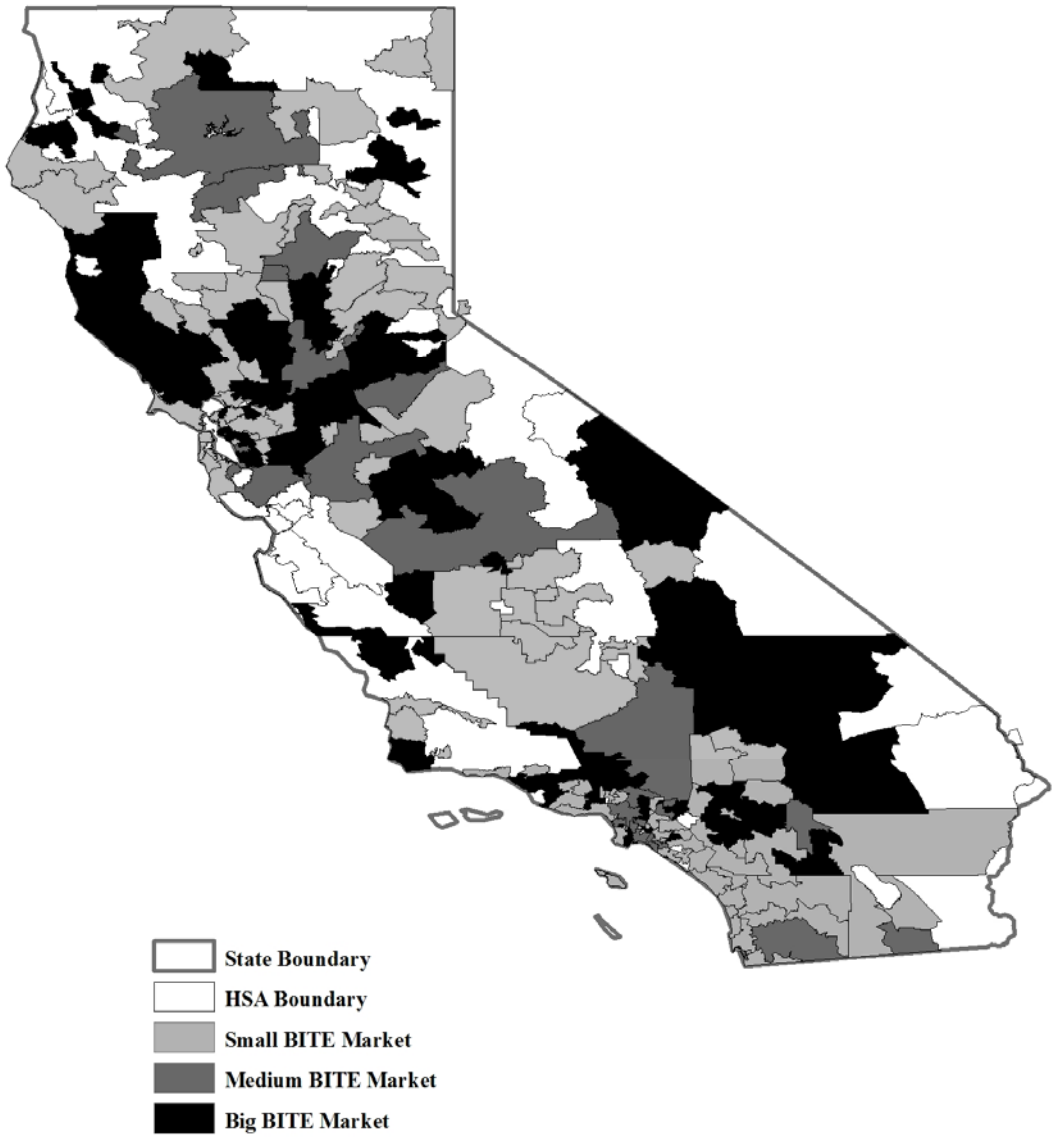
I then estimate equation (4) separately for each distance category the high-end nursing home falls in as defined in section 4.3, i.e., DIST = 4 (nursing homes that barely meet the standards), DIST = 5 (modestly high-quality nursing homes), and DIST = 6 (very high-quality nursing homes).

The market definition I use is the Dartmouth Atlas (2000) Hospital Service Areas (HSAs),

which delineate local health care markets more precisely than a simple county by county categorization. An HSA is defined as a collection of zip codes whose residents receive most of their hospitalizations from the hospitals in that area. Since it is important for a nursing home to locate near a hospital, to get referred post-acute care patients and to send patients to if their condition deteriorates (some nursing homes are even hospital-based), I believe HSAs are a reasonable market definition for nursing homes too.

Since a large majority of nursing homes in Ohio have already met mandated minimum staffing standards before the regulation, the distribution of BITE in Ohio heavily skews to the left and does not provide enough variation across markets. (See appendix C for histograms of the size of BITE in California and Ohio.). Therefore, I restrict attention to California and its control states in this market analysis. Figure 2.4 provides the map of California markets where high-end nursing homes are located highlighted by the different extent of BITE of MQS.

Figure 2.4. Distribution of High-End Nursing Homes across Geographic Markets: By BITE Type



Notes: The unshaded areas refer to markets where no high quality nursing homes are located whose total HPPD is already above the minimum nurse staffing standards.

(b) Results

Table 2.8. Test of Vertical Differentiation in Total Direct Care Hours: By Market Bite Type

	Dependent Variable: Total HPPD		
	(1)	**(2)**	**(3)**
	[1.0, 1.1)	**[1.1, 1.3)**	**≥ 1.3**
Small Bite	0.034	-0.085	0.068
	(0.071)	(0.084)	(0.167)
Medium Bite	0.255***	-0.115	-0.067
	(0.087)	(0.150)	(0.240)
Big Bite	0.272**	0.299*	0.699***
	(0.116)	(0.158)	(0.238)
R-squared	0.261	0.387	0.650
N	2,860	2,452	1,647

Notes: Small bite market is defined as BITE<30; medium bite is defined as BITE>=30 & <40; big bite is defined as BITE>=40. All regressions include year and facility fixed effects. Robust standard errors clustered by market-year are reported in parentheses.

***signifies p<.001, ** signifies p<.05 and * signifies p<.1.

Table 2.8 presents market analysis results for high-end nursing homes in California and its control states. Coefficients in column (1) are from OLS estimation of equation (4) using nursing homes that just meet or are only a little above the minimum standards (with median total HPPD prior to MQS equal or above the mandated 3.2 hours per patient day, but less than 1.1 times 3.2 total HPPD.). This type of nursing homes' total direct care staffing increases significantly by 0.255 and 0.272 respectively if they are located in a medium "bite" or big "bite" markets. Coefficients in column (2) are from the OLS estimation of equation (4) using nursing homes with modestly high quality (defined as initial staffing prior to MQS falling in the distance cutoff

category [1.1, 1.3)). Coefficients in column (3) are from the OLS estimation of equation (4) using the very high-quality nursing homes with initial staffing prior to MQS equal or above 1.3 times the state minimum mandates. In these two columns, only coefficients of big "bite" are positively significant, while coefficients of medium and small "bite" are insignificant. Viewed from another angle, in markets with small "bite", which means few or no competitors are expected to increase their staffing due to the imposition of MQS, no high end nursing homes increase their total HPPD. In markets with medium "bite", which means some rivals will be bound by the minimum mandates, but the extent of such mandates is not the greatest, only nursing homes that are initially positioned closest to their low-end rivals increase their staffing, while in markets with big "bite", all the high-end nursing homes respond by increasing their staffing. The differences in high end nursing homes' responses to MQS based on their initial position and the extent of their rivals' binding by the regulation is consistent with the vertical differentiation theory and the subsequent development by Ronnen (1991) and Crampes and Hollander (1995) in the MQS context, which stress that the impact of MQS on firms' quality choice may depend on the degree of market competition.

2.5.4 Robustness Checks

To address the concern about the assignment of control states to CA and OH and the contribution of these two experiment states to the results respectively, I test the robustness of the basic specifications and the results are reported in table 2.9. Column (1) presents the baseline results from estimating equation (2) using the full sample as in table 3 column (3). Column (2),

(3), (4) and (5) include results from estimating the same equation through different sample restrictions. Columns (3) and (5) report results from running the regression separately using CA with its assigned control states and OH with its assigned control states. The same pattern as using the full sample prevails in both experiment states although the effect of MQS is less pronounced in OH. Column (2) and (4) present the results of combining all the control states for CA and OH instead of using their assigned controls. The results are not sensitive to the specific assignment of the controls to the experiment state by comparing (2) to (3) and (4) to (5).

Table 2.9. Sensitivity of Results to Assignment of Control States:

Robustness Checks

	Dependent Variable: Total HPPD				
	(1) **Full Sample**	**(2)** **CA & Full Controls**	**(3)** **CA & Its Controls**	**(4)** **OH & Full Controls**	**(5)** **OH & Its Controls**
$MQS_{t,-3}$ (3 or More Years Prior to Regulation)	0.027	0.055	0.054	-0.017	0.035
	(0.028)	(0.039)	(0.058)	(0.039)	(0.039)
$MQS_{t,-2}$ (2 Years Prior to Regulation)	-0.012	-0.014	-0.019	-0.031	0.019
	(0.029)	(0.038)	(0.047)	(0.037)	(0.034)
$MQS_{t,1}$ (The Year of Regulation or Post 1 Year)	0.141***	0.191***	0.199***	0.095*	0.118**
	(0.024)	(0.026)	(0.035)	(0.050)	(0.044)
$MQS_{t,2}$ (Post 2 Years)	0.182***	0.227***	0.216***	0.092**	0.137***
	(0.036)	(0.038)	(0.054)	(0.041)	(0.035)
$MQS_{t,3}$ (Post 3 or More Years)	0.135**	0.164***	0.154***	0.071	0.169***
	(0.033)	(0.032)	(0.041)	(0.054)	(0.043)
R-squared	Y	0.684	0.672	0.634	0.638
N	Y	22,805	17,412	21,301	12,017

Notes: For CA, the control states used are NY, NH, VA and WA. For OH, the controls are AL, KY and NE. The omitted MQS variable is the year right before the regulation took effect. Robust standard errors clustered by state-year are reported in parentheses.

***signifies p<.001, ** signifies p<.05 and * signifies p<.1. All regressions include year and facility fixed effects.

2.6. Conclusion

In this paper, I examine the choice of quality levels by nursing homes in response to the minimum quality standards, one of the regulatory mechanisms to solve the problem of under-production and under-consumption of the high quality products or services. The main findings can be summarized as follows. First, there is a significant increase in nursing homes' total direct care hours per patient day after the imposition of MQS on average. Most of this increase in nurse staffing comes from the increase in the least skilled and least paid Certified Nurse Assistants. Second, the effect of MQS differs by nursing homes' initial quality position. Nursing homes that fell short of the minimum standards levels increased their staffing as well as those that met the standards but were not far above them, whereas the very high-quality ones did not change their staffing level. Third, when incorporating the market competitive environment and strategic interaction into consideration, I found that high-end nursing homes increase their staffing level only in markets where they are likely to face quality upgrading from their low-end rivals.

These findings have policy and managerial implications. They provide policy makers with evidence that minimum quality standards do boost the quality overall and also quantify the different effect of MQS on different ranges of the quality distribution. MQS can have bigger impact than thought since not only low-end nursing homes which were initially below the standard improve their quality but high-end nursing homes which are not directly affected by the standard also increase quality. On the other hand, MQS can cause unintended distortion in input

mix (nursing skill mix in this case). This guidance on the effectiveness of MQS is of particular importance given that heated discussion about whether to adopt similar minimum nurse staffing standards in hospital industry is currently underway.

Caution needs to be exercised in interpreting the findings and especially in attempting to draw welfare conclusions. Although this analysis shows that the more stringent minimum standards may cause a bigger spillover effect on high-end nursing homes' quality, it may not be the case that more stringent minimum standards will lead to higher quality because firms may deter entry and cause exit[14]. Moreover, nursing homes may display other interesting strategic behavior in facing more stringent minimum standards. Given the fact that more than 50% of the nursing homes are for-profit and owned by a chain, when it is hard to find enough nursing staff due to shortage and inelastic supply in the short run, there may be reallocation of nursing staff across nursing homes within market and within chain. Another possibility is that when minimum standards become very stringent, high-end nursing homes might differentiate along other quality dimensions, such as nicer rooms or better meals, due to the increasing marginal cost of obtaining nursing staff. These speculations point to fruitful directions for further research.

[14]It is not trivial to identify exit in this industry because big nursing home chains sometimes divest all of their nursing homes in one state due to the "worsening of litigation environment". Some of the sites might be purchased by other nursing home chains or private investors and still operate as nursing homes, others might be purchased for other purposes. With this complication of change in ownership, we can not simply code a newly appearing provider number as an entrant and to a suddenly disappearing number as an exiter. For this reason, I need to check the names and addresses one by one and match them with the organizations to which they belong.

3 The Impact of Market Structure on Nursing Home Quality

3.1. Introduction

The impact of competition on product quality has long been of interest to both industrial organization economists and regulators. The theoretical literature provides ambiguous predictions. On one hand, firms with market power may cut quality in order to lower costs, and competition instead may provide incentives for a firm to increase quality given consumers' higher willingness-to-pay for a higher quality product. On the other hand, high quality can be associated with more concentrated market structure if entry is more difficult or exit more likely where firms offer higher quality.

Although the theoretical literature dates back at least to the early 20th century, there is surprisingly little evidence. The empirical challenges lie in measuring quality and especially addressing the endogeneity of market structure. The prior studies more or less suffer from a fundamental identification problem: Does market structure affect product quality choice or do these choices reflect unobserved characteristics correlated with market structure. In other words, does competition lead to higher quality or is quality endogenously chosen by firms to drive out competitors and lead to more concentrated market structure? Existing studies in the healthcare literature assume the presence of a correlation between market structure measure and quality as being indicative of the effect of competition. Failure to account for reverse causality in these

papers leads to biased estimates. Moreover, evidence from the healthcare literature is entirely on hospital markets and these studies only use clinical outcome measures such as mortality rate and surgery complications to infer the quality level, but do not examine dimensions that are more directly related to hospitals' quality choice such as inputs.

In this paper I examine how market structure affects the choice of product quality levels (measured as total nursing inputs) in the nursing home industry. Specifically, I analyze whether local markets which have a higher concentration have higher quality. In order to addresses the potential endogeneity of market structure (measured by Herfindahl-Hirschman Index), I consider exogenous shocks caused by the divestiture of chain affiliated nursing homes due to Medicare/Medicaid reimbursement changes or "the worsening of the litigation environment". I construct an instrumental variable Δ(DivestHHI) to capture the change in the Herfindahl-Hirschman Index (HHI) caused solely by statewide chain divestiture. I then examine the changes in quality of the existing nursing homes with the change of HHI. By including leads and lags of Δ(DivestHHI) in both the first stage and second stage reduced form least square regressions, I validate the identifying assumption that the change in quality is indeed caused by the change of HHI which is the results of chain divestitures instead of other unobserved factors.

Using the robust instrumental variables estimation method, I find substantial increase in total nursing inputs associated with increase in market concentration: a one standard deviation increase in HHI increases total nursing inputs by 38% of total nurse staffing Hours Per Patient Day (HPPD). Among markets with positive change of HHI, total HPPD increase 18.3%. In

comparison, the HHI estimates are insignificant at conventional levels under fixed effects OLS regressions, implying that that market structure could be endogenous and quality choice is a strategic choice variable.

The rest of paper is organized as follows. The next section reviews the relevant theoretical and empirical literature. Section 3.3 provides a brief introduction of the nursing home industry and the recent trend of chain divestiture. Section 3.4 describes the data. Section 3.5 outlines the empirical analysis and describes the instrumental variable in detail. Section 3.6 presents the main results. The final section concludes with some discussion of the results and policy implications.

3.2. Literature Review

3.2.1. Theoretical Literature

The early theoretical literature, such as Spence (1975) and Mussa and Rosen (1978), in general agree that the more concentrated the market, the lower the quality of the good. Schmalensee (1979) notes that the outcomes of the different theoretical models are very sensitive to the assumptions made by the model and pointed out that "there is an obvious need for empirical work to confront the implications of the theoretical literature with data."

The vertical differentiation theory, developed since Gabszewicz and Thiesse (1980) and Shaked and Sutton (1982), argues that firms have incentives to strategically vertical differentiate to relax price competition in ogligopolistic markets (see Tirole (1988) in *The Theory of Industrial*

Organization for an excellent review). This literature implies that once quality variation is considered, it is not clear whether competition increases or decreases quality -- it depends on how to model competition and whether quality is strategic complement or substitute.

The impact of market structure on quality choice is even more complicated when market structure itself is endogenous. Demsetz (1973) argued that a more concentrated market structure is likely to be related to a higher level of quality. His "critique" of the relationship between competition and quality is essentially a "last man standing" argument that higher quality is consistent with a more concentrated market as only the firms whose products satisfy consumers remain in the market. Sutton (1991) reached similar conclusions, though for different reasons. Sutton showed that a firm tends to use fixed cost investment to increase the quality of its products in order to drive out competitors who cannot afford to compete on quality, hence increasing market concentration. I summarize the relevant theories in the table below.

Table 3.1. Summarization of Relevant Theories

Theories	Correlation Between Market Concentration and Quality	Causal Link Between Market Structure and Quality Choice
Early Theories (Mussa and Rosen 1978, Maskin and Riley 1984)	-	→
Vertical Differentiation (Tirole 1988)	+ or -	→
"Last Man Standing" (Demsetz 1973)	+	←
Endogenous Sunk Cost (Sutton 1991)	+	←

Notes: → and ← indicate which direction the theory predicts the causal link between market structure and quality choice.

3.2.2. Empirical Literature

Compared to the abundant literature on the price effects of competition, the impact of competition on quality has been much less studied. This is largely due to the difficulty in measuring quality and clearly establishing the causal link between market structure and quality outcomes. The available papers are in specific industry context. For example, Cotterill (1999) looks at food retailing, Hamilton and Macauley (1999) examine car maintenance, Mazzeo (2002) examines motel industry and Mazzeo (2003) finds that flight delays are longer on average in more concentrated airline markets. While these studies overall find positive correlation between

competition and product quality, they all treat market structure as exogenously given and interpret the correlation as causal effect of competition. Cohen and Mazzeo (2004) explore bank branching decisions, and they try to account for the endogeneous market structure by using an equilibrium structural model. They divided banks into three different types and argues that the effect of competition on quality depending on the specific type of banks and the interaction with product differentiation.

In health care, the existing literature is almost entirely on hospital markets and the results are mixed. Dranove and White (1994) summarize the evidence from the early related studies. In recent studies, Kessler and McClellan (2000) find that competition significantly adverse health outcomes. Sari (2002) showed that market concentration is associated with lower quality of care as measured by the in-hospital complications. Similarly, Rivers and Fottler (2004) found that more competitive markets have lower risk-adjusted mortality rates. In contrast, Ho and Hamilton (2000) study the impact of hospital mergers of on outcome based measures of quality, namely inpatient mortality, readmission rates and early discharge of newborns, and find no detectable impact of merger on mortality. Mukamel et al. (2001) finds no significant correlation between hospital competition and risk-adjusted hospital mortality rates.

These existing health care studies, however, have some limitations. First and foremost, although they present results on the correlation between competition and quality, the identification of causality still remains unclear. For instance, if the coefficient of HHI is negative when regression quality measures on HHI, it could suggest that competition leads to better

quality, it is also possible that high quality firms are more likely to exit as well as low quality firms are more likely to enter those more concentrated markets. It is therefore the strategic entry or exit that causes the change of market structure rather than the market structure that leads to different quality decisions. Second, these studies are solely based on clinical outcome measures such as mortality rate and surgery complications to infer quality levels. Since health outcomes are the end products of patients' initial conditions and hospital inputs, it would be valuable to isolate the input quality and focus on the part where hospitals are in complete control[15]. Finally, the evidence from this literature is entirely on hospital markets. Hospital markets are one of the most important sectors in health care, but "the impact of competition on quality should be extended to other parts of the health care sector."[16]

In summary, this study contributes to the literature by shedding lights on the impact of competition in an industry that has been rarely studied. With the help of a detailed firm level dataset, this study also clearly identifies the effects of competition on firms' quality choice by exploiting shocks to HHI caused by chain divestiture. The underlying instrumental variable idea can be generalized to study other industries as well.

[15]Some studies such as Kessler and McClellan (2000) use risk-adjusted outcome measures to reduce the noisy cause by different patient initial conditions. However, the design and implementation of report cards and risk coefficients themselves remain problematic and are still under heated debate.
[16]Gaynor (2006)

3.3. Background

For-profit and large national chains play an important role in the industry, with more than half of all nursing homes belonging to a chain and almost two-thirds of the industry operating on a for-profit basis. This is largely due to the reimbursement policies and the prospects for a greater demand because of population aging. The nursing home industry rose in the mid 1980s and expanded quickly until the mid 1990s. The implementation of Medicare's acute care hospital Prospective Payment System (PPS) in 1984 created an incentive for hospitals to discharge patients more quickly. This lead to a higher acuity case-mix for nursing homes and a substantial increase in Medicare's spending for skilled post-acute care. The relatively generous Medicaid reimbursement policies and the expectations to reap profits from the soon-to-retire "baby boomer" generation attracted investment in the nursing home industry from the national corporations and Wall Street[17]. As a result, for-profit and large chains dominate the industry.

Since mid 1990s, the nursing home industry has been financially distressed and some national chains started strategically divesting their nursing homes. Anecdotes, the press and government reports attribute this outcome to several factors. One is the transition to prospective payment (PPS) for Medicare financed post-acute care. PPS eliminated cost-plus reimbursement and implemented a case-mix adjusted per-diem payment instead, leading to substantial cuts in payments to nursing homes, especially Skill Nursing Facilities (SNFs). Besides the Medicare payment scheme change, the fast growth of nursing home litigation and the resulting high

[17]Nursing Home Divestiture and Corporate Restructuring: Final Report (2006).

liability insurance premiums lead national nursing home chains to divest their ownership and exit from states with particularly high litigation costs and malpractice insurance rates. For example, in January 201, Beverly announced to exit Florida and other states with "higher-than average malpractice expenses." By 2004, other large chains such as Genesis, Kindred, Extendicare, and Mariner also exited Florida and Manor Care divested some of its assets in the state. In the paper I choose to focus on the four states (California, Florida, Ohio and Texas) with among the highest malpractice costs and thus the most chain divestitures.

3.4. Data

3.4.1. Data Sources

The two data sources used in this study are from the OSCAR files (On-line Survey, Certification, and Reporting Database) and the Dartmouth Atlas (2001). Details about these two data sources are explained in section 2.4.1.

3.4.2. Data Description

After data cleaning, the whole datasets contains a total of 21,634 Medicare and/or Medicaid certified nursing homes from 1996 to 2005, with a total 147,860 observations. I then restrict attention to four large states, i.e. California, Florida, Ohio and Texas, because these four large states have the "worst litegation environment" for malpractice and thus the highest nursing home

divestiture frequencies as explained in section 3.3. This helps to create the variation in changes of market HHI.

I exclude Medicare-certified-only facilities, which account for 2 percent of the total nursing home certified beds, because they specialize in serving post-acute patients and are not comparable to Medicaid-only or dually-certified nursing homes. I also exclude nursing homes that appear in the bottom and top 5 percentiles of the distribution of total HPPD in order to exclude extreme values due to misreporting. For big HSA markets such as Los Angeles, there are more than 200 nursing homes. It would be very unlikely that each nursing home in the market competes with all the other more than 200 nursing homes. To avoid such a strong assumption, I restrict attention to small markets with no more than 20 nursing homes. The empirical results are nonetheless robust in spite of these sample restrictions.

The resulting sample used for this study includes 2,376 Medicare and/or Medicaid certified nursing homes located in four states from 1996 to 2005, with a total 19,179 observations. Table 3.2 presents summary statistics for some key variables. Around 80% of nursing homes are for-profit and 2/3 are chain affiliated. Table 3.2 also reports unweighted and weighted (by nursing homes) market HHI and instruments DivestHHI and Δ(DivestHHI)[18].

[18]DivestHHI and Δ(DivestHHI) are defined in section 3.5.1.

Table 3.2. Summary Statistics for Key Variables

	Mean	Std. Deviation	Number of Obs.
Dependent Variable			
Total HPPD	3.17	0.72	22,901
Nursing Home Characteristics			
Chain-Owned?	0.64	0.48	27,272
For-profit	0.78	0.41	27,272
Non-Profit	0.18	0.38	27,272
Government	0.04	0.19	27,272
Number of Beds	103.27	72.21	27,272
Occupancy Rate	0.78	0.22	27,272
Total Number of Residents	78.59	47.03	27,272
Proportion of Medicaid Residents	0.61	0.28	27,272
Proportion of Medicare Residents	0.16	0.23	27,272
Proportion of Other Resident	0.23	0.20	27,272
Market Characteristics			
HHI (weighted)	0.30	0.23	27,272
HHI (unweighted)	0.48	0.31	5,586
Instrument			
DivestHHI (weighted)	0.33	0.24	27,272
DivestHHI (unweighted)	0.51	0.31	5,586
Δ(DivestHHI) (weighted)	0.01	0.04	5,586
Δ(DivestHHI) (unweighted)	0.01	0.04	27,272

Notes: Unit of observations is nursing home-year. Percentages may not add up to 1 due to rounding. Market definition in this table and all the tables that follow is Hospital Service Areas (HSAs) as defined in the Dartmouth Atlas (2001).

3.5. Empirical Analysis

I am interested in knowing the impact of competition on nursing home quality. As explained

in section 3.1, directly regressing some quality measure on a market concentration measure such as HHI subject to endogeneity. To deal with this issue, I estimate a two-stage least squares (2SLS) instrumental variables regression with nursing home as the unit of analysis. The variables and estimation specifications of the first and second stages are explained in detail below.

3.5.1. First Stage: Instrumenting for Nursing Home Market Concentration

An ideal instrumental variable should help explain variation in HHI (the endogenous predictor), while being uncorrelated with unobserved determinants of nursing home quality.

Noticing the dominant role of chain play in the nursing home industry and the recent trend of chain divestiture as described in section 3.3.1 and 3.3.2, this paper proposes to exploit these divestitures as a source exogenous identification in market concentration. I define the instrumental variable as follows:

$$(5)\quad \text{DivestHHI}_{m,t} = \sum_{k=1}^{K} (s_{k,t_0} * O_{k,t})^2$$

S_{k,t_0} denotes the market share of organization k in period 0 [year 1996] and $O_{k,t}$ is the system structure of nursing homes in period t. Thus, I construct the instrumental variable DivestHHI by taking the market shares of nursing homes in the beginning period (year 1996) and then assigning these nursing homes to the organizations to which they belong in year t. Changes in DivestHHI over time are solely due to changes in ownership and nursing home system

structure caused by a whole state divestiture.

The instrumental variable is constructed in a way similar to HHI, the key difference is that the change of value in such an instrumental variable is solely due to chains' exit of a whole state which is the result of divestiture decision. The distribution of chain affiliated nursing homes is not uniform across markets, i.e., for a given chain, there may be none of its member homes in some market, one homes in other markets and more than one homes in the rest markets. Therefore, once a chain decides to divest all the nursing homes and exit the state, it creates variation in HHI.

Assuming chain divestiture provides sufficient variation in HHI, we must then examine whether this variation in HHI is indeed exogenous. If, for instance, chains selectively divest their homes in markets where they face high quality competitors, then it is rivals' quality that leads to divestiture and the variation in HHI, and the exogeneity assumption is violated. However, as explained in section 3.3, the main reason claimed for chains divestitures is the financial pressure brought out by reduction in Medicare and/or Medicaid reimbursement rate and the increase of litigation costs caused by changes in malpractice laws. All of these do not directly link to differences in nursing home quality and they are at the state level and bear the same changes on each local market. What's more, I present the econometric test of the exogeneity assumption in section 3.6.3. The basic idea is to add leads and lags in the reduced form regression

For example, there are 4 nursing homes in a given market in state X in 1996. One does not affiliate with any nursing home chain, one belongs to chain A, and two belong to chain B. Their

market shares are 0.2, 0.5 and 0.3 (combined market share for the two affiliated with the same chain) respectively. DivestHHI is thus the sum of the squared market share (equal to 0.38) and it will remain the same value if no chain divestiture happens. Suppose at some point of the time, chain A decides to divest all of its nursing homes in X including this market we focus on. I use two ways to calculate the post-divestiture DivestHHI. One is assume that all of chain A's share of 50% is allocated to the rest of the nursing homes proportionally to their initial market share, and the second is assume all the 50% market share is equally distributed to the rest of the nursing homes. The resulting market shares are summarized in the table below and DivestHHI is 0.52 and 0.505.

Table 3.3. Market Share Allocation

<table>
<tr><td></td><td></td><td></td><td colspan="3">Market Share</td></tr>
<tr><td rowspan="2">Firm</td><td rowspan="2">Chain Affiliation</td><td rowspan="2">Divested</td><td rowspan="2">Before</td><td colspan="2">After</td></tr>
<tr><td>Proportionally Allocate</td><td>Equally Allocate</td></tr>
<tr><td>1</td><td>Chain A</td><td>Y</td><td>0.5</td><td>N/A</td><td>N/A</td></tr>
<tr><td>2</td><td>Chain B</td><td>N</td><td rowspan="2">0.3</td><td rowspan="2">0.6</td><td rowspan="2">0.55</td></tr>
<tr><td>3</td><td>Chain B</td><td>N</td></tr>
<tr><td>4</td><td>N/A</td><td>N</td><td>0.2</td><td>0.4</td><td>0.45</td></tr>
</table>

Equation (6) represents the first stage in the instrumental variables estimation procedure.

$$(6)\quad HHI_{j,m,t} = \alpha_0 + \alpha_1 * DivestHHI_{j,m,t} + Year_t + Market_m + \varepsilon_{j,m,t}$$

In this equation and all the equations that follow, j indexes the nursing home, m indexes the market and t indexes the year of observation. Both HHI and DivestHHI are defined at the market-year level. However, to maintain consistency with the unit of observation used for the second stage, I estimate this equation using the nursing home as the unit of observation. However, results are quite similar when I estimate the equation using the market as the unit of observation. Year and Market are the year and market fixed effects

Although DivestHHI is the instrument for the IV estimate of HHI, for purposes of robustness check, it is helpful to define Δ(DivestHHI), which is coded as zero for all the years until chain divestiture and then the differential between the pre- and after- divestiture divestHHI for each market[19]. I then take the leads and lags of Δ(DivestHHI), using the year of chain divestiture as the reference point.

$$\begin{aligned}(7)\quad HHI_{j,m,t} = {} & \alpha_{-3} * \Delta(DivestHHI)_{jmt,-3} + \alpha_{-2} * \Delta(DivestHHI)_{jmt,-2} \\ & + \alpha_{-1} * \Delta(DivestHHI)_{jmt,-1} + \alpha_1 * \Delta(DivestHHI)_{jmt,1} \\ & + \alpha_2 * \Delta(DivestHHI)_{jmt,2} + \alpha_3 * \Delta(DivestHHI)_{jmt,3} \\ & + \alpha_0 + Year_t + Market_m + \delta_{j,m,t}\end{aligned}$$

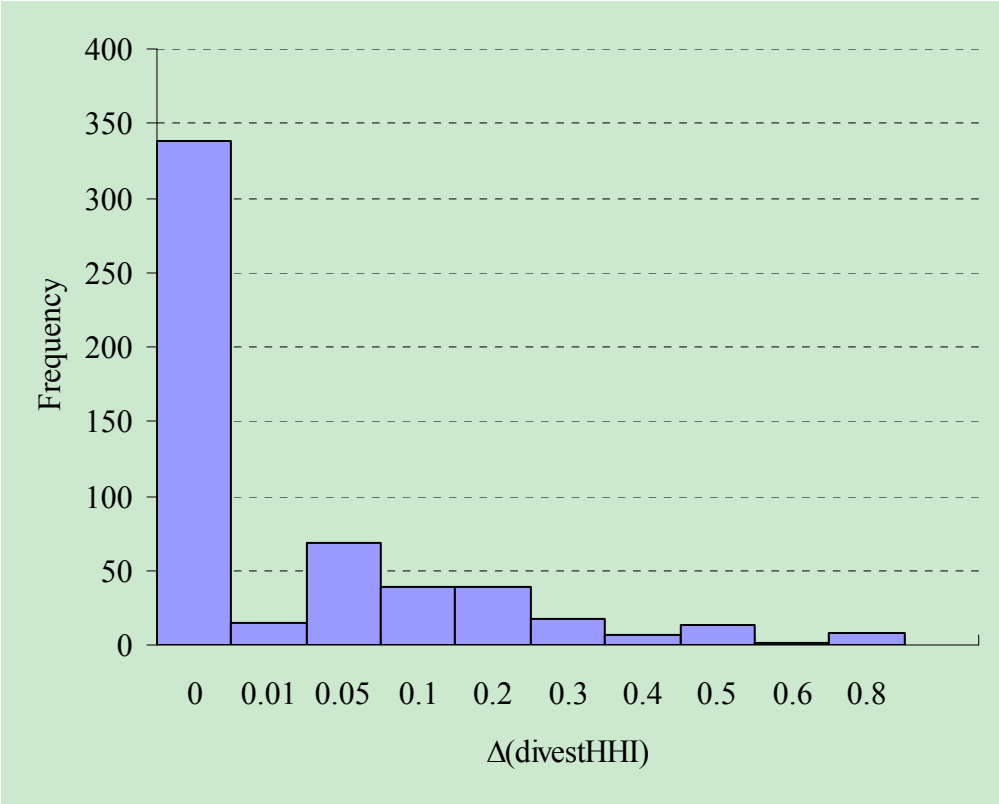
$\Delta(DivestHHI)_{jmt,-3}$, $\Delta(DivestHHI)_{jmt,-2}$, $\Delta(DivestHHI)_{jmt,-1}$, $\Delta(DivestHHI)_{jmt,1}$, $\Delta(DivestHHI)_{jmt,2}$, and $\Delta(DivestHHI)_{jmt,3}$ denote 3 or more years before divestiture, 2 years

[19] DivestHHI and Δ(DivestHHI) give the same first-stage results. I use Δ(DivestHHI) in the leads and lags analysis since it looks more straightforward and easier to interpret.

before divestiture, 1 year before divestiture, 1 year after, 2 years after and 3 or more years after divestiture respectively. If it is indeed the case that Δ(DivestHHI) (and DivestHHI) captures the effect of chain divestiture rather than other factors such as nursing home chains' anticipation of some unobservable demand or supply shocks, we should expect the coefficients on the leads of Δ(DivestHHI) to be insignificant.

Equation (7) is identified by the variation of Δ(DivestHHI) across local markets (HSAs), which causes the variation in market concentration. Figure 3.1 shows the accumulated distribution of Δ(DivestHHI) by 2005 and the exact number of markets within the Δ(DivestHHI) range is reported in the table below. A little more than 60% (N=338) markets do not have any chain divestitures, so the change in DivestHHI is zero. However, there are still around 40% markets have one or more chain divestitures happening over the years from 1997 to 2003, and the change in DivestHHI varies greatly across markets ranging from less than 0.01 to 0.8.

Figure 3.1. Distribution of Δ(DivestHHI) across Market by 2005



Δ(DivestHHI) Bin	Frequency
0	338
0.01	15
0.05	68
0.10	39
0.20	39
0.30	17
0.40	7
0.50	14
0.60	2
0.80	8
Total (0.01-0.80)	209

3.5.2. Second Stage: The Impact of Competition on Quality

We examine the impact of nursing home market structure on quality at the nursing home level. I first proxy for nursing home quality by the total nursing input, more specifically the total nurse staffing hours per patient day. Nurse staffing as a quality measure for nursing homes has been supported by abundant medical literature and consumer surveys (see section 2.3.1 for detailed discussions). I then estimate parameters from the following nursing home-level fixed effects regression:

$$(8)\quad Y_{j,m,t} = \beta_0 + \beta_1 * \hat{HHI}_{m,t} + \sum_{m=1}^{M} POST_{m,t} + Year_t + Firm_j + \eta_{j,m,t}$$

where $Y_{j,m,t}$ is a measure of nursing home quality. The primary predictor $\hat{HHI}_{m,t}$ denotes the predicted value from the first stage regression (6). The coefficient β_1 tells us the effect of market concentration on nursing home quality. A negative sign on β_1 will support the hypothesis that less competition leads to lower quality. $Post_m$ are a set of dummy variables which help to control for different time trends for different markets. $Post_m$ = 1 for the year and all the years after chain divestiture in market m and 0 otherwise. Year, Market and Firm denote the year, market and firm fixed effects respectively. I run the regression both with and without firm fixed effects and when the firm fixed effects are included, market fixed effects become redundant.

The key identifying assumption is that $\eta_{j,m,t}$ is uncorrelated with Δ(DivestHHI). If demand or supply shocks to nursing home quality are correlated with market structure, the

assumption is violated and the DivestHHI estimate will be biased. For example, it is plausible that negative demand shocks make it unprofitable for nursing homes to maintain high quality and also prompt nursing home chain divestitures. If this is the case, we should expect coefficients of both Δ(DivestHHI) and leads to be significantly negative unless nursing home chains can accurately time their divestitures. I therefore use the year when all affiliated homes of a chain exit a state as the omitted reference category and compare the effect of leading and lagged values of DivestHHI relative to the reference category.

3.6. Results

3.6.1. Testing the Instrumental Variable Validity

As explained in section 3.5.1, a valid instrumental variable needs to be correlated with HHI, but on the other hand, uncorrelated with unobserved determinants of nursing home quality. Table 3.4 presents the first stage regression results with and without firm fixed effects. The coefficient of DivestHHI is highly significant at 1% level for both market level and firm level regression, which shows that DivestHHI is positively correlated with HHI even after controlling for market fixed effects.

Table 3.4. Relationship between Market Concentration and Instrument (First Stage)

	Dependent variable: HHI	
	(1)	(2)
DivestHHI	0.145***	0.072***
	(0.042)	(0.017)
Year Fixed Effects	Y	Y
Market Fixed Effects	Y	N/A
Firm Fixed Effects	N	Y
R-squared	0.842	0.860
N	5,586	27,272

Notes: This table reports the first stage regression results with and without firm fixed effects. Column (1) presents the market level results and column (2) presents the result where I use nursing home as the unit of observation.

*** signifies p<.01, ** signifies p<.05 and * signifies p<.1

Having verifying the relevance of DivestHHI to HHI, the next step is to justify the exogeneity assumption of DivestHHI. I validate the assumption by testing if the decision of chain divestiture is influenced by the local market structure in the previous periods. I do so by adding leads to the enriched first stage regression. Table 3.5 shows the relationship between HHI and the leading as well as lagged values of Δ(DivestHHI) when the reference category is the year when all of a chain affiliated nursing homes exit a given state (see Appendix D for an illustration of the data structure and how leads and lags are coded). The coefficients display similar patterns no matter Δ(DivestHHI) is computed by distributing the market shares proportionally or equally among the remaining nursing homes. Compared to the reference year, the coefficients of Δ(DivestHHI) are insignificant for all the leading years. This suggests that the decision of chain divestiture is not induced by previous market structure. The coefficients are most significant for

the lagged one year, less significant for the lagged two years and become insignificant again for the lagged 3 or more years. This suggests that the effects of divestiture on market concentration last no more than two years. It could be due to the fact that new chains or corporations enter the market, buy the divested properties and reopen under different ownerships.

Table 3.5. Testing the Instrumental Variable

(With Leads and Lags of DivestHHI)

	Dependent variable: HHI	
	Proportionally Distributed	Equally Distributed
Δ(DivestHHI) lead 3 or more years	0.037	-0.011
	(0.051)	(0.057)
Δ(DivestHHI) lead 2 years	0.040	0.003
	(0.067)	(0.075)
Δ(DivestHHI) lead 1 year	0.032	0.008
	(0.059)	(0.066)
Δ(DivestHHI) lag 1 year	0.189***	0.178***
	(0.056)	(0.062)
Δ(DivestHHI) lag 2 years	0.109*	0.062
	(0.058)	(0.065)
Δ(DivestHHI) lag 3 or more years	0.043	0.019
	(0.045)	(0.050)
Year Fixed Effects	Y	Y
Market Fixed Effects	Y	Y
R-squared	0.842	0.842
N	5,586	5,586

*** signifies p<.01, ** signifies p<.05 and * signifies p<.1

3.6.2. The Impact of Market Structure on Quality

Table 3.6 presents the fixed-effects regression coefficients of the total nursing inputs (total

nurse staffing hours per patient day) on HHI. The first and second column presents the estimates from OLS regression without and with firm fixed effects. The coefficients of HHI and is small and not significantly different from zero at traditional levels of confidence[20]. Column (3) and (4) present the estimates when HHI is instrumented by DivestHHI. After controlling for the firm fixed effects, the coefficient of HHI is positively significant at 1% level. A one standard deviation increase in HHI increases total nursing inputs by 80% of HPPD. Among markets with chain divestitures, HHI on average increase 0.11, which translates to 1.2 hours (72 minutes) increase in total nurse staffing hours per patient day, a 40% increase. The results suggest that market structure does have substantial effects on quality choice, on the other hand, they also suggest that directly regressing quality measures on market concentration subjects to omitted variable bias, which infers that market structure could be endogenous.

[20]The coefficient of logarithm of HHI when only the market fixed effects are included is significant at 0.05; however, the magnitude is trivial (equal to -0.008).

Table 3.6. The Effect of Market Concentration on Nursing Home Quality

	Dependent Variable: Total HPPD			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
HHI	0.093	0.041	14.781**	10.616***
	(0.063)	(0.042)	(6.866)	(3.810)
Year Fixed Effects	Y	Y	Y	Y
Market Fixed Effects	Y	N/A	Y	N/A
Firm Fixed Effects	N	Y	N	Y
N	22,901	22,901	22,901	22,901

*** signifies p<.01, ** signifies p<.05 and * signifies p<.1

3.6.3. Robustness

For DivestHHI to be a valid instrumental variable, it needs to be correlated with HHI, but on the other hand, Table 3.7 shows the results of the reduced form regression of HHI on the leading as well as lagged values of Δ(DivestHHI). Column (1) and (2) represent results when Δ(DivestHHI) is constructed in a way that the exiting nursing homes' market share are distributed to the remaining ones proportionally to their initial market shares. Column (3) and (4) represent results when the exiting nursing homes' market shares are distributed equally to the remaining ones. When the reference category is the year when all of a chain affiliated nursing homes exit a given state. Compared to the reference year, which is the year when all of a chain affiliated nursing homes exit a given state, the coefficients of Δ(DivestHHI) are insignificant for all the leading years. It shows there is no significant difference in changes of total nursing inputs

among markets prior to chain divestiture caused exits. This partially supports the identifying assumption which assumes that, absent the chain divestitures, local market would follow the same trend in total direct care hours per patient day. Interestingly, the coefficients of Δ(DivestHHI) are also insignificant for the lagged one and two years and become highly significant for the lagged 3 or more years. The change of nursing inputs and market concentration are not contemporaneous, which implies that it takes nursing homes some time to adjust quality and it can be as long as two years. Finally, the results are quite robust despite the different market share allocation rules.

Table 3.7. Robustness Analysis I

Reduced Form with Leads and Lags

	Dependent Variable: Total HPPD			
	Proportionally Distributed		Equally Distributed	
	(1)	(2)	(3)	(4)
Δ(DivestHHI) lead 3 or more years	-0.128	-0.123	-0.209*	-0.194
	(0.102)	(0.112)	(0.126)	(0.139)
Δ(DivestHHI) lead 2 years	-0.143	-0.114	-0.141	-0.117
	(0.123)	(0.130)	(0.151)	(0.166)
Δ(DivestHHI) lead 1 year	0.038	0.050	0.023	0.051
	(0.110)	(0.118)	(0.127)	(0.145)
Δ(DivestHHI) lag 1 year	0.036	0.078	-0.003	0.082
	(0.109)	(0.122)	(0.130)	(0.148)
Δ(DivestHHI) lag 2 years	0.126	0.170	0.069	0.135
	(0.110)	(0.115)	(0.125)	(0.142)
Δ(DivestHHI) lag 3 or more years	0.265***	0.292***	0.239**	0.274**
	(0.086)	(0.094)	(0.103)	(0.115)
Year Fixed Effects	Y	Y	Y	Y
Market Fixed Effects	Y	N/A	Y	N/A
Firm Fixed Effects	N	Y	N	Y
R-squared	0.364	0.629	0.364	0.629
N	19,179	19,179	19,179	19,179

*** signifies p<.01, ** signifies p<.05 and * signifies p<.1

Table 3.8 repeat the same regressions but restricts attention to the markets with chain divestiture. The results remain the same as those in table 3.7. This assures us that the shown patterns indeed come from markets with positive shocks in HHI instead of being driven by the results of markets without changes in DivestHHI[21].

[21]The coefficients of ΔDivestHHI represent the net effect of DivestHHI on total HPPD in markets with shocks in HHI relative to those markets without. Interpreting the effects of DivestHHI on total HPPD only from table 3.7 can give rise to spurious relationships. For instance, if markets with positive shocks in HHI have no change in nursing input, however, those without changes in HHI decrease their nursing input, it gives the same results as in table 3.7. Running regressions only using the market with chain divestitures assures us that the results are not driven by such spurious relationship.

Table 3.8. Robustness Analysis II

Reduced Form with Leads and Lags
(Chain Divestiture Markets Only)

	Dependent Variable: Total HPPD			
	Proportionally Distributed		Equally Distributed	
	(1)	(2)	(3)	(4)
Δ(DivestHHI) lead 3 or more years	-0.135	-0.145	-0.210	-0.213
	(0.106)	(0.116)	(0.130)	(0.144)
Δ(DivestHHI) lead 2 years	-0.119	-0.106	-0.129	-0.114
	(0.124)	(0.134)	(0.152)	(0.169)
Δ(DivestHHI) lead 1 year	0.003	0.018	-0.012	0.021
	(0.109)	(0.121)	(0.127)	(0.148)
Δ(DivestHHI) lag 1 year	0.018	0.057	-0.022	0.057
	(0.109)	(0.124)	(0.131)	(0.151)
Δ(DivestHHI) lag 2 years	0.116	0.164	0.073	0.145
	(0.109)	(0.120)	(0.129)	(0.147)
Δ(DivestHHI) lag 3 or more years	0.214**	0.247**	0.181*	0.221*
	(0.090)	(0.10)	(0.107)	(0.147)
Year Fixed Effects	Y	Y	Y	Y
Market Fixed Effects	Y	N/A	Y	N/A
Firm Fixed Effects	N	Y	N	Y
R-squared	0.371	0.613	0.365	0.608
N	8,883	8,883	8,867	8,867

3.7. Conclusion

In this paper, I examine the impact of market structure on an important dimension of non-price outcomes: quality decision. Specifically, I study whether markets which have higher concentration ratio have higher quality investment. In order to do so, I develop an instrumental variables estimation method that addresses the potential endogeneity of market structure. As my identification strategy, I consider exogenous shocks to the local market HHI in four large states

(California, Florida, Ohio and Texas) caused by the exit or acquisition of nursing homes resulting from chain divestiture in the whole state. Using this instrument, I find substantial effects of market concentration on quality decision: a one standard deviation increase in HHI increases total nursing inputs by 80% of total nurse staffing Hours Per Patient Day (HPPD). Among markets with positive change of HHI, total HPPD increase 40%.

The results suggest that market structure does have substantial effects on quality choice. On the other hand, they also suggest that directly regressing quality measures on market concentration subjects to omitted variable bias, which implies that market structure could be endogenous and quality choice is a strategic choice variable. The results are consistent with the vertical differentiation theory which states that firms use quality as a strategic choice variable to differentiate from competitors. It is worth noting that the conventional theory which predicts competition leads to better quality can not be refuted although it may appear so at first thought. This is because the positive sign may be the net effect of the negative estimates caused by market power and positive estimates caused by vertical differentiation and the effect of the latter outweighs that of the former.

These finding have implications for policy markers especially antitrust regulators. When evaluating mergers, acquisitions, divestitures and other firm practices which affect market structure and the competition environment, it is important to not only consider price outcome but also quality effects. To understand the overall impacts, it is also important to not only consider the negative consequences of increasing market power but also take into account the potential

positive consequences of vertical differentiation.

4 To Profit or Not to Profit: An Empirical Study of Competition, Ownership Conversions and Nursing Home Performance

4.1. Introduction

The recent trend of ownership conversions has captured much public attention. For example, in the financial sector, Chicago Mercantile Exchange demutualized and became a shareholding public corporation in 2000 through a public offering. The Chicago Board of Trade, the New York Stock Exchange (NYSE) and Mastercard all followed suits in 2005 and Visa in 2006. In Developing countries such as China, Malaysia and Chile the economic reforms have spurred management buyout of State-Owned Enterprises (SOEs) since 1990s, and this tide of privatization is likely to continue.

Most notably in health care, ownership conversions are increasingly common, which can be found from the insurance markets to the hospital and nursing home industry. For instance, by 2004, more than 100 counties in the US have divested their nursing facilities through change of ownership to nonprofit or for-profit or through termination according to OSCAR data (Amirkhanyan 2006). Between 1985 and 1999, about 700 hospitals changed their ownership status (Shen 2003). In recent years, health plans started taking on a variety of corporate structures including publicly traded companies as compared to the traditional not-for-profit status only. For example, Anthem Inc., a major health plan, began as a not-for-profit, converted to a

mutual benefit company, acquired other not-for-profits, then demutualized and raised $2.1 billion in a recent initial public stock offering.

The movement of organizational form gives rise to many interesting questions. For instance, what determines the organizational choice? Is for-profit ownership more efficient and suit competitive environment better? How does organizational form affect quality choice? Does the efficiency of for-profit come as a sacrifice for quality especially along unobservable dimensions? In health care setting, this could mean changes in patient severity and payer composition such as admitting healthier patients and more-profitable patients and increase total nurse-staffing but cut highly skilled staffing.

This paper examines two questions. First, what role does competition play in organizational choice? Herbst and Prufer (2006) argue that increased competition induces a shift towards firm organization and away from nonprofits. There is also anecdotal evidence implying that the movement away from not-for-profit status is a direct response to the competitive changes in the industry. For instance, one of the primary reasons cited by health plans for changing their organizational structure is the underlying competitive pressures to acquire additional business and extend their business to other markets. Second, what is the impact of ownership conversion on firm performance? Given the popular practice of ownership conversion across industries, it is important to understand the actual impact on firm performance including size, capacity, quality and so on.

Using a detailed panel dataset covering each nursing home ownership conversion from 1996

to 2005 and two-stage least square econometric technique instrumenting for market competition, I find that when the market becomes more concentrated, the conversion to non-profit increases while the conversion to for-profit decreases. In other words, competition does lead to more for-profit conversions but less non-profit conversions. Comparing across markets, more for-profit nursing homes enter markets with more competition or exiting more concentrated markets, while it is the opposite for non-profit nursing homes. I also find that facilities converting from for-profit to nonprofit exhibited significant increase in total nurse staffing inputs starting from the second years after the conversions. This increase in nursing input mainly comes from the increase in Licensed Vocational Nurses (LVNs) and Certified Nurse Assistants (CNAs), but not Registered Nurses (RNs). There is no significant change in other dimensions of performance such as size, capacity and patient composition for both pre and after conversion periods.

The rest of paper is organized as follows. The next section describes the conceptual framework, reviews the relevant literature and provides some background information about the nursing home industry and the recent trend of chain divestiture. Section 4.3 describes the data. Section 4.4 outlines the empirical analysis and presents the main estimation results. The final section concludes with some discussion of the results and policy implications.

4.2. Background and Conceptual Framework

4.2.1. Conceptual Framework and Prior Studies

What determines optimal organizational structures and changes is a complex problem. Most public attention focuses on the direction from nonprofit to for-profit. Some prior studies have suggested that firms convert from NP to FP to raise capital, enhance their ability to expand existing business, acquire new business and improve their competition position in the industry (Barro 1999; Goddeeris and Weisbrod 1998; Mark 1999; Sloan 2001).

Herbst and Prufer (2006) formalize the difference between firms, nonprofits and cooperatives and predict organizational change towards for-profit ownership when competitive pressures rise. This is consistent with anecdotal evidence. For instance, one of the primary reasons cited by health plans for changing their organizational structure is the underlying competitive pressures to acquire additional business and extend their business to other markets. NYSE, Mastercard and Visa also announced that market competition played an important role in their organizational changes. However, the hypothesis still awaits empirical testing.

Ownership conversions have been studied most extensively in the hospital setting. There is much theoretical literature on hospital behaviors under different ownership status. Generally for profit hospitals are modeled as profit maximizers, while nonprofit hospitals are assumed to be utility maximizers that value multiple objectives such as profits, quality, quantity and charity care (Newhouse 1970; Frank and Salkever 1991; Hansmann 1996; Glaeser and Shleifer 1998). Therefore, nonprofit hospitals are not forced to be at zero profit as for-profit hospitals are in a

perfectly competitive world. Government hospitals, while often thought of as being inefficient (Weisbrod 1988), play a vital role of being the "last resort" hospitals for people who cannot pay for medical care (Shen 2003).

Compared to the vast amount of empirical work offering direct comparison of hospital performance among nonprofit, for-profit, and government hospitals (see a comprehensive review in Sloan 2000), there has been relatively little empirical evidence on the effect of ownership conversion. There is especially few studies on the conversion from for-profit to non-profit, despite the fact that it is about equally common as the opposite conversion direction. Among the few, Chou, Picone and Sloan (2002) found that converting from government or private nonprofit status reduced hospital quality while converting from for-profit to government or nonprofit did not change quality. Shen (2003) found that conversions to for-profit ownership reduced staffing, but did not change bed capacity and the amount of unprofitable care. Grabowski and Stevenson (2008) found that nursing homes converting from nonprofit to for-profit status generally exhibit deterioration in their performance before and after conversion, while nursing homes converting from for-profit to nonprofit status generally exhibit improvement.

In sum, most previous studies showed little or no difference in hospital behavior by ownership type (except the few noted in the above paragraph), although theoretical work predicts strong behavioral differences. This may be due to the fact that these studies did not properly account for omitted heterogeneity among firms. It may also because these studies all treat ownership choice or ownership conversion as exogenous. However, competition among hospitals

eliminates performance differences among hospitals with different ownership, which is the known "spillover effect". Assuming that nonprofit hospitals value quality more than for-profit hospitals, the presence of a high nonprofit share in a market may force for-profit hospitals to maintain a higher quality level (Hansmann 1980).

This paper contributes to the literature by taking the endogenous organizational choice into consideration and explicitly examining the effect of competition on ownership decision. It is also one of the few papers that study ownership conversions in health care but outside of the hospital setting. As pointed out in Shen (2003), conversion activities have slowed down in the hospital industry in the initial years of the 21st century, but there is increasing activity in ownership conversions among other health care providers such as managed care plans and nursing homes. It is therefore interesting and valuable to learn what determines the ownership conversions and how the conversions affect performance measures in these sectors.

4.2.2. The Nursing Home Industry

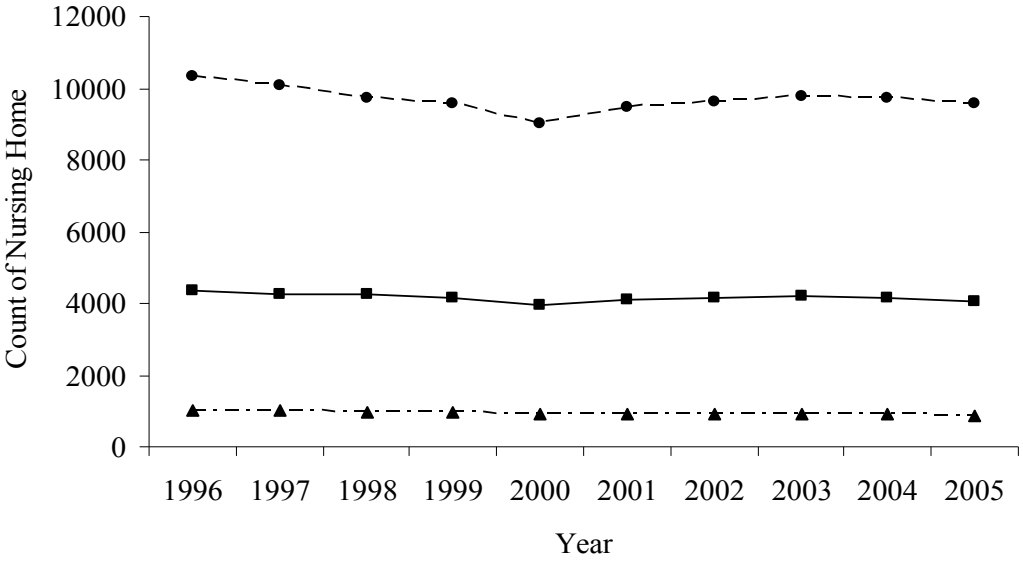
Please see section 3.3 for a detailed description of the nursing home industry, including the role of large national chains and the trend and reasons for nursing home chain divestitures.

4.3. Data

The data used in the study comes from the same sources as essay 2 in chapter 3. In total it cotains 21,634 Medicare and/or Medicaid certified nursing homes from 1996 to 2005, with a total 147,860 observations. Figure 4.1.A and B show the absolute number and percentage of for-profit, nonprofit and government owned nursing homes from 1996 to 2005 respectively. For-profit is the dominant organizational form in the nursing home industry, accounting for about 65%. Nonprofit and government owned account for around 28% and 7% respectively. In general, the composition of all three types of ownership is quite stable, with a slight decrease in the percentage of government owned and a slight increase in for-profit nursing homes over time.

Figure 4.1. Trends of Nursing Home Ownership

A. Absolute Number



B. Composition

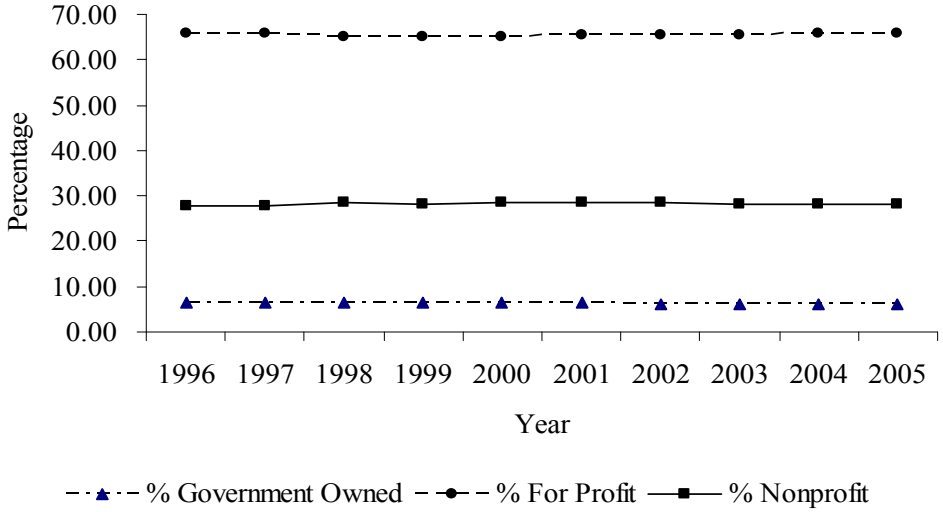


Table 4.1.A and B report the number of different types of ownership conversions for the whole nation and the four states I focus on (California, Florida, Ohio and Texas) respectively. The conversions between for-profit and nonprofit nursing homes are the most frequent, accounting for 80% of the total conversions. They are also of the most important policy implications. The paper thus focuses on these two types of conversions.

Table 4.1. Different Types of Ownership Conversions: 1996 - 2005

A. All States

	Total	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NP→FP	811	6	36	49	49	41	65	164	138	137	126
GOV→FP	154	1	8	4	7	4	16	40	18	29	27
FP→NP	791	9	54	62	66	77	111	161	104	78	69
GOV→NP	170	1	9	23	14	14	23	30	23	18	15
FP→GOV	90	0	2	5	8	7	5	15	19	13	16
NP→GOV	116	2	18	10	13	6	13	14	13	15	12

Notes: This table shows the total number of ownership conversions from 1996 to 2005 and the breakdown by different types of conversions and by year. NP denotes nonprofit, FP denotes for-profit and GOV denotes government owned nursing homes. If a nursing home is coded as ownership type A until year T-1 and then coded as B in year T, it is counted as a conversion from A to B in year T.

B. California, Florida, Ohio and Texas

	Total	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NP→FP	119	0	7	7	5	4	10	29	17	23	17
GOV→FP	17	0	0	2	1	0	0	8	1	4	1
FP→NP	120	0	6	4	9	13	16	26	18	15	13
GOV→NP	12	0	1	1	2	0	2	1	4	1	0
FP→GOV	12	0	0	0	1	0	0	4	4	1	2
NP→GOV	17	0	0	3	0	2	3	6	3	0	0

Notes: Same as table 4.1.A, but the sample is limited to the four large states: CA, FL, OH and TX.

I focus on California, Florida, Ohio and Texas because these four large states have the "worst litegation environment" for malpractice and thus the highest nursing home divestiture frequencies. This helps to create the variation in changes of market HHI. See Table 3.2 in section 3.4.2 for the summary statistics for some key variables.

4.4. Empirical Specifications

4.4.1. Does Competition Lead to More For-Profit Conversion?

The first hypothesis I want to test is whether for-profit ownership suits competition environment better, in other words, whether market competitiveness is a key determinant of organizational choice. It may subject to endogeneity problem if we directly regressing ownership status on measures of market structure such as the Herfindahl index (HHI). For instance, if we observe the coefficient of HHI to be negative, it may indicate that more FP conversions happen when market becomes less concentrated. However, it is also consistent with the explanation that when more nursing homes convert to FP status or more FP nursing homes enter, competition is more head-to-head and the market becomes less concentrated.

To clearly identify the causal effect of market structure on organizational choice, I use the 2SLS econometric specification and propose an instrument variable for market competitiveness. The detailed procedure is described in section 4.4.1(a) and 4.4.1(b) below.

(a) First Stage: Instrumenting for Nursing Home Market Concentration

An ideal instrumental variable in this case should help explain variation in HHI (the endogenous predictor), while it is uncorrelated with unobserved determinants of nursing home ownership status.

As explained in section 3.2 of essay 2, the main causes claimed for chains to divest the financial pressure brought out by reduction in Medicare and/or Medicaid reimbursement rate as

well as the increase of litigation costs due to changes in malpractice laws. All of these do not directly link to differences in nursing home quality and they are at the state level and bear the same changes on each local market.

I define the instrumental variable as follows:

$$(9)\quad \text{DivestHHI}_{m,t} = \sum_{k=1}^{K} (s_{k,t_0} * O_{k,t})^2$$

At the market level, I construct the instrumental variable DivestHHI by taking the market shares of nursing homes in the beginning period (year 1996) and then assigning these nursing homes to the organizations to which they belong in year t. S_{k,t_0} denotes the market share of organization k in period 0 and $O_{k,t}$ is the system structure of nursing homes in period t. Thus the change in DivestHHI over time is solely due to changes in ownership and nursing home system structure caused by a whole state divestiture.

Table 4.2 presents the first stage regression results with and without firm fixed effects. The coefficient of DivestHHI is highly significant at 1% level for both market level and firm level regression, which shows that DivestHHI is positively correlated with HHI even after controlling for market and/or firm fixed effects.

For robustness check, I define an alternative way to instrument for HHI, Δ(DivestHHI), which is coded as zero for all the years until chain divestiture and then the differential between the pre- and after- divestiture divestHHI for each market[22]. I then take the leads and lags of

[22]DivestHHI and Δ(DivestHHI) give the same first-stage results. I use Δ(DivestHHI) in the leads and lags analysis since it looks more straightforward and easier to interpret.

Δ(DivestHHI), using the year of chain divestiture as the reference point.

$$
\begin{aligned}
HHI_{m,t} = {} & \alpha_{-3} * \Delta(DivestHHI)_{-3} + \alpha_{-2} * \Delta(DivestHHI)_{-2} + \alpha_{-1} * \Delta(DivestHHI)_{-1} \\
& + \alpha_{1} * \Delta(DivestHHI)_{1} + \alpha_{2} * \Delta(DivestHHI)_{2} + \alpha_{3} * \Delta(DivestHHI)_{3} \\
& + \alpha_{0} + Year_{t} + Market_{m} + \varepsilon_{m,t}
\end{aligned} \tag{10}
$$

If it is indeed the case that Δ(DivestHHI) (and DivestHHI) captures the effect of chain divestiture rather than other factors such as nursing home chains' anticipation of some unobservable demand or supply shocks, we should expect the coefficient of leading Δ(DivestHHI) to be insignificant.

Table 3.5 shows the relationship between HHI and the leading as well as lagged values of Δ(DivestHHI) when the reference category is the year when all of a chain affiliated nursing homes exit a given state. The coefficients display similar patterns no matter Δ(DivestHHI) is computed by distributing the market shares proportionally or equally among the remaining nursing homes. Compared to the reference year, the coefficients of Δ(DivestHHI) are insignificant for all the leading years. This suggests that the decision of chain divestiture is not induced by previous market structure. The coefficients are most significant for the lagged one year, less significant for the lagged two years and become insignificant again for the lagged 3 or more years. This suggests that the effects of divestiture on market concentration last no more than two years. It could be due to the fact that new chains or corporations enter the market, buy the divested properties and reopen under different ownerships.

(b) Second Stage: The Impact of Competition on Organizational Choice

We examine the impact of nursing home market structure on organizational choice at the nursing home level by estimating parameters from the following nursing home-level fixed effects regression:

(11) $$Y_{j,m,t} = \beta_0 + \beta_1 * \hat{HHI}_{m,t} + Year_t + Market_m + [Facility_j] + \eta_{j,m,t}$$

where $Y_{j,m,t}$ denotes ownership status of nursing home j in market m year t. It includes dummy variables FP (=1 if it is for profit) and NFP (=1 if it is nonprofit). The primary predictor $\hat{HHI}_{m,t}$ denotes the predicted value from the first stage regression (1). The coefficient α_1 tells us the effect of market concentration on ownership decision. A negative sign on α_1 will support the hypothesis that more competition leads to better quality. Year, Market and Facility denote the year, market and firm fixed effects respectively. I run the regression both with and without firm fixed effects and when the firm fixed effects are included, market fixed effects become redundant. Finally, $\eta_{j,m,t}$ is the facility- specific error term.

Table 4.2.A, B and C presents the effect of market concentration on each of the three types of ownership choices (FP, NFP and government-owned respectively).

Table 4.2. The Effect of Market Concentration on Ownership Status

A. For-Profit

	Dependent Variable: FP			
	(1)	**(2)**	**(3)**	**(4)**
	OLS	**OLS**	**IV**	**IV**
HHI	0.020	-0.002	-7.636*	-2.749***
	(0.026)	(0.011)	(4.563)	(0.863)
Year Fixed Effects	Y	Y	Y	Y
Market Fixed Effects	Y	N/A	Y	N/A
Firm Fixed Effects	N	Y	N	Y
N	27,272	27,272	27,272	27,272

B. NonProfit

	Dependent Variable: NP			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
HHI	0.005	-0.0005	6.212*	2.689***
	(0.024)	(0.011)	(3.826)	(0.850)
Year Fixed Effects	Y	Y	Y	Y
Market Fixed Effects	Y	N/A	Y	N/A
Firm Fixed Effects	N	Y	N	Y
N	27,272	27,272	27,272	27,272

C. Governmental

	Dependent Variable: GOV			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
HHI	-0.025	0.003	1.424	0.060
	(0.011)	(0.003)	(1.164)	(0.158)
Year Fixed Effects	Y	Y	Y	Y
Market Fixed Effects	Y	N/A	Y	N/A
Firm Fixed Effects	N	Y	N	Y
N	27,272	27,272	27,272	27,272

The first and second column of each table reports the estimates from OLS regression without and with firm fixed effects. The coefficients of HHI are not significantly different from zero at traditional levels of confidence and the magnitude is trivial. Column (3) and (4) present the estimates when HHI is instrumented by DivestHHI. The coefficients of HHI are significantly positive for NP, significantly negative for FP and insignificant for GOV. This suggests more competition leads to more conversions to nonprofit nursing homes, less conversions to for-profit ones and no effect on conversions to government owned ones. The difference between column (3) and (4) are that column (3) reports regression results when controlling for year and market fixed effects, while coefficients reported in column (4) are those with firm fixed effects also included. Since firm FEs are in finer category than market FEs, once firm FEs are included, market FEs are marked none applicable (NA).

After controlling for the firm fixed effects, the coefficient of HHI is highly significant at 1% level. A one standard deviation increase in HHI decreases the probability to be for-profit by 80% and increases the probability to be nonprofit by 350% for an average nursing home in the market. Among markets with chain divestitures, HHI on average increase 0.11, which translates to 37.5% decrease in probability to be for-profit and 170% increase in probability to be nonprofit. The results suggest that market structure does have substantial effects on organizational choice, on the other hand, they also suggest that directly regressing ownership status on market concentration subjects to omitted variable bias, which infers that market structure could be endogenous.

It is worth noting that after controlling for firm FEs in column (4), the absolute value of HHI coefficients becomes smaller for both FP and NFP regressions as compared to results in column (3) where only market FEs are controlled. This suggests that more FP nursing home enter more competitive markets or exit more concentrated markets. It may also suggest that more nfp nursing homes enter less competitive markets or exit more competitive markets.

4.4.2. How Do Organizational Choice Affect Nursing Home Performance?

I use the following specification to assess changes in nursing home finances, capacity and input pre versus post conversion using the nursing home/year as the observational unit.

$$(12)\quad Q_{j,m,t} = \alpha_0 + \sum_{i=1}^{3} \phi_i NFPtoFP^{i}_{j,m,t} + \sum_{i=1}^{3} \lambda_i FPtoNFP^{i}_{j,m,t} + Year_t + Facility_j + Market_m * Year_t + \varepsilon_{j,m,t}$$

$Q_{j,m,t}$ is a set of performance measures including staffing intensity, capacity (measured by number of beds), occupancy rate, percentage of Medicaid, Medicare and private-pay patients and patient composition respectively. $\sum_{i=1}^{3} \phi_i NFPtoFP^{i}_{j,m,t}$ are dummy variables indicating periods before, at and after ownership conversion from nonprofit to for-profit. $\sum_{i=1}^{3} \phi_i FPtoNFP^{i}_{j,m,t}$ are dummy variables indicating periods before, at and after ownership conversion from for-profit to nonprofit.

Table 4.3 reports the dynamic effect of ownership conversions on nursing home performance. Facilities converting from for-profit to nonprofit exhibited significant increase in total nurse staffing inputs starting from the second years after the conversions. This increase in nursing input mainly comes from the increase in Licensed Vocational Nurses (LVNs) and Certified Nurse Assistants (CNAs), but not Registered Nurses (RNs). There is no significant change in other dimensions of performance such as size, capacity and patient composition for both pre and after conversion periods[23]. Nor did I find a change in quality when nursing homes switched from nonprofit or government toward for-profit ownership, implying that the result for the change in ownership toward nonprofit status is not an artifact of converting, but rather of the change in ownership.

[23]For nursing homes converting from for-profit to nonprofit, there is a slight increase in occupancy rate for three or more years before conversions, a slight increase in Medicaid patients percentage, a slight decrease in private-pay patients in the year before conversion. For nursing homes converting from nonprofit to for-profit, there is a slight increase in LVN Hours Per Patient Day, a slight decrease in Medicaid patients percentage and a slight increase in private-pay patients in the three year before conversion. However, the magnitude of all these coefficients is too small to be of major concern.

Table 4.3. The Dynamic Effect of Ownership Conversions on Nursing Home Performance

	Dependent Variables							
	(1) TOThppd	(2) RNhppd	(3) LVNhppd	(4) Beds	(5) Occup	(6) Medcare	(7) Medcaid	(8) Other
For-profit to Nonprofit								
Lead ≥3 years	0.030	0.004	0.006	-0.742	0.025**	-0.010	0.005	0.0006
	(0.050)	(0.010)	(0.028)	(0.833)	(0.010)	(0.005)	(0.008)	(0.009)
Lead 2 years	-0.037	0.004	-0.004	-1.022	0.018	0.002	0.002	-0.004
	(0.059)	(0.012)	(0.020)	(0.883)	(0.012)	(0.010)	(0.010)	(0.012)
Lead 1 year	0.053	0.003	0.029	-0.525	-0.016	0.007	0.018**	-0.025**
	(0.055)	(0.011)	(0.022)	(1.003)	(0.011)	(0.008)	(0.009)	(0.010)
Lag 1 year	0.066	-0.011	0.027	1.021	-0.0001	-0.002	0.016	-0.014
	(0.059)	(0.013)	(0.022)	(1.706)	(0.014)	(0.009)	(0.011)	(0.011)
Lag 2 years	0.288***	-0.006	0.062**	0.234	-0.001	0.005	0.009	-0.014
	(0.066)	(0.013)	(0.026)	(1.107)	(0.014)	(0.008)	(0.011)	(0.011)
Lag ≥3 years	0.110*	-0.017	0.056**	-2.263	-0.001	-0.004	0.003	0.0008
	(0.067)	(0.012)	(0.023)	(1.626)	(0.013)	(0.006)	(0.009)	(0.008)
Nonprofit to For-profit								
Lead ≥3 years	0.019	0.006	0.028**	-2.263	0.016	-0.026**	0.003	0.023**
	(0.056)	(0.011)	(0.014)	(1.626)	(0.010)	(0.010)	(0.009)	(0.010)
Lead 2 years	-0.041	-0.004	-0.029	0.360	-0.004	-0.011	0.002	0.009
	(0.057)	(0.013)	(0.018)	(1.008)	(0.011)	(0.011)	(0.010)	(0.012)
Lead 1 year	0.033	-0.008	0.029	2.330	-0.019	-0.009	-0.007	0.016
	(0.050)	(0.011)	(0.018)	(2.981)	(0.012)	(0.010)	(0.010)	(0.011)
Lag 1 year	-0.050	-0.012	-0.003	-0.752	0.014	-0.002	-0.003	0.005
	(0.062)	(0.015)	(0.021)	(2.613)	(0.015)	(0.013)	(0.014)	(0.013)
Lag 2 years	-0.032	-0.021	0.005	-1.676	0.010	0.040	-0.019	-0.021
	(0.071)	(0.016)	(0.021)	(2.362)	(0.017)	(0.017)	(0.017)	(0.020)
Lag≥3 years	-0.080	-0.013	0.016	-0.306	-0.010	-0.013	-0.002	0.015
	(0.065)	(0.010)	(0.013)	(1.225)	(0.010)	(0.010)	(0.014)	(0.007)
N	17,300	20,963	19,291	24,676	24,676	24,676	24,676	24,676

Notes: Each column is a separate regression including the covariates listed in specification (5) along with nursing home and year fixed effects. To mitigate the effects of the possible misreporting, I exclude nursing homes that appear in the bottom and top 5 percentile of the distribution of total HPPD, RN HPPD and LVN HPPD at each state-year. This makes the numbers of observations in the first three columns are smaller than those in the rest of the columns. Moreover, the total number of observations from column (4) to (8), which is 24,676, is a little smaller than that from table 4.2. This is caused by the missing values due to generating leading and lagged periods.

4.5. Conclusion

Our analysis allowed us to examine impact of market competitiveness on ownership choice and assess effects of switching ownership, holding location constant. I found that market concentration increases the probability to convert to nonprofit while reduce the probability to convert to for-profit. I found no change in performance from NP → FP conversions, but found increase in nursing inputs starting from the second year after converting from FP → NFP.

These results provide valuable policy implications, especially considering the recent trends of local governments' decisions to privatize public nursing homes. Policy makers have expressed concern regarding the implications of ownership conversions for nursing home performance. Proponents of privatization argue that it helps to increase accessibility of care and generate more tax revenue for the government, while opponents quote the reasons such as price increases, quality deduction, lower admission rate for unprofitable patients, and failure to provide adequate community benefits, et cetera. The best public policy would establish rules that discourage

nonprofit officials from proposing conversions not for efficiency gain but for private gain. How high public policy sets the barriers should reflect a balancing of marginal gains and losses. (Goddeeris and Weisbrod 1998)

Without a structural model, this paper did not provide an optimal public policy scheme in terms of regulating ownership conversions; however, it does help to understand the interaction between market structure and organizational choice and how would ownership change affects performance. This paper did not find nursing homes experiencing a drop in quality are more likely to convert (to FP or NFP), however, the results imply that there is significant heterogeneity among nursing homes which were not controlled in most prior studies. The results also imply that entry, exit or changes in ownership of nursing homes may cause the behavior of other existing firms in the market to change. These suggest that regulator and policy makers should not only monitor the direct outcomes of nursing home conversions, but also the target of these conversions and the spillover effects.

Some interesting extensions of this study will be to directly examine the effect of spillovers of ownership changes on behavior of competing nursing homes as well as the effect of ownership conversions on patient outcomes if the patient level Minimum Data Set is available.

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6 Appendices

Appendix A

In this study, the acuity index used is developed by Cowles Research Group based on work done as part of the minimum data set development for resident assessment. It is the sum of an ADL index and a special treatments index, where ADL index is the sum of the proportion of residents with certain characteristics times their associated weights as follows.

ADLINDEX =
[proportion of residents totally dependent when eating X 3]
+ [proportion of residents requiring the assistance one or two staff with eating X 2]
+ [proportion of residents who are either independent or require supervision eating]
+ [proportion of residents totally dependent when toileting X 5]
+ [proportion of residents requiring the assistance of one or two staff with toileting X 3]
+ [proportion of residents independent or requiring supervision with toileting]
+ [proportion of residents totally dependent when transferring X 5]
+ [proportion of residents requiring the assistance of one/two staff with transferring X 3]
+ [proportion of residents independent or requiring supervision with transferring X 1]
+ [proportion of residents who are bedfast X 5]
+ [proportion of residents who are chairbound X 3]
+ [proportion of residents who are ambulatory].

The special treatments index is defined as the sum of the proportion of residents receiving respiratory care, suctioning, intravenous therapy tracheotomy care, and intravenous feeding.

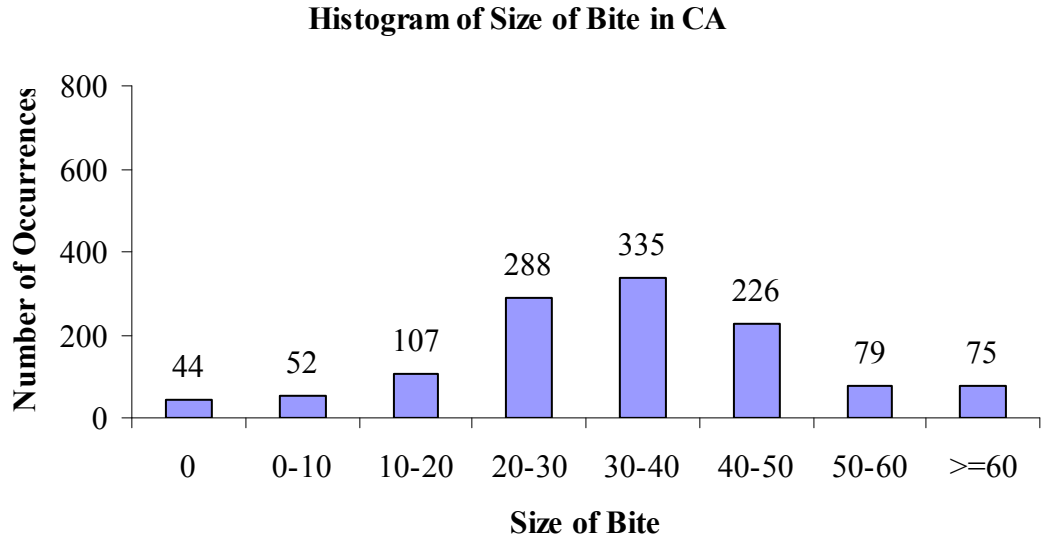
Appendix B

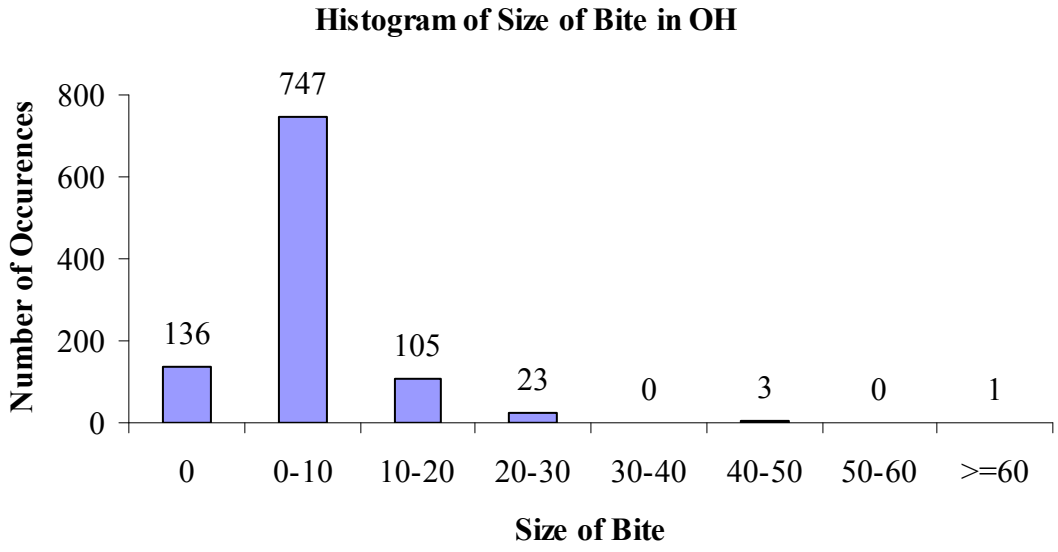
Mean Total HPPD and Number of Nursing Homes Prior to MQS: By Distance from Minimum Standards

	CA		CA's Controls		OH		OH's Controls	
	Total HPPD	N	Total HPPD	N	Total HPPD	N	Total HPPD	N
<0.8	2.23 [0.35]	207	2.06 [0.44]	228	2.00 [0.20]	25	1.98 [0.19]	67
[0.8, 0.9)	2.73 [0.08]	318	2.73 [0.09]	217	2.35 [0.09]	55	2.35 [0.08]	89
[0.9, 1.0)	3.02 [0.09]	262	3.04 [0.09]	254	2.63 [0.07]	141	2.62 [0.08]	130
[1.0, 1.1)	3.34 [0.10]	136	3.35 [0.09]	263	2.89 [0.08]	245	2.89 [0.08]	125
[1.1, 1.3)	3.76 [0.19]	110	3.78 [0.18]	233	3.28 [0.16]	351	3.27 [0.16]	180
≥ 1.3	6.08 [1.48]	167	5.28 [1.17]	112	4.16 [0.90]	198	4.65 [1.41]	191

Notes: Supplemental descriptive statistics for table 2.5. The experiment states are CA and OH. For CA, the control states used are NY, NH, VA and WA. For OH, the controls are AL, KY and NE.

Appendix C


Histogram of Size of Bite in CA
Number of Occurrences
800
600
400
200
0
44
52
107
288
335
226
79
75
0
0-10
10-20
20-30
30-40
40-50
50-60
>=60
Size of Bite


Histogram of Size of Bite in OH
Number of Occurences
800
600
400
200
0
136
747
105
23
0
3
0
1
0
0-10
10-20
20-30
30-40
40-50
50-60
>=60
Size of Bite

Appendix D

Illustration of the Data Structure for the First Stage Regression in Chapter 3 and 4

Year	chain exit	HHI	DivestHHI	Δ divestHHI	Δ divestHHI lead 3 or more years	Δ divestHHI lead 2 years	Δ divestHHI lead 1 year	Δ divestHHI year 0	Δ divestHHI lag 1 year	Δ divestHHI lag 2 years	Δ divestHHI lag 3 or more years
1996	0	0.4	0.4	0	0.2	0	0	0	0	0	0
1997	0	0.4	0.4	0	0.2	0	0	0	0	0	0
1998	0	0.4	0.4	0	0	0.2	0	0	0	0	0
1999	0	0.4	0.4	0	0	0	0.2	0	0	0	0
2000	1	0.5	0.6	0.2	0	0	0	0.2	0	0	0
2001	0	0.5	0.6	0.2	0	0	0	0	0.2	0	0
2002	0	0.5	0.6	0.2	0	0	0	0	0	0.2	0
2003	0	0.5	0.6	0.2	0	0	0	0	0	0	0.2
2004	0	0.5	0.6	0.2	0	0	0	0	0	0	0.2
2005	0	0.5	0.6	0.2	0	0	0	0	0	0	0.2

Notes: This table offers an illustration of the data structure I used for the first stage regression and the identification assumption test. Consider a market where there is some chain divestiture happening in year 2000. Then year 2000 is coded as year 0, which is the reference point. In the ideal case which means DivestHHI is a good instrument variable for HHI, DivestHHI and HHI will both suddenly increase in 2000.

The shaded column (Δ divestHHI year0) is the omitted category used in table 3.5, 3.7 and 3.8 and all the leads and lags are defined related to this reference category.