Does Competition Improve Quality?
The Case of Nursing Homes Where Public and Private Payers Coexist

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Abstract

Competition plays an ambiguous role in markets for credence goods. We examine the nursing home industry and find a U-shaped relationship between competition and quality where private and public patients coexist, and a monotonic relationship where the public segment dominates. These observations are consistent with a repeated game model that highlights two opposing effects: the reputation building effect—competing firms choose high quality to build good reputation, and the rent extraction effect—competition hinders quality improvements by eliminating price premia. These findings suggest that anti-trust policy should consider a “rule of reason” to guide mergers in markets with endogenous quality.

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Key Words: Competition, Mixed Payers, Reputation, Quality, Health Care

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1. Introduction

The effects of competition on efficiency in health care is widely debated (Gaynor and Town 2011, Gaynor, Ho, and Town 2015). Advocates believe that competition drives down costs, improves quality and motivates innovation (Bloom et al. 2015). Skeptics argue that competition results in unintended consequences such as demand inducement, overcapacity and multi-task principal agent concerns (Arrow 1963). Porter and Teisberg (2004) argue that competition in the American health care system has become a zero-sum game. Health facilities compete to reduce costs through bargaining, rather than to create values, e.g. improving quality of care. Policy makers and the public are left to wonder: does competition indeed improve quality in health care? In this study, we revisit the relationship between competition and quality both theoretically and empirically in healthcare markets where public and private payers coexist.

Competition among medical providers plays an ambiguous role in assuring quality in health care markets, where quality is not contractible ex ante and not verifiable ex post. In this study, we examine the effects of competition in the nursing home industry. We argue that this is an ideal setting to study the market structure-quality relation for at least three reasons. First, the nursing home industry spans a wide range of market structures for identifiable, exogenous reasons such as population density.\(^1\) Second, there is widespread variation in nursing home quality as documented by a variety of publicly-reported measures. Third, nursing home care is both non-contractible and often not reported by consumers ex post (who may be too infirm to do so).

Using the Online Survey Certificate and Reporting (OSCAR) nursing home data from 2000 to 2005, we find, first, that the overall effect of competition on quality is “U-shaped” conditional on nursing homes serving a mix of private and public segments. Quality is highest in monopoly and highly competitive markets, and lowest in intermediate ranges where there are 4 competitors within a nursing home’s five-mile radius. Second, however, we also find a monotonic relationship (quality strictly increasing in competition) where nursing homes only serve the public, price-regulated segment. These results are robust under different samples, alternative specifications and various measures of competition and quality.

\(^1\) By contrast, most previous studies only demonstrate the relationship between competition and quality in a narrow range of market structures. For example, Becker and Milbourn (2011) consider changes from two credit rating agencies to three, and show that competition leads to quality deterioration of Moody’s and Standard & Poor's who conduct business by reputation. Mazzeo (2003) shows that on-time performance increases when a second non-stop carrier serves a route. The U-shaped pattern could be easily overlooked in studies that focus on the effect of an increment of one competitor.
The empirical evidence raises the question of how competition leads to a U-shaped relationship on quality when providers serve both private and public patients. To understand these results, we develop a repeated-game model that incorporates two segments of payers, where: 1) the price is fixed in the segment regulated by the government and; 2) determined by market competition in the private-pay segment. Our model assumes that providers are vertically and horizontally differentiated and compete on both quantity and quality. The quality-competition relation can then be explained by the interplay of two opposing effects. First, the reputation building effect, where price is fixed (as is the case in the regulated segment), competing firms choose high quality to establish a good reputation because competition weakens incentives for firms to unilaterally deviate to low quality. Hence, higher quality is easier to sustain in equilibrium as the number of competitors increases. Second, the rent extraction effect, where price is set by firms (as is the case in the private pay segment), competition lowers the rents firms can earn from reputation and hence hinders the incentives for quality improvements. We show that in concentrated markets, where the market price is relatively high, the rent extraction effect dominates (because the market price falls fast as the number of competitors increases), in which case it becomes difficult to sustain high quality as competition intensifies. On the other hand, in competitive markets, where the market price is sufficiently low, the rent extraction effect is attenuated and the reputation building effect dominates, leading to an increase in quality as competition intensifies. Overall, the effect of competition on quality becomes non-monotonic when providers serve both segments of patients.

Our work makes three main contributions. First, we theoretically analyze the impact of competition on quality where public and private payers coexist. Existing theory focused on the monotonic relationship between competition and quality. Based on different assumptions about providers’ price setting behavior and thus their ability to appropriate the surplus from providing good quality, previous studies find that competition can either increase or decrease the incentives to maintain good reputation (Hörner 2002, Kranton 2003). To the best of our knowledge, our paper is the first to incorporate a mix of private and public segments into a repeated-game framework in the healthcare competition-quality literature. Second, the empirical healthcare

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2 In a more competitive market, each nursing home serves fewer patients, so the cost savings due to offering lower quality are lower. Hence, it is more likely that firms supply higher quality in equilibrium.

3 Our use of the term “rent extraction” refers to the rents that firms can extract from consumer surplus. This is not to be confused with political-economic uses of the term.

4 Gaynor, Ho, and Town (2015) provide a comprehensive literature review of competition and quality in the health care industry.
literature has primarily focused on establishing a linear association between competition and quality of care (Forder and Allan 2014, Dafny, Gruber, and Ody 2015, Gaynor, Ho, and Town 2015). Our paper is the first to show that there is an “inflection point” in this relation. It provides critical evidence to the ongoing debate on competition in the U.S. healthcare system (Dafny and Lee 2015). Third, our U-shaped result suggests that anti-trust policy in the healthcare industry might consider a “rule of reason” to guide mergers, given the ambiguous effect that market structure has on the quality of care.

The remainder of the paper proceeds as follow. In section 2, we discuss the institutional background of the nursing home industry and summarize the theoretical and empirical literatures. Section 3 develops a theoretical model and forms several testable hypotheses. Section 4 discusses our data and provides some descriptive statistics. Section 5 provides our main non-monotonicity result on the quality-competition relationship while section 6 presents validating evidence of the two mechanisms with opposite directions that influence the U-shaped relation. Section 7 concludes with a short discussion.

2. Background and Literature Review

The nursing home industry exhibits several features that make it an ideal setting for testing the market structure-quality relation. These include non-contractible aspects of quality and wide variation in the ability to extract surplus through price. We start by reviewing these features in this section, and then discuss the relevant literature.

2.1 Quality and Price in the Nursing Home Industry

Quality provided by nursing homes has the following important features. First, quality is delivered subsequent to purchase, allowing caregivers to “shirk” relative to the implicitly promised quality levels. Moreover, it is difficult for consumers to identify quality \textit{ex ante} and verify it \textit{ex post}. Instead, consumers rely on report cards, word of mouth or brand reputation to form their expectations of the quality level provided by different nursing homes. This suggests that elderly care offered by the nursing home industry is “credence” good and is not contractible \textit{ex ante}.

Revenues received by nursing homes come from a mix of private and public/regulated sources (Huang and Hirth 2016). Consumers utilizing nursing home services may be grouped into three different payer types: Medicaid, Medicare and private-pay. Medicaid is a welfare
program that provides health insurance for low-income individuals. Its regulated nursing home reimbursement rates are relatively low and vary across states (Eljay 2010). About 67 percent of nursing home residents are Medicaid recipients during our sample period. They generate the lowest revenue and profit margin among all payer types. Medicare is a federal health insurance program for people over 65 and individuals with disabilities. Its coverage for nursing home services is limited to episodes of post-acute care. About 12 percent of nursing home residents use Medicare’s regulated payments to pay for their medical services. Finally, private-pay consumers account for the remaining 21 percent of residents in nursing homes. Nursing homes set prices for their private-pay consumers, which are on average 20 to 30 percent higher than Medicaid rates.

In 2002, the Centers for Medicare and Medicaid Services (CMS) introduced report cards, Nursing Home Compare, to improve consumers’ information about nursing home quality. However, the introduction of quality information disclosure along limited dimensions precipitated a multi-task principal agent problem (Lu 2012). In spite of strong government involvement and regulation, the quality of care provided by nursing homes continues to be a major concern (GAO 1999, 2003). For this reason, the role of competition in motivating nursing homes to provide high quality remains a relevant issue (Zhao 2016).

In spite of payment disparities, nursing homes are not permitted, by law, to discriminate in the provision of services on the basis of payment (Health Care Financing Administration, 1995). The assumption of uniform quality across payer groups has been widely used in previous studies (Scanlon 1980, Gertler and Waldman 1992), and has been examined and confirmed by a recent study (Grabowski et al. 2008). Given uniform quality, nursing homes focus on securing private-pay consumers to realize greater revenues. A profit-maximizing health provider will set private prices to attract more private-pay patients and fewer government patients whenever the price set by the government is lower (Dranove and White 1998). Trends in the nursing home industry confirm these predictions. Under the 1997 Medicaid payment system reform, many state governments cut their Medicaid reimbursement rates significantly, reducing the profit margin for serving Medicaid patients (and resulting in a wave of nursing home bankruptcies in the early 2000s). To survive, nursing homes have competed more fiercely for non-Medicaid patients since

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5 To qualify, patients must spend at least 3 full days in a hospital before their admission into a nursing home, and they must show a need for skilled nursing care. In addition, the transfer from a hospital must occur within a certain time period. Medicare pays for the first 20 days at full cost, and the difference between $114 per day and the actual cost for up to another 80 days (The BBA of 1997).

6 Source: http://longtermcare.gov/costs-how-to-pay/costs-of-care/
that time. In this sense, nursing homes are similar to any other industries in which firms operate with a demand curve that is decreasing in price and increasing in quality. Indeed, even nursing homes that enjoy monopoly market positions must supply expected quality levels sufficient to convince consumers to forego outside options, such as staying at home independently and home health.

2.2 Theoretical Literature

The relationship between market structure and quality is an important topic in the theoretical industrial organization literature. Most existing theories focus on the market for search goods (i.e., goods for which quality can be easily evaluated before purchase), instead of credence goods (i.e., goods for which quality is difficult to observe before purchase). The literature explores dimensions of quality such as innovation (Scanlon 1980, Gilbert 2006) and product durability (Swan 1972).

A small, but important branch of literature uses models of repeated games to study how market structure influences firms’ reputational commitments for quality in markets of credence goods (Bar-Isaac and Tadelis, 2008). This literature has developed different alternative predictions, including a monotonically increasing relation by Hörner (2002) where firms are assumed to only compete on reputational quality, a monotonically decreasing relation by Kranton (2003) where competition erodes price premiums thus weakening the incentive to provide high quality, and an inverse-U shape relation by Dana and Fong (2011) which assumes firms in oligopoly markets can enjoy higher price through tacit collusion and therefore maintain higher quality.

The closest study to our theoretical model is the repeated game of Bar-Isaac (2005), where all payers are private and competition can have a U-shape effect on quality. We build on Bar-Isaac (2005) by incorporating a mix of private and public payers—a key feature of the nursing home industry. We show that the relationship between quality and competition becomes monotonic when nursing homes serve only public patients and could turn into a U-shape when both types of patients are present.

2.3 Empirical Literature

Most empirical studies have estimated a monotonic relationship between market structure and service quality, in spite of theoretical work that points to a potentially non-monotonic
relationship. Some studies find that competition promotes quality. For example, Domberger and Sherr (1989) demonstrate that the liberalization of the conveyance monopoly led to improvement in quality of conveyancing services in England and Wales. Mazzeo (2003) shows that on-time performance increases dramatically when a second non-stop carrier serves a route. In contrast, other studies show that competition may hinder service quality when price is significantly lower in competitive markets. For example, Kwoka (1984) shows that as advertising enhances competition, both price and quality of optometrist services decreased. Becker and Milbourn (2011) find that the entry of a third rating company is associated with lower quality ratings from incumbents, as increased competition reduces expected future rents. McMaster (1995) finds that the quality of health services deteriorated after the introduction of competitive bidding in the United Kingdom. Since most of these studies focus on competition level increments from one (or two) firm(s) to two or three firms, their results only demonstrate the relationship within a narrow range of market structure.


For our purposes, the most relevant literature is the small set of studies that focus on the nursing home industry. Results are mixed, depending on the quality measures and time period used. Some studies find a positive association between competition and nursing home quality (Gertler and Waldman, 1992, Grabowski 2004); while others find a negative association (Zinn 1994, Bowblis 2012). Our empirical analysis is unique in the focus of reputation—we show a positive correlation between quality and reputation (see section 4.2 for detailed tests) and provide

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7 There are studies that directly document the positive correlation between profit margin and quality. For example, Park and Werner (2011) demonstrate that the profit margin of nursing homes is positively correlated with quality of care. Rose (1990) shows that lower profit margins of airline companies are associated with high accident and incident rates, particularly for smaller carriers.
the first evidence (to our knowledge) of a U-shaped relationship between competition and quality.

3. Theory and Hypotheses

In this section, we present a theoretical model that builds on Bar-Isaac (2005) by allowing for a mix of public and private-pay patients. We show that the relationship between competition and quality is linear when prices are regulated, and it can be U-shaped when prices are set by providers. We then combine the two scenarios and show that the relationship can be U-shaped when providers serve both government and private-pay patients.

3.1 The Theoretical Model

The market consists of \( n + 1 \) nursing homes, \( i = 1, \ldots, n + 1 \). In every period \( t \) nursing homes simultaneously and independently choose quality \( u_{it} \) and quantity \( x_{it} \). Consumers cannot verify quality before they join a nursing home. There are two possible quality levels, low and high: \( u_{it} \in \{l, h\} \). When a nursing home offers low quality, the marginal cost is 0; while when it offers high quality the marginal cost is \( c > 0 \). Nursing homes serve two types of consumers: Medicaid/Medicare and private-pay patients. For the former group the price is regulated by the government, while for the latter group the price is set by nursing homes.

First, we focus on the regulated segment of the market by assuming price is fixed and we offer the intuition about how competition affects the equilibrium quality. Then, we study the private-pay segment where the price is determined by market forces and we explain the role of an endogenously determined price. Finally, we combine the two segments since the average nursing home serves both types of patients.

We allow nursing homes to be both vertically and horizontally differentiated. The inverse demand function nursing home \( i \) is facing in period \( t \) is

\[
p_{it} = 1 - \frac{2x_{it}}{u_{it}^2} - \frac{2\sigma}{u_{it}} \sum_{j \neq i} x_{jt},
\]

where \( \sigma \in [0,1] \) denotes the degree of horizontal differentiation among the nursing homes. Note that in a one-shot game the Nash equilibrium would have each nursing home choosing the low quality, because quality is not observable before a purchasing decision is made and each nursing
home has no incentive to offer high quality. Therefore, in order to sustain the high quality, we need a “relational contract” between the nursing homes and consumers.

We consider an infinitely repeated game, with a common discount factor $\delta \in [0,1]$. We assume that nursing homes coordinate on quality but not on quantities. That is, for any quality vector the equilibrium prices are consistent with one-shot profit maximization. We will look for a (symmetric) subgame perfect Nash equilibrium using grim-trigger strategies where nursing homes wish to sustain quality $h$. We assume that $h(1 - c) > l$, which ensures that high quality provision is efficient and nursing homes would choose to provide it if it was observable. Further, we assume that consumers’ and rivals’ expectations of nursing home $i$’s quality and future behavior are not affected by its quantity decision. This implies that $x_{it}$ plays no signaling role.

Finally, we assume that there is a fixed cost $B$ in switching strategies from producing high quality to producing low quality.

3.1.1 The Regulated Segment: Medicaid/Medicare Patients

The price is regulated by the government, so $p_{it} = p$ for all $t$ and $i$. Hence, the equilibrium quality depends on $n$ only through changes in market share $x_{it}$. We invert the system given by (1) to derive $x_{it}$ as a function of the regulated price $p$ and qualities $u_{it}$

$$x_{it} = \frac{(1 - p)u_{it}}{2(1 - \sigma)(1 + n\sigma)}\left[(1 + \sigma(n - 1))u_{it} - \sigma \sum_{j\neq i} u_{jt}\right]$$

The profits on the equilibrium path where every nursing home provides quality $h$ are

$$\pi_h = \frac{(1 - p)(p - c)h^2}{2(1 + n\sigma)}.$$  (2)

When a nursing home deviates to low quality it saves the cost $c$, but its market share does not change since the price cannot be adjusted and consumers anticipate high quality. Therefore, the deviation profits are

$$\pi_d = \frac{(1 - p)ph^2}{2(1 + n\sigma)}.$$  (3)

In the continuation equilibrium (punishment phase $pm$) $m$ firms offer low quality and $n + 1 - m$ firms offer high quality. The quantity of a low quality nursing home, when it is positive, is

$$x_{pm} = \frac{(1 - p)l[h\sigma(m - (n + 1)) + l\sigma(n - m) + l]}{2(1 - \sigma)(1 + n\sigma)}.$$
As expected $x_{pm}$ is increasing in $m$. The most severe punishment is when all other nursing homes offer high quality, i.e., $m = 1$. However, it may not be possible to sustain it as an equilibrium. On the other hand, there is always a continuation equilibrium where all nursing homes offer low quality, i.e., $m = n + 1$. The per-period profit in the punishment phase is

$$\pi_{pm} = px_{pm},$$

which is increasing in $m$. Using (2), (3) and (4), the incentive compatibility constraint (ICC) is

$$\frac{\pi_h}{1-\delta} \geq \pi_d - B + \frac{\delta}{1-\delta} \pi_{pm}.$$ 

Let $\delta(m,n)$ denote the minimum $\delta$ above which high quality is sustained in equilibrium. Given that $\pi_{pm}$ is increasing in $m$, $\delta(m,n)$ is increasing in $m$ for any $n$. The critical $\delta$ above which high quality is sustained in equilibrium must lie within $[\delta(1,n), \delta(n + 1, n)]$, depending on how many nursing homes provide low quality in the continuation equilibrium. We are interested in the effect of $n$ on $\delta(m,n)$.

It turns out that $\delta(m,n)$ is decreasing in $n$. The intuition, which relies on the effect of competition on market shares, is as follows. First, assume that the punishment profits are zero. This, for example, can be true when we use the most severe punishment where $m = 1$. Then, given that price stays fixed as $n$ increases, the deviation profits (3) decrease faster than the equilibrium profits (2). This is because while the difference in revenues between the equilibrium path and a deviation is zero (since deviations in quality are observed by consumers only with a time lag), the cost savings decrease as $n$ increases. Higher $n$ implies fewer patients for each nursing home and so total cost savings are lower. As a result, $\delta(m,n)$ is decreasing in $n$. Now assume that the punishment profits are not zero. It can be easily shown that $\pi_{pm}$ are decreasing in $n$, for any given $m$. Hence, once $0$ is replaced by $\pi_{pm}$ in the ICC, the $\delta(m,n)$ must be decreasing even faster with respect to $n$. Figure 1.a depicts the two critical discount factors using the following numerical values: $h = 0.88$, $l = 0.3$, $c = 0.25$, $\sigma = 0.5$, $p = 0.29$ and $B = 0.01$.\(^8\)

Both discount factors decrease as $n$ increases. Thus, for a fixed discount factor $\delta$, it is easier to sustain high quality in a more competitive market.

To sum up, when the market price is fixed by the government, an increase in competition makes reputation building easier for the nursing homes because it weakens the incentives for

\(^8\) In the most severe continuation equilibrium, $m = 1$, the market share of the low quality nursing home is zero for any $n$. 

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unilateral deviations to low quality, the reputation building effect.\textsuperscript{9} Therefore, high quality is more likely to be observed in markets with more nursing homes.

3.1.2 The Private-pay Segment

Since expectations about future quality depend only on past quality, then, if high quality is sustained on the equilibrium path, the per-period quantity is consistent with one-shot Nash equilibrium. We denote the profit-maximizing quantity by \( x_h \) and the associated per-period profit by \( \pi_h \). It can be easily shown that

\[
x_h = \frac{(1 - c)h^2}{2(2 + n\sigma)} \quad \text{and} \quad \pi_h = \frac{(1 - c)^2h^2}{2(2 + n\sigma)^2}.
\]  

When a nursing home deviates in quality it offers low quality and changes its quantity to \( x_d \), where

\[
x_d = \arg\max_x \left\{(1 - 2x) \frac{2\sigma}{h^2} n x_h x \right\} = \frac{(cn\sigma + 2)h^2}{4(n\sigma + 2)}.
\]

The one time deviation profits associated with \( x_d \) are

\[
\pi_d = \frac{(cn\sigma + 2)^2 h^2}{8(n\sigma + 2)^2}.
\]  

After a deviation, in the continuation equilibrium, the deviator offers the low quality forever. We assume that \( m \) nursing homes offer low quality in the continuation equilibrium, where \( m \in \{1, 2, ..., n + 1\} \). Assuming that the market share \( x_{pm} \) is positive, the per-period equilibrium profits for the deviator in the punishment phase (p) as a function of \( m \) are

\[
\pi_{pm} = \frac{[\sigma(h(1 - c) - l)m + l(2 + n\sigma) - (1 - c)(n + 1)]^2}{2(2 - \sigma)^2(2 + n\sigma)^2}
\]  

Note that \( \pi_{pm} \) is increasing in \( m \), so the most severe punishment is when \( m = 1 \), that is when no nursing home other than the one that deviated offers low quality. However, it may not be possible to sustain it as an equilibrium. On the other hand, there is always a continuation equilibrium where all nursing homes offer low quality, i.e., \( m = n + 1 \).

Using (6), (7) and (8), the incentive compatibility constraint (ICC) is

\[
\frac{\pi_h}{1 - \delta} \geq \pi_d - B + \frac{\delta}{1 - \delta} \pi_{pm}.
\]  

\textsuperscript{9} Hörner (2002) shows a similar result.
Let $\delta(m, n)$ denote the minimum $\delta$ above which high quality is sustained in equilibrium. Given that $\pi_{pm}$ is increasing in $m$, $\delta(m, n)$ is increasing in $m$ for any given $n$, that is $\delta(m, n) \in [\hat{\delta}(1, n), \hat{\delta}(n + 1, n)]$. The critical $\delta$ above which high quality is sustained in equilibrium must lie within $[\hat{\delta}(1, n), \hat{\delta}(n + 1, n)]$, depending on how many nursing homes provide low quality in the continuation equilibrium. We are interested in the effect of $n$ on $\delta(m, n)$.

Consider the following numerical example that demonstrates that $\delta(m, n)$ can be non-monotonic in $n$. We use the same numerical values as in the example for the regulated segment: $h = 0.8$, $l = 0.3$, $c = 0.25$, $\sigma = 0.5$ and $B = 0.01$, except that $p$ is endogenously determined. Figure 2 plots the lowest and highest critical discount factors. They both exhibit inverse U-shapes which suggests that for a given $\delta$ high quality can be sustained only when $n$ is either low or high, and for intermediate $n$’s the nursing homes provide low quality.\(^{10}\) Therefore, equilibrium quality follows a U-shape pattern as a function of the number of nursing homes.

When the price is determined by competition, in addition to the reputation building effect, we have the rent extraction effect. The lower price, when competition intensifies, reduces the rents nursing homes are earning in equilibrium. Thus, nursing homes are more likely to deviate to low quality as competition increases. This is indeed the case when the number of firms is low, as the above numerical example illustrates (where punishment profits are zero for $n > 2$). For low $n$, prices are high on the equilibrium path and an increase in competition has a sizeable effect on profits, the rent extraction effect dominates the reputation building effect. Therefore, initially, an increase in competition increases the critical discount factor, making it harder to sustain high quality. For high enough $n$, the equilibrium market price is already low in which case deviation profits decrease faster, the reputation building effect dominates. In this case as competition intensifies nursing homes are more likely to sustain high quality.

### 3.1.3 The Two Segments Combined

We now assume that each nursing home serves both types of patients. We combine the two ICCs, (5) and (9). If a nursing home deviates, it does so in both segments, since we have assumed away quality discrimination, and then it also gets punished in both segments. Figure 3 depicts the highest and lowest critical discount factors, using the same numerical values as in the

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\(^{10}\) When $m = 1$, the market share of the low quality nursing home becomes zero for $n > 2$ in the continuation equilibrium. So, for $n \geq 3$, $x_{pm} = 0$ and the punishment profits are also zero.
two previous examples. The regulated price in the example is \( p = 0.29 \), while the market price is higher. For example, for \( n = 3 \) it is 0.608. Therefore, given that all patients receive high quality and nursing homes are symmetric, the number of Medicaid/Medicare patients in equilibrium is much higher than the number of private-pay patients, provided that \( n \) is not too high. The critical discount factors continue to exhibit an inverse U-shape pattern (although less pronounced than in the private-pay segment due to the presence of the Medicaid/Medicare market), suggesting that equilibrium quality can be U-shaped with respect to the number of nursing homes.

3.1.4 Testable Hypotheses

Based on the above theoretical predictions, we form the following testable hypotheses regarding the relationship between competition and reputational quality.

*Hypothesis 1*: when nursing homes serve a mix of public and private patients, the relation between lagged quality and competition is non-monotonic and can be U-shaped.

*Hypothesis 2*: The competition-quality relationship is more positive in markets with a higher percentage of government-sponsored (e.g., Medicaid) patients.

4. Data

4.1 Data Sources

Information on nursing home quality comes from the Online Survey, Certification and Reporting (OSCAR) database, maintained by the Centers for Medicare and Medicaid Services (CMS). It provides detailed facility-level information for all certified nursing homes in the United States on an annual basis, including chain status, the identity of the parent company, payer shares, quality information (such as deficiency citations and staffing), and a set of other nursing home characteristics. It also provides the name and address of each nursing home, which allows us to construct nursing home-specific competition measures as described in section 4.3. Using the OSCAR data, we extract a sample consisting of all for-profit nursing homes accepting private-pay patients between 2000 and 2005.\(^{11,12}\) We supplement the OSCAR data with financial data from Medicare’s skilled nursing facility Cost Reports as well as demographic information from the Bureau of Census. We note that the panel nature of the dataset permits us to use both

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\(^{11}\) For-profit nursing homes account for around 66% of the total number of nursing homes in our sample. We do not include non-profit nursing homes or government-owned nursing homes because their objective function is ambiguous. Our model requires the assumption that nursing homes are profit-maximizing firms, which applies only to for-profit nursing homes.

\(^{12}\) 96% of nursing homes accept private-pay patients in our sample.
cross-sectional differences across markets and data variation across years as the sources of identification for the relationships of interest. The final dataset consists of 62,668 nursing home-year observations. Descriptive statistics are presented in Table 1.

4.2 Measure of Quality with Reputational Consequences

Our empirical analysis focuses on a specific indicator of non-contractible, service quality—deficiency citations. Each year, an inspection team from the CMS randomly conducts a health inspection in each nursing home using a checklist of approximately 190 quality dimensions. When a particular dimension of quality does not satisfy minimum requirements, a deficiency citation is issued. An extensive body of prior research uses deficiency citations as a measure of nursing home performance (Nyman 1985, Harrington et al. 2000, Grabowski 2004, Lu 2012). In addition, in order to rank nursing homes using a “5-star” ranking system, the CMS uses aggregate deficiency citations as its main criterion for assigning ratings.

In Table 2, we provide validating evidence of the relation between nursing home reputation and deficiency citations. Following a methodology described in McDevitt (2011) and Lu and Wedig (2013), we investigate the relationship between a nursing home’s lagged citations and its likelihood of both changing its name (a proxy for declines in its reputation) and, more significantly, exiting from the market. Model I of Table 2 shows that a one-standard deviation increase in deficiency citations leads to a 7.2% increase in the likelihood of name change and a 6.6% increase in the likelihood of exit. Consistent with the reputation literature, we find that the number of deficiency citations can predict both name changes and market exit. The results suggest that there are reputational consequences from deficiency citations. This validates our use of deficiency citations as the main service quality measure.

In addition, we conduct the same test using the number of nursing hours per resident day as an alternative measure of nursing home quality. Although this staffing ratio is widely used in the health services literature as a measure of quality (Unruh and Wan 2004, Schnelle et al. 2004, Lin 2015, Hackman, 2016), Model II of Table 2 shows an insignificant relationship between staffing ratios and name changes, and a positive association between staffing ratios and the likelihood of exit. This suggests that staffing ratios do not have direct reputational consequences for nursing

13 Results in Table 2 are from Probit regressions. The sample excludes nursing homes in which the owner changed during the study period (these nursing homes will very likely change name, but not necessarily because of bad reputation). The dependent variable is either name change or exit from the market. The regressions control for local competition, share of Medicaid patients, total number of beds, share of patients who are not able to perform daily activities without assistance, and year and state fixed effects.
homes, and that high staffing ratios may even lead nursing homes to exit the market due to high labor costs. Nevertheless, we use staffing information as an alternative measure of quality in our robustness checks, so as to avoid any concerns about the selection of nursing home quality measures.

4.3 Measure of Competition

We employ several measures of competition commonly adopted in the literature, including a count of competitors within a specified radius, as well as the Hirschman-Herfindahl Index (HHI). Following the theory developed in the reputation literature, we argue that the number of competitors is more appropriate because it proxies the spatial nature of nursing home competition, where transportation time horizontally differentiates consumer choices. It is also arguably more exogenous than the HHI, given that the distribution of market shares (used in the HHI) may be endogenously determined by quality. We therefore use the number of nursing homes within a specified radius as our preferred measure of competition and use HHI in our robustness checks.

One important feature of the nursing home industry is the prevalence of nursing home chains. Lu and Wedig (2013) find that nursing homes form chains to achieve scale economies in both monitoring and supervision. In this paper, we observe the identity of chains and define competition using the number of competing chains, instead of the number of nursing homes.

Counts of competitors require a definition of market boundaries, i.e., the radius around each nursing home. Prior literature has relied upon county-defined markets to investigate the effects of competition (Zinn 1994, Lin 2015). County-defined markets yield 9 competitors at the median, 27 on average and 293 at the maximum in our sample, numbers which exceed a reasonable estimate of the number of choices actively considered by an average consumer. As noted by Zhao (2016), large counties with denser population may have segmented markets where consumers only choose from a subset of providers within the county. For our purposes, we define each nursing home’s market as a geographic radius of 5 miles around the nursing home, which corresponds to more reasonable assumptions about search behavior. By this definition, each nursing home is surrounded by 3 other competitors within 5 miles at the median and 13 on

---

14 We note that ownership concentration in the nursing home industry, measured at the national level, is relatively low. According to the 2003 OSCAR data, the top four chains owned 1,264 nursing homes collectively, and accounted for 7.7 percent of market share, nationwide.

15 According to an online search, almost all nursing home search websites offer searches within a five-mile radius. Therefore, we believe that this market definition will more closely approximate geographic markets for nursing care.
average. We also consider alternative radii in our robustness checks, trying 7.5, 10, 15, and 20 mile radii and the county-level as market boundaries. We find that the market structure-quality relation is robust to these alternatives.\textsuperscript{16}

Figure 4a presents the distribution of the number of nursing home competitors (counting the nursing home itself) within a radius of 5 miles. We find a wide cross-sectional variation in market structures, ranging from monopoly to extremely competitive markets. As Figure 4a shows, 17.4\% of nursing home owners monopolize a local market within 5 miles, while 23.2\% of nursing home owners have to compete with at least 10 other competitors. The average number of competitors within 5 miles is around four (including itself). Such variation is important for testing theories that competition’s effect on quality is non-monotonic, since these tests require us to measure the quality-competition relation across a wide range of market structures.

Figure 4b shows the relationship between market structure and service quality by payer types. We use two subsamples to construct this figure, which include nursing homes whose percentage of Medicaid and percentage of private-pay residents are above the 90\textsuperscript{th} percentile of the full for-profit nursing home sample. These two subsamples are exclusive to one another. The private-paying line in Figure 4b shows a rough U-shaped curve in which the number of deficiency citations first increases as the number of competitors increases up to four, and then decreases after the number of competitors reaches more than ten. By contrast, the Medicaid line shows that the number of deficiency citations fluctuates and exhibits a noisy pattern when the number of competitors is greater than four. The different line patterns suggest that the impact of competition on service quality may differ by payer types. Furthermore, the fact that the Medicaid line exceeds the private-paying line suggests that nursing homes serving more Medicaid residents may have more deficiency citations. We suspect that the low Medicaid reimbursement rate may lead to such an association in nursing homes (Grabowski 2001). We therefore control for each nursing home’s Medicaid share in our main analysis.

4.4 Control Variables

We control for factors that may influence nursing homes’ service quality, including nursing home characteristics such as the number of certified beds, resident health status, measured by the percent of patients who cannot perform daily activities without assistance, and payer mix,

\textsuperscript{16} Results are available upon request.
measured by the percentage of Medicaid residents. Bed size controls for scale economies as well as incentives to maintain quality. Resident health status may affect service quality if less healthy residents lead to poorer outcomes, and reputation formation fails to adjust for this. As explained in section 4.4, including the percentage of Medicaid residents is important to control for potential impact of low Medicaid rates on quality. In addition, we include several market demand shifters such as per capita income and the percentage of the population who are African American in the county, as well as state-level regulated Medicaid rates as suggested by Gaynor (2006).

5. Tests of the Non-Monotonicity Hypothesis: The Quality-Competition Relation

5.1 Methodology

We employ instrumental variables regressions to test the non-monotonicity hypothesis. The major challenge to identify the relationship between market structure and service quality is the endogeneity problem. For example, factors that attract firms to the market may also induce firms to offer higher quality (e.g., unmeasured willingness to pay by consumers). Or, firms offering high quality may deter entry. To address these concerns, we follow the literature (Borenstein and Rose 1994, Gerardi and Shapiro 2009, Dai, Liu and Serfes 2014) and adopt the following variables as instruments: the one year lagged number of nursing home residents within a certain radius, the one year lagged number of elderly population in a county, and their squares. We argue that these lagged variables are uncorrelated with the current service quality of individual nursing homes, and yet are correlated with market structure, because nursing homes are more likely to locate in markets with a large elderly population and a great demand for nursing home services.

Our empirical strategy is similar to Dai, Liu and Serfes (2014), who investigate the non-monotonic relationship between competition and price-dispersion. We adopt the following quadratic model:

\[ Y_{i,m,t} = \beta_0 + \beta_1 \ln(options_{i,t}) + \beta_2 [\ln(options_{i,t})]^2 + \beta_3 X_{i,m,t-1} + \beta_4 Z_{m,t} + \gamma_t + \gamma_i + \epsilon_{i,m,t} \]  

Since we include nursing home fixed effects in our main specification, we do not need to control for nursing home characteristics that do not change over time, such as ownership status and chain affiliation.

17 Since we include nursing home fixed effects in our main specification, we do not need to control for nursing home characteristics that do not change over time, such as ownership status and chain affiliation.

18 Appendix A shows the description of the full list of instrumental variables.
where $Y_{i,m,t}$ is a measure of the service quality of a nursing home $i$ in market (county) $m$ in year $t$; $\text{options}_{i,t}$ refers to the number of nursing homes within a 5-mile radius of nursing home $i$’s location.\(^{19}\) $X_{i,m,t-1}$ are one-year lagged, time varying nursing home characteristics such as total number of beds, patient composition by payer type and their health status; $Z_{m,t}$ are time-varying demand shifters such as income, proportion of African American population and state-regulated Medicaid prices. We include year fixed effects $\gamma_t$ and nursing home fixed effects $\gamma_i$ to absorb shocks that are common to all nursing homes and time-invariant unobserved characteristics of each nursing home respectively. In order to control for both serial correlation and correlation between the decisions of nursing homes in the same market, we cluster our standard errors at the nursing home level. In robustness checks, we include an interaction term between state fixed effects and a linear time trend $ST_{m,s} \times Year_t$ to control for state-specific trends in service quality. The coefficients of interest are $\beta_1$ and $\beta_2$. Under the U-shape hypothesis, since our dependent variable—the number of deficiency citations—carries a lower value when quality is better, we expect $\beta_1$ to be positive and $\beta_2$ to be negative.

To address concerns about model overfitting which might lead to spurious rejection of linearity, we also employ an alternative linear specification, in which we classify each market in each year into one of the three market structure types: mono (monopoly), inter (intermediate) and comp (competitive). Thus, we test whether non-monotonicity can be confirmed using a piecewise linear approach.$^{20}$

The alternative specification is as follows:

$$Y_{i,m,t} = \alpha_0 + \alpha_1 \text{mono}_{i,t} + \alpha_2 \text{comp}_{i,t} + \alpha_3 X_{i,m,t-1} + \alpha_4 Z_{m,t} + \gamma_t + \gamma_i + \epsilon_{i,m,t} \quad (11)$$

where the effects of intermediate competition are found in the intercept. All of the other control variables are the same as in Equation (10). Thus, $\alpha_1$ and $\alpha_2$ respectively show the differential effects of monopoly and competitive status on quality relative to an intermediate market structure. Under the assumption that the dependent variable $Y_{i,m,t}$ is strictly increasing in competition, we expect $\alpha_1 < 0$ and $\alpha_2 > 0$. Alternatively, we expect $\alpha_1 > 0$ and $\alpha_2 > 0$ if a U-

\(^{19}\) For robustness checks, we replace $\ln(\text{options}_{i,t})$ with county-level HHI in Equation (10).

\(^{20}\) We follow Borenstein and Rose (1994) and classify the markets in the following way: a market is considered a monopoly if the share of a single owner is greater than 90%; it is considered a duopoly or intermediate if it is not a monopoly and the sum of shares from the top two owners is greater than 90%; it is assigned competitive if it is neither monopoly nor duopoly.
shaped relation holds, i.e. quality is higher in either monopoly or competitive markets relative to the intermediate competitive markets. Finally, the signs are reversed where \( Y_{t,m,t} \) is decreasing in competition. We apply the same set of instrumental variables to estimate Equation (11).

5.2. Main Results

Table 3 presents results for the overall relationship between competition and service quality. The first three columns show results for Equation (10), where we use the natural log of the number of nursing homes within 5 miles to measure the level of local competition faced by the nursing home, and also include a quadratic term of the competition measure to test the hypothesis of non-monotonicity. Column 1 is estimated using OLS. Columns 2 and 3 are estimated using 2SLS without and with state trends respectively. We find that the competition coefficient is positive and significant, while its square is negative.

To provide a visual depiction of these results, we use the coefficients in column 2, our preferred baseline specification, to calculate and plot the net effect of competition in figure 5. The implied marginal effect of competition on citations is \( \beta_1 + 2\beta_2 \ln(options_{i,t}) \). The estimates suggest that nursing homes incur the most deficiency citations where the number of nursing home competitors (counting the nursing home itself) within 5 miles is close to 4.21

Columns 4-5 present estimates of equation (11). The columns differ in the categorization of different market types as described previously. Column 4 defines a monopoly market where the number of competitors (including the nursing home itself) is 1 or 2; and an intermediate market where the number of competitors (including itself) is 3 or 4. Column 5 defines a monopoly market where the market share of a single nursing home is more than 90%; and an intermediate market as a market that is not a monopoly market and where the sum of market shares of two nursing homes is greater than 90%. The coefficients of the indicator variables for monopoly and competitive market in both columns are negative and significant, suggesting that nursing homes in either monopoly or competitive markets receive fewer deficiency citations than those in markets with intermediate competition levels. As before, this evidence supports a non-monotonic relationship between competition and deficiency citations.

5.2 Robustness Checks

21 The first order condition for maximization of citations is \( \beta_1 + 2\beta_2 \ln(options_{i,t}) = 0 \). Therefore, the number of owners at the inflection point is \( \exp\left(-\frac{\beta_1}{2\beta_2}\right) = \exp(4.63/(2 \times 1.70)) = 3.9 \).
The main results demonstrate a strong U-shape pattern between competition and quality under two alternative specifications. Yet we still have some concerns regarding the definition of markets, the choice of measures and other institutional factors. In this subsection, we carry out a number of robustness checks to alleviate our concerns. The results are presented in table 4 and 5.

First, there might be market segmentation within overly competitive markets, such that a nursing home may focus on a limited number of nearby competitors and consumers may only choose from a subset of providers (Zhao, 2016). To address this concern, we subset our sample to those nursing homes with the maximum of 7 or 10 competitors within 5 miles. The results presented in table 4, columns 1 and 2 using this subsample remain to show a robust U-shape.

Second, nursing homes potentially compete with home health agencies in the provision of sub-acute care. One concern is that these home health substitutes may change the local market structures of nursing homes and thus affect the nature of competition among them. For example, a monopoly nursing home surrounded by many home health agencies may have strong incentives to provide high quality due to the competition from its substitutes. In our opinion, home health could be viewed as an outside option for nursing home care. Nevertheless, to alleviate the concern of substitutability, we include the number of home health agencies and the number of home health admissions in a county as additional control variables, and present the results in table 4, columns 3 and 4. The coefficients of the two home health control variables are negative and significant, suggesting that the substitutability by home health is negatively associated with the number of deficiency citations. Most importantly, the U-shaped pattern remains to be robust after controlling for the effect of home health.

Third, we use county to define a market and construct county-level HHIs. We then replace our preferred competition measure (the number of nursing homes within 5 miles) with the county-level HHI as well as the number of nursing homes in a county. We rerun regressions for equations (10) and (11) using these two new competition measures. Results presented in table 4, columns 5 and 6 are robust.

Fourth, since the citation measure is a count variable, we replace the assumption of a normal distribution with a Poisson distribution for the error terms. We re-estimate equations (10) and (11) and report the results in table 4, columns 7 and 8 respectively. We also rerun the 2SLS estimations using a limited set of instrumental variables (only the number of nursing home residents and its squares) and report the results in table 4, columns 9 and 10.
Finally, to ensure that the U-shaped pattern is not an artifact of our selection of quality measures, we use an alternative quality measure based on nursing inputs. Table 5 reports the overall relationship between market structure and staff-resident ratio. Columns 1 and 2 use total nursing hours per resident per day as the dependent variable. Columns 3-6 use staffing measures of different nurse types: registered nurse and certified nurse aids. All results are estimated by 2SLS estimation using the same set of instrumental variables as before. Table 5 shows that the coefficients of the competition measures are significant and consistent with the U-shaped relation.

To summarize, we explore the relationship between market structure and quality of care using the sample of for-profit nursing homes accepting both public and private-pay consumers. The results show that nursing homes in markets with high or low competition levels receive fewer deficiency citations and input more staffing than nursing homes that are located in markets with an intermediate level of competition. The overall relationship between competition and service quality is U-shaped. The results are robust to alternative specifications, market definitions and measures.

6. Validating the Main Results
6.1 Differential Effect of Competition by Patient Mix

In Hypothesis 2, we predict that the shape of the quality-competition relation depends upon whether price is regulated. To test this hypothesis, we conduct estimations of the quality-competition relation using two subsamples of nursing homes: those for which the percentage of Medicaid residents is above the 90th percentile and those for which the percentage of private-pay residents is above the 90th percentile. For each of the two subsamples, we estimate a linear model and a quadratic model following equation (10), and a model following equation (11) and report the results in Table 6.

Columns 1-3 report results for the Medicaid subsample. Column 1 shows that, using the linear model, the coefficient of the competition measure is negative and significant. After adding a quadratic term, column 2 shows that the coefficients of the competition measure and its square become insignificant. Column 3 shows a positive coefficient for being a monopoly and a negative coefficient for being in a competitive market, although both are insignificant. Overall, columns 1-3 suggest a linear relation between competition and quality—the number of
deficiency citations decreases as the number of competitors increases for nursing homes where Medicaid patients dominate.

Columns 4-6 report the results for the private-pay subsample. Column 4 shows that the coefficient of the competition measure is insignificant in the linear model. Column 5 shows that the quadratic model fits this subsample better—the coefficient of the competition measure is positive and the coefficient of its square is negative. Using results in column 5, we calculate the number of owners at the point of inflection, which is also close to 4 (similar to the results shown in table 3 when using the full sample). Column 6 shows that the coefficients of being a monopoly and being in a competitive market are both negative. These findings are similar to what we found for the full sample shown in table 3.

Overall, table 6 indicates that the relationship between market structure and service quality is influenced by nursing homes’ dependence upon third party payer sources. When the majority of residents pay a regulated price (i.e., Medicaid), the U-shaped pattern disappears, and quality is weakly increasing in the number of competitors.

6.2 The Reputation Building Effect: Competition, Quality and Market Share

In our theoretical model, a key mechanism for competition to affect quality is through market share (see section 3.1.1). In this section, we test this mechanism empirically. We hypothesize that a nursing home with bad quality might lose more market share in a market with many alternative choices (i.e. competitors), than a nursing home with the same bad quality level in a market with fewer alternative choices. We employ a simple discrete choice model as in Berry (1994). Since this model requires markets with fixed boundaries, we use county as the market definition. The specification is as follows:

\[
\ln(s_{i,m,t}) - \ln(s_{0,m,t}) = \eta_0 + \eta_1 Subs_{m,t} + \eta_2 Quality_{i,t-1} + \eta_3 Subs_{m,t} \times Quality_{i,t-1} \\
+ \eta_4 X_{i,t-1} + \eta_5 Z_{m,t} + \gamma_m + \gamma_t + \varepsilon_{i,m,t},
\]

(12)

where \(s_{i,m,t}\) refers to the market share of nursing home \(i\) in market (county) \(m\) in year \(t\), and \(s_{0,m,t}\) refers to the market share of the generic outside option (defined as either receiving no care or receiving alternative types of skilled care such as home health care an informal care). \(Subs_{m,t}\) is the measure of substitutability (i.e., the number of options available to consumers), which we define as the number of nursing homes per square mile in the county. We use one-year lagged
citation counts, $Quality_{i,t-1}$, to proxy consumer expectations of quality provided by a nursing home.

The interaction term, $Subs_{m,t} \times Quality_{i,t-1}$, is the key explanatory variable, which identifies the differential effects of quality differences across markets with different degrees of substitutability. Given that our quality measure is a measure of quality deficiency, the sign of the interaction term should be negative if competition affects quality through market share. That is, reductions in quality should lead to a greater loss of market share in more competitive markets, ceteris paribus. $X_{i,t-1}$ and $Z_{m,t}$ represent one-year lagged nursing home characteristics and market characteristics, respectively, while $\gamma_m$ and $\gamma_t$ are controls for market fixed effects and year fixed effects. Here, market share is calculated as the number of private-pay residents in a given nursing home divided by the elderly population (above age 65) in a market. In robustness checks, we theorize that the Medicare population may also have freedom to choose a nursing home and thus use the sum of private-pay patients and Medicare patients in the numerator.

To address possible endogeneity of market structure, we introduce an instrumental variable for the measure of substitutability—the elderly population density, which equals the population over 65 divided by the total land area of the county. Our first stage IV results indicate a positive and significant coefficient of elderly population density on nursing home density.22 Since we do not observe price set by each nursing home for the whole sample, and price and quality are positively correlated, omission of price from equation (12) will cause the estimated effect of quality to be biased towards zero.

Results are presented in columns 1 and 2 of table 7, using OLS and 2SLS estimations respectively. The coefficient of the interaction term between substitutability and quality expectation is negative and significant in both models. The results indicate that, given the same marginal increase in deficiency citations (i.e. deterioration in quality), nursing homes suffer a greater decrease in market share when they are located in a market where consumers have more options. We also find that the coefficient of substitutability is negative and significant at the one percent level, suggesting that a higher degree of substitutability results in lower market share. Finally, the coefficient of expected quality suggests that increases in deficiency citations also reduce market share.

22 The Anderson Canonical Correlation test shows that the minimum eigenvalue statistic is significantly larger than the critical value of 16.38, thus allowing us to reject the null hypothesis of a “weak” instrument. We do not report the first stage regression results. The results are available upon request.
We carry out a series of robustness checks and report the results in columns 3-5 of table 7. Column 3 shows results where we include a price proxy—total revenue divided by total bed days. Column 4 shows the results where we use three-year lagged citation counts and a three-year moving average to proxy quality expectations. Finally, column 5 shows results where both Medicare and private-pay patients comprise the market. Overall, our results remain robust and support the reputation building effect that competition motivates high quality provision through market share.

6.3 The Rent Extraction Effect: Profit Margin and Quality

Park and Werner (2011) examine the effect of profit margin on quality in nursing homes from 1994 to 2006. They find a positive correlation between profit margin and quality measures such as total staff per resident day, incidence rates of pressure sores and restraint use, and the number of deficiency citations. These results indicate that a high profit margin is necessary to induce firms to provide high-quality services. In this study, we cite this work to fill in the logic gap for the rent extraction effect that competition hinders quality improvements by lowering the rents that firms are earning.

7. Discussion

Despite the policy importance of understanding the competition-quality relationship, theory and empirical evidence are inconclusive when it comes to credence goods markets where quality is not directly observed by consumers prior to purchase, and the incentive to improve quality is mostly driven by a reputation commitment. This paper develops a repeated game framework for the mix-payment system faced by most health care providers, and tests the predictions in the nursing home industry. Consistent with our theoretical predictions, we find robust evidence that overall, quality is high in either monopolistic or highly competitive markets and low in intermediate markets with about 4 competitors on average. More importantly, the relationship between competition and quality depends on the patient mix: the U-shaped relationship would disappear and become monotonically increasing when the majority of the patients are Medicaid patients. We further validate our measure of reputational quality, the number of deficiency citations, by showing that it could significantly predict nursing home name changing and exiting behaviors. Our empirical results are highly robust to alternative specifications and methods. We
also find supporting evidence that intensive competition makes patient demand increasingly sensitive to service quality.

Our results are significant on several levels. From a policy perspective, we suggest that simple anti-trust rules for the nursing home industry may be insufficient due to the non-monotonic relationship between competition and quality under a mixed-payment system. For example, a merger that reduces local competition from 5 to 4 nursing homes may be worse than one that reduces competition from 3 to 2. While both mergers presumably result in price increases (to private payers), in the latter example quality may increase as well. On the other hand, competition is almost always beneficial to consumers where regulated payment predominates. In short, our results argue for a “rule of reason” in applying anti-trust judgments to the health care industry where there is a mixed payment system.

Similar implications apply to other policies that affect market structure. For example, Certificate of Need (CON) laws frequently regulate entry into healthcare markets and may have an ambiguous effect on equilibrium quality if the quality-market structure relation is not monotonic. More importantly, quality of care is a big concern in the healthcare sector. It might be dangerous to use competition as a tool to promote quality if quality does not monotonically increase in the number of competitors in a market. Therefore, documenting the existence of a non-monotonic competition-quality relation can shed new light on the role of competition in ongoing antitrust policy decisions and entry regulations in healthcare sectors where public and private payers coexist.
Figure 1: Regulated segment—the lowest and highest critical discount factors as a function of the number of nursing homes in the market. Equilibrium quality exhibits an increasing pattern with respect to market structure.

Figure 2: Private-pay segment—the lowest and highest critical discount factors as a function of the number of nursing homes in the market. Equilibrium quality exhibits a U-shaped pattern with respect to market structure.
Figure 3: Both segments combined—the lowest and highest critical discount factors as a function of the number of nursing homes in the market. Equilibrium quality exhibits a U-shaped pattern with respect to market structure.
Figure 4a: Distribution of Competitors within Five Miles

Figure 4b: Relationship between Market Structure and Deficiency Citations by Payer Types
Figure 5: Simulated Partial Effect of Competition on Deficiency Citations

Notes: Figure 5 uses the coefficients of $\ln$ options and its square in Table 3, Column 3.
Table 1: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Obs</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measure of Quality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deficiency Citations</td>
<td>Number of deficiency citations</td>
<td>62668</td>
<td>6.9</td>
<td>6.0</td>
</tr>
<tr>
<td>Total Staffing</td>
<td>Nurse hours per resident day</td>
<td>62620</td>
<td>2.2</td>
<td>2.9</td>
</tr>
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<td><strong>Measure of Competition</strong></td>
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<td></td>
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<tr>
<td>Options</td>
<td>Number of competitors (including itself) within five miles</td>
<td>62668</td>
<td>13.7</td>
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<td>HHI</td>
<td>Herfindal Index in a county</td>
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<td>.2</td>
<td>.2</td>
</tr>
<tr>
<td><strong>Instrumental Variables</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Elderly Population</td>
<td>Log of 65+ elderly population in a county</td>
<td>62668</td>
<td>10.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Total Demand</td>
<td>Log of number of nursing home residents within 5 miles</td>
<td>62668</td>
<td>6.1</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Control Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Medicaid</td>
<td>Percentage of Medicaid residents</td>
<td>62668</td>
<td>.7</td>
<td>.2</td>
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<td>Beds</td>
<td>Total number of beds</td>
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<td>110.9</td>
<td>54.2</td>
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<td>ADL</td>
<td>Percent of patients who cannot perform daily activities without assistance</td>
<td>62668</td>
<td>26.7</td>
<td>12.3</td>
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<td>Income per Capita</td>
<td>Income per Capita in a county</td>
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<td>29564.9</td>
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<td>Percentage Black</td>
<td>Percentage black population in a county</td>
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<td>.1</td>
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<td>MSA</td>
<td>1 if located in a Metropolitan Area</td>
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<td>.6</td>
<td>.5</td>
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<td>Adj Medicaid Rates</td>
<td>State Medicaid rates adjusted by case mix</td>
<td>62668</td>
<td>119.2</td>
<td>24.9</td>
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</tbody>
</table>

Notes: Unit of observation is the nursing home-year. The study sample consists of all 12,900 for-profit nursing homes (66% of the total number of nursing homes in our sample) from 2000 to 2005.

Table 2: The Reputational Consequences of Deficiency Citations

<table>
<thead>
<tr>
<th></th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
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<tr>
<td></td>
<td>(1) Name Change (2) Exit</td>
<td>(3) Name Change (4) Exit</td>
<td>(5) Name Change (6) Exit</td>
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<tr>
<td>Deficiency Citations (1-year lagged)</td>
<td>.013*** (.002)</td>
<td>.011*** (.002)</td>
<td>.012*** (.002)</td>
</tr>
<tr>
<td>Staffing Ratio (1-year lagged)</td>
<td>.008 (.013)</td>
<td>.079*** (.013)</td>
<td>.013 (.013)</td>
</tr>
<tr>
<td>Firm Characteristics</td>
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<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>60344</td>
<td>61853</td>
<td>60339</td>
</tr>
</tbody>
</table>

Notes: Results are from probit regressions. Firm characteristics include local competition, share of Medicaid patients, total number of beds, share of patients who are not able to perform daily activities without assistance. All regressions include state and year fixed effects. Standard errors in parentheses are clustered by nursing home. *** p<0.01, ** p<0.05, * p<0.1
Table 3: The Gross Relationship between Market Structure and Deficiency Citations

<table>
<thead>
<tr>
<th>Deficiency Citations</th>
<th>Equation 10</th>
<th>Equation 11</th>
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</thead>
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<tr>
<td></td>
<td>FE</td>
<td>2SLS FE</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Ln Options</td>
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<td>4.63*** (.98)</td>
</tr>
<tr>
<td>Ln Options^2</td>
<td>.0003 (.11)</td>
<td>-1.70*** (.38)</td>
</tr>
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<td>Mono</td>
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<td></td>
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<td>Comp</td>
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<td>Home Characteristics</td>
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<tr>
<td>Lagged Medicaid</td>
<td>.51** (.23)</td>
<td>.47** (.24)</td>
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<tr>
<td>Lagged Beds</td>
<td>.002 (.002)</td>
<td>.002 (.003)</td>
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<td></td>
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<tr>
<td>Lagged ADL</td>
<td>.001 (.003)</td>
<td>.001 (.003)</td>
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<tr>
<td>Demand Shifters</td>
<td></td>
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<tr>
<td>Ln Income per Capita</td>
<td>2.36*** (.80)</td>
<td>2.92*** (.83)</td>
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<tr>
<td></td>
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<tr>
<td>Percentage Black</td>
<td>11.97 (.81)</td>
<td>10.49 (.61)</td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lagged Adjusted Medicaid Rate</td>
<td>-.002 (.003)</td>
<td>-.002 (.003)</td>
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<tr>
<td>State Dummies * Year</td>
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<td>N</td>
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<tr>
<td>Inflection Point</td>
<td>3.9</td>
<td>4.3</td>
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<td>Observations</td>
<td>62668</td>
<td>61440</td>
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Notes: All regressions control for year fixed effects and nursing home fixed effects. Standard errors in parentheses are clustered by nursing home. *** p<0.01, ** p<0.05, * p<0.1
Table 4: The Relationship between Market Structure and Deficiency Citations: Robustness Checks

<table>
<thead>
<tr>
<th>IV Approaches</th>
<th>Trimmed Competitors</th>
<th>Controlling for Home Health Competition</th>
<th>Alternative Market Definition (County)</th>
<th>Poisson</th>
<th>Alternative IVs</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Max=10</td>
<td>Max=7</td>
<td></td>
<td></td>
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<tr>
<td>Ln Options</td>
<td>6.86***</td>
<td>8.16***</td>
<td>4.42***</td>
<td>4.68***</td>
<td>20.45***</td>
</tr>
<tr>
<td>(1.61)</td>
<td>(1.95)</td>
<td>(.93)</td>
<td>(.96)</td>
<td>(7.14)</td>
<td>(.01)</td>
</tr>
<tr>
<td>Ln Options^2</td>
<td>-3.23***</td>
<td>-4.27***</td>
<td>-1.57***</td>
<td>-1.71***</td>
<td>-4.37***</td>
</tr>
<tr>
<td>(.78)</td>
<td>(1.05)</td>
<td>(.35)</td>
<td>(.36)</td>
<td>(1.51)</td>
<td>(.002)</td>
</tr>
<tr>
<td>Mono</td>
<td>-14***</td>
<td>-5.51***</td>
<td>(.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(.02)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp</td>
<td>-.062**</td>
<td>-7.78***</td>
<td>(.025)</td>
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<td>(.025)</td>
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<td>HHI</td>
<td>128.05**</td>
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<tr>
<td>(51.66)</td>
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<tr>
<td>HHI*HHI</td>
<td>-143.38**</td>
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<td></td>
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<tr>
<td>(57.27)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td># Home Health Agencies</td>
<td>-.012***</td>
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<td># Home Health Admissions/1000</td>
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<td></td>
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</tr>
<tr>
<td>N</td>
<td>47111</td>
<td>42384</td>
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<td>61554</td>
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<td></td>
<td>62668</td>
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<td></td>
<td>61440</td>
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</table>

Notes: All regressions control for nursing home characteristics, demand shifters, year fixed effects and nursing home fixed effects. Standard errors in parentheses are clustered by nursing home. *** p<0.01, ** p<0.05, * p<0.1
Table 5: The Gross Relationship between Market Structure and Staffing: Five Miles

<table>
<thead>
<tr>
<th>Measure of Competition</th>
<th>2SLS</th>
<th>Total Staffing</th>
<th>Registered Nurses</th>
<th>Nurse Aids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Ln Options</td>
<td>-12.69***</td>
<td>(.40)</td>
<td>-2.74***</td>
<td>(.99)</td>
</tr>
<tr>
<td>Ln Options^2</td>
<td>4.56***</td>
<td>(1.32)</td>
<td>1.03***</td>
<td>(.39)</td>
</tr>
<tr>
<td>Mono</td>
<td>15.13***</td>
<td>(4.01)</td>
<td>3.20***</td>
<td>(1.18)</td>
</tr>
<tr>
<td>Comp</td>
<td>20.56***</td>
<td>(6.22)</td>
<td>4.64***</td>
<td>(1.84)</td>
</tr>
<tr>
<td>Inflection Point</td>
<td>4.0</td>
<td>61392</td>
<td>3.8</td>
<td>61434</td>
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<td>N</td>
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<td>61392</td>
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</table>

Notes: All regressions control for nursing home characteristics, demand shifters, year fixed effects and nursing home fixed effects. Standard errors in parentheses are clustered by nursing home. *** p<0.01, ** p<0.05, * p<0.1

Table 6: The Relationship between Market Structure and Deficiency Citations by Payer Types

<table>
<thead>
<tr>
<th>Measure of Competition</th>
<th>Percentage of Medicaid (Top 90%)</th>
<th>Percentage of Private-paying (Top 90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Linear (1)</td>
<td>Equation 1 (2)</td>
</tr>
<tr>
<td>Ln Options</td>
<td>-2.12*</td>
<td>(.25)</td>
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<tr>
<td>Ln Options^2</td>
<td>.33</td>
<td>(.60)</td>
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<td>Mono</td>
<td>2.82</td>
<td>(2.45)</td>
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<tr>
<td>Comp</td>
<td>-1.09</td>
<td>(3.56)</td>
</tr>
<tr>
<td>Inflection Point</td>
<td>3.7</td>
<td>5302</td>
</tr>
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</table>

Notes: All regressions control for nursing home characteristics, demand shifters, year fixed effects and nursing home fixed effects. Standard errors in parentheses are clustered by nursing home. *** p<0.01, ** p<0.05, * p<0.1
### Table 7: The Effect of Substitutes on Market Share

<table>
<thead>
<tr>
<th></th>
<th>Market Share</th>
<th>Private-paying Consumers</th>
<th>Private-paying + Medicare</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>OLS (1)</td>
<td>2SLS (2)</td>
<td>2SLS (3)</td>
</tr>
<tr>
<td># Subs</td>
<td>-2.91**</td>
<td>-24.47***</td>
<td>-35.70***</td>
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<tr>
<td></td>
<td>(1.46)</td>
<td>(6.38)</td>
<td>(9.86)</td>
</tr>
<tr>
<td>Q(t-1)</td>
<td>-0.011***</td>
<td>-0.10***</td>
<td>-.005***</td>
</tr>
<tr>
<td></td>
<td>(.001)</td>
<td>(.001)</td>
<td>(.001)</td>
</tr>
<tr>
<td># Subs * Q(t-1)</td>
<td>-.031*</td>
<td>-.085***</td>
<td>-.098***</td>
</tr>
<tr>
<td></td>
<td>(.188)</td>
<td>(.022)</td>
<td>(.026)</td>
</tr>
<tr>
<td>Q(3-year average)</td>
<td></td>
<td></td>
<td>-0.010***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(.002)</td>
</tr>
<tr>
<td># Subs * Q(3-year average)</td>
<td></td>
<td></td>
<td>-0.054**</td>
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<td></td>
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<td></td>
<td>(.027)</td>
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<td>Price Proxy</td>
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<td>N</td>
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<td>50684</td>
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<td>R-squared</td>
<td>.84</td>
<td>.84</td>
<td>.87</td>
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</tbody>
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**Notes:** All regressions control year fixed effects and county fixed effects. Standard errors in parentheses are clustered by nursing home. *** p<0.01, ** p<0.05, * p<0.1

### Appendix A: Instrumental Variables Description

- **Ln (Elderly Population):** The natural log of the elderly population with age above 65 in a county. We obtain this variable from the Area Resource Files. We introduce this instrument following (Borenstein and Rose 1994) that uses the log arithmetic mean and the log geometric mean of Metropolitan Statistics Area population of end-point cities of a flight route as instruments for the competition level of the route.

- **Ln² (Elderly Population):** Ln (Elderly Population) squared.

- **Ln (Total Demand):** total residents using nursing home services within a geographic radius. We use the address and number of residents in the OSCAR data to construct this measure. We introduce this instrument following (Gerardi and Shapiro 2009) and (Dai, Liu, and Serfes 2014) that use the log of total enplaned passengers on a flight route as an instrument for the competition level the route.

- **Ln² (Total Demand):** Ln (Total Demand) squared.
REFERENCES


Hackman, Martin. 2016. "Incentivizing Better Quality of Care: The Role of Medicaid and Competition in The Nursing Home Industry" working paper


