

Quality Rating and Private-Prices: Evidence from the Nursing Home Industry[†]

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Abstract: We use the rollout of the five-star rating of nursing homes to study how private-pay prices respond to quality rating. We find that star rating increases the price differential between top- and bottom-ranked facilities. On average, prices of top-ranked facilities increased by 3.8 to 7.5 percent more than the prices of bottom-ranked facilities. We find stronger price effects in markets that are less concentrated and consumers' choices are more meaningful. Our results suggest that with proper design and when markets are less concentrated, consumers respond to public reporting and efficiency can be enhanced.

Keywords: quality rating, nursing home, price

JEL Codes: I11, I18

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1. Introduction

Throughout the health care sector, efforts to improve quality and contain costs increasingly rely on consumers as agents of change. Consumer-oriented strategies include public and private releases of quality data, efforts to enhance price transparency, education aimed at making consumers more informed about and engaged in clinical decisions, and greater use of financial incentives through mechanisms such as value-based insurance design and high deductible health plans. Public reporting of quality data has been a particularly prevalent consumer strategy, encompassing health plans, hospitals, physicians, nursing homes, renal dialysis facilities, organ transplant centers, fertility clinics, and other types of providers. Quality reporting is intended to relieve informational asymmetries that inhibit the efficient operation of markets. Accessible and credible information can help consumers select better providers, motivate providers to compete on quality by increasing the reward (market share and/or price) for better performance, and provide benchmark data to facilitate quality improvement efforts of providers who may have intrinsic motivations to improve their scores.

Not surprisingly, a large body of literature investigates the impacts of quality reporting on quality and patient choice of facility. In the nursing home context, the largest quality reporting effort has been the Nursing Home Compare (NHC) system operated by the Centers for Medicare and Medicaid Services (CMS). Grabowski and Norton (2012) summarize the literature on the effects of reporting on nursing home quality by stating there is a "modest (but inconsistent) positive effect on quality." Several key papers in this literature found improvements in some but not all quality measures (Zinn, 2005; Mukamel et al., 2008; Werner et al., 2009). Castle et al. (2007) found increased quality in competitive and lower occupancy markets but mixed evidence

on the overall effect of reporting on quality, and Grabowski and Town (2011) showed only minimal quality changes and no quantity response. Mukamel et al. (2010) found some corroborating evidence that facilities respond, showing that nursing home spending shifted to areas more likely to affect measured clinical quality. In terms of facility choice in the nursing home context, Werner et al. (2012) found that consumers were more likely to choose high quality post-acute facilities after quality reporting, but the magnitude of the effect was small.

In contrast to the significant literature on how reporting affects quality and choice, perhaps due to the lack of price transparency, the effects of quality reporting on prices has not been studied extensively in the nursing home or other health care contexts. Most of the literature on the effects of reporting has assumed (explicitly or implicitly) that prices are fixed. That assumption may not be valid in private-pay (insurance or self-pay) segments, and flexible prices complicate theoretical predictions about effects on quality and quantity and welfare analysis.

Theoretically, quality reporting can affect private-pay prices by increasing consumers' ability to distinguish the quality of different providers. In a competitive marketplace, the ability to ascertain quality would lead to price differentiation reflecting differences in marginal costs of producing different quality levels. In a non-competitive market, similar price differentiation by quality would be expected, but prices would reflect consumers' willingness to pay for different quality levels in addition to differences in marginal costs of production.

In this paper, we use the rollout of the five-star rating of nursing homes by CMS in December 2008 to provide exogenous variation in the representation of quality information. The new rating system synthesizes complex quality information into an aggregated rating intended to improve the usability of information. The design of CMS star rating is also similar to other

rating systems that consumers use frequently (e.g., Amazon.com, Yelp for restaurants and IMDB for movies). This similarity may reduce consumers' learning costs and encourage them to use CMS rating more effectively. On the CMS website, each nursing home is assigned an overall rating and three domain ratings for health inspections, staffing, and clinical quality measures. Furthermore, because the CMS provides detailed documentation of the rating calculation algorithm, we can simulate and compute the quality ratings prior to implementation of the five-star rating. We use the simulated rating and pre-post analysis as the primary identification strategy.

Compared to other healthcare markets, the nursing home industry provides several advantages for studying price effects. First, most private-pay revenues are out-of-pocket expenditures paid by consumers directly. Second, the bundle of services delivered by nursing homes is relatively standard (compared to, say, hospital services), allowing more accurate calculation of the private price and inter-facility comparisons. We collected the private-price of nursing home care from several state-administered nursing home datasets, including California, Florida, Ohio, New York, Minnesota, Pennsylvania, and Texas, during the period between 2005 and 2011.

The first and most fundamental question is whether private prices respond to quality rating. Findings of differential price responses between top- and bottom- rated facilities would provide suggestive evidence that quality rating improves market efficiency by promoting matching between providers and consumers. Second, we examine whether the response to quality rating depends on the level of market concentration. While quality rating theoretically can empower

consumers' ability to choose, market concentration limits the alternative options and may compromise the effectiveness of quality rating.

Using a longitudinal price dataset consisting of about 4,400 unique nursing homes, we find significant and differential price responses after the implementation of the five-star rating. The prices of top-ranked facilities rose at least 3.0% more than those of the bottom-ranked facilities. We also find that such price response mostly comes from the markets that are less concentrated (more competitive), and facilities facing capacity constraints. The primary contribution of this paper is new empirical evidence of the price effects of quality rating, particularly when many private-pay consumers lack insurance coverage. We also advance the understanding the role of market structure in implementing quality rating. We see stronger price response in marketplaces where markets are less concentrated, presenting consumers' with broader choice sets. We argue that implementation of public reporting and other forms of market regulation may act as policy complements and should be considered jointly. Overall, with increasing interest in using consumers to drive healthcare quality improvements and cost control, these findings may have implications for consumer engagement and price and quality transparency in settings other than nursing homes.

2. Quality Rating and Nursing Home Private Prices

2.1 Five-star Quality Rating

The CMS introduced its original nursing home quality reporting in 2003. That system provided data on multiple quality measures (i.e., 3 staffing and 19 resident-based measures, and all elements of the facility's health and life safety inspection). As noted above, the effects of the

earlier reporting system on quality and choice were small and inconsistent. Grabowski and Norton (2012) suggest that the limited response to quality reports may arise from the difficulty of interpreting complex report card data. Similarly, a literature review on how consumers use quality information concluded that easy-to-read presentation formats and messages are important (Faber et al., 2009). The five-star rating system, rolled out in December 2008, may simplify and enhance the usability of the NHC quality data. This modification provides an overall star rating that synthesizes data across multiple dimensions of quality measures to better enable consumers to use the quality information effectively (CMS, 2008). Calculation of the overall rating is based on ratings in three subcomponents: health inspection, staffing, and clinical quality. The ratings of overall quality and subcomponents are published and can be accessed freely on the Nursing Home Compare website¹.

While no specific weight is assigned, the health inspection is the most important dimension in calculating overall quality rating (CMS, 2008). The process of generating quality ratings starts with the health inspections. Each nursing home facility receives a standard health inspection by state personnel every 9 to 15 months (on average, 12 months) as well as complaint-based inspections. Each facility is assigned a composite inspection score consisting of the past three standard inspections and complaint inspections in the past 36 months. The documented deficiencies are then assigned numeric points based on their scale and severity. To account for different standards and practices during health inspections across states, the aggregated inspection scores of individual facilities are compared to those of other facilities within the same state. The facilities with the lowest 10% deficiency scores receive five-star rating (best quality) in the inspection domain and the facilities with the highest 20% deficiency scores receive one-

¹ <http://www.medicare.gov/nursinghomecompare/search.html>.

star ratings (worst quality). The facilities with scores in the middle range of the deficiency distribution are ordered and proportionally distributed among four-star, three-star, and two-star ratings. The overall quality rating starts with this inspection rating and then adjusts for performance in the staffing and resident quality domains. A facility's overall rating can be up to 2 stars above or below its inspection rating (CMS, 2008). Importantly, different rating rules are applied in each quality domain. For health inspection, only a fixed percentage of facilities will receive a specific rating. For example, the top 10% receives a five-star rating. For staffing and resident quality domains, specific cutoff values are used in assigning ratings. Thus, the proportion of facilities that receive a five-star staffing rating can vary over time. With the ratings on these domains, we focus on the inspection domain because the fixed percentages of facilities receiving specific ratings exclude the change of the distribution of quality ratings. More importantly, the inspection rating is compared to all other facilities within the same state and can be more difficult for the facilities to game (Konetzka et al., 2013; New York Times, 2014).

Figure 1. CMS' Five Star Rating System

Medicare.gov | Nursing Home Compare
The Official U.S. Government Site for Medicare

Nursing Home Results

97 nursing homes within 25 miles from the center of 22201.
Choose up to three nursing homes to compare. So far you have none selected.

Viewing 1 - 20 of 97

<u>Nursing Home Information</u>	<u>Overall Rating</u>	<u>Health Inspections</u>	<u>Staffing</u>	<u>Quality Measures</u>	<u>Distance</u>
CHERRYDALE HEALTH AND REHABILITATION CENTER 3710 LEE HIGHWAY ARLINGTON, VA 22207 (703) 243-7640 Add to My Favorites	★★★★★ Below Average	★★★★★ Much Below Average	★★★★★ Below Average	★★★★★ Much Above Average	1.3 Miles
JEFFERSON, THE 900 NORTH TAYLOR STREET ARLINGTON, VA 22203 (703) 741-7582 Add to My Favorites	★★★★★ Much Above Average	★★★★★ Average	★★★★★ Above Average	★★★★★ Much Above Average	1.3 Miles
MANORCARE HEALTH SERVICES-ARLINGTON 550 SOUTH CARLIN SPRINGS ROAD ARLINGTON, VA 22204 (703) 379-7200 Add to My Favorites	★★★★★ Average	★★★★★ Below Average	★★★★★ Below Average	★★★★★ Much Above Average	3.2 Miles
POTOMAC CENTER, GENESIS HEALTHCARE 1785 HAYES STREET	★★★★★ Average	★★★★★ Much Below Average	★★★★★ Above Average	★★★★★ Above Average	3.4 Miles

2.2 Nursing Home Private Prices

Self-pay skilled nursing home care (SNC) expenditures represent a major financial burden for the elderly who are not eligible for Medicaid coverage. Annual costs often exceed \$60,000 (Stewart et al., 2009), and only a small minority of the elderly has private long-term care insurance coverage. Out-of-pocket payments are estimated to account for 33% of formal long-term care spending among the elderly, while only 4% of the expenditure is paid through private insurance (CBO, 2004; Catlin et al., 2007). The estimation from a life-cycle model (Kopecky and Koreshkova, 2014) suggests that out-of-pocket nursing home expense account for 6.75% of aggregate wealth, and is the primary driver of precautionary savings. Generally, nursing homes

can flexibly adjust private prices to reflect capital investments, market demands, and macroeconomic conditions².

Several studies have examined pricing in the nursing home industry. Stewart et al. (2009) examined the evolution of private-pay prices from 1977 to 2004, but did not explore facility or market variation in prices or attempt to assess the impact of quality reporting that had been initiated near the end of their study period. They concluded that the annual growth rate was 7.5%, outpacing growth in both the medical and general consumer price indexes and the growth in Medicaid payment rates. This price growth includes both “pure” inflation, the increase in price of a fixed level of service, and changes due to the changing nature of the services provided. By 2004, the private price was \$60,249 per resident year, which implied a 25% premium above Medicaid prices. Several studies pre-dating major quality reporting efforts linked nursing home prices to market characteristics, often focusing on states with regulations such as Certificate-of-Need (CON) and construction moratoria. Nyman (1994) used data from Wisconsin nursing homes in 1988 to show that higher concentration led to higher prices. Likewise, Mukamel and Spector (2002) calculated private-pay markups above marginal costs and above Medicaid rates using a sample of for-profit facilities in New York State in 1991.

To our knowledge, the only study that has examined the effect of public quality reporting on prices is Clement et al. (2012). Using a data set for Wisconsin (a CON state) nursing homes from 2001-2003, they find no effect on prices for medium or high quality homes. Among low quality homes, they find a small increase in prices. Because that increase is accompanied by

² We interviewed two nursing homes about their flexibility in revising private contracts for care. One suggested that it requires no longer than 60 days notice before any price change, and the other suggested the contract prices usually are reviewed and revised annually for existing residents.

reductions in restraint use, they suggest that the price increase may reflect an increase in quality spurred by reporting.

3. Hypothesis

The central hypothesis of our paper is that the five-star rating alleviates asymmetric information and facilitates quality sorting based on consumers' willingness to pay and providers' marginal costs of providing a specific level of quality. Because more transparent quality information can inhibit the price growth of lower quality facilities, spike the price of high quality facilities, or result in both effects, instead of absolute price changes, we focus on the relative price and price changes between higher and lower quality facilities. That is, if the five-star rating effectively achieves its policy purposes, the price differentials between top- and bottom-ranked facilities should widen when the market moves toward separating equilibrium. This leads to our first hypothesis, as follows:

H1: After the implementation of five-star rating, the top-ranked facilities have larger price increases than the bottom-ranked facilities.

In addition to asymmetric information, other forms of market imperfections (e.g., concentrated marketplace) exist concurrently. Because the concentration level of the nursing home sector varies geographically, it creates a great opportunity to examine the role of market concentration in the price response to quality rating. Ideally, better quality information facilitates consumer selection of nursing facilities that provide care that maximizes consumer surplus. However, the effects of reporting can be compromised if marketplaces are not competitive (Grabowski and Town, 2011; Chou et al. 2014). Based on the literature (Gaynor, 2006), we relax

the assumption of administrative pricing and use private-pay prices to empirically examine the interplay between quality rating and competition. In markets that are less concentrated, consumers are more likely to choose the alternatives based on reported rating and the providers face more pressures to adjust their prices according to their quality rating. By increasing the elasticity of demand with respect to quality, we hypothesize that price response to rating is stronger in marketplaces that are more competitive:

***H2:** The price effect of quality rating is stronger in less-concentrated (more competitive) markets.*

As noted in the earlier nursing home literature (Scanlon, 1980), the presence of regulatory barriers to entry (e.g., CON) may create capacity constraints and lead to excess demand. While the capacity constraint has become less binding in some states due to the expansion of alternative modes of care (e.g., home care, assisted living) (Grabowski 2008), in 2009, average occupancy rates varied from 64.9% (Oregon) to 97.1% (South Dakota) across states³. Because capacity constraints can increase the scarcity of nursing home beds in top-ranked facilities, in the presence of capacity constraints, quality rating enables good-quality facilities to raise prices more than those have lower occupancy rates and in markets with lower barriers of entry. Theoretically, quality rating enables good-quality facilities to increase revenues through higher prices or/and volumes. Under capacity constraints, the volume response is less feasible and hence, capacity constraints can amplify price effects. To account for the variations in capacity constraints across markets and facilities, we identify facilities as more likely to face capacity constraints if they reside in CON states or their existing occupancy rates are above the sample median of 90.3%. We also consider the interaction between market concentration and capacity

³ Based on the authors' calculation.

constraints. If a market is ex-ante concentrated, CON may inhibit price differentiation due to the lack of entry and the low-quality facilities can keep pace with the price increases of the high-quality facilities. Overall, we expect to see capacity constraints to play a more significant role in less-concentrated markets where consumers have more alternatives and price competition is more likely.

H3: Capacity constraints can amplify price effects, particularly in less-concentrated markets.

4. Data and Empirical Strategy

4.1 Data

The main analysis relies on several state-administered datasets to compute facility-level private-pay prices. These datasets include all freestanding nursing homes in California, Florida, Minnesota, New York, Ohio, Pennsylvania, and Texas from 2005 to 2011. These nursing facilities provide information on revenues from specific service lines (e.g., skilled nursing care, intermediate care, sub-acute care, other routine and ancillary services) and from different payers including Medicare, Medicaid, Self-Pay, and others. The richness of information allows us to calculate daily average prices by payer and by service line. To enhance the comparability of price information across providers, we exclude ancillary revenues outside direct patient care. Therefore, we have clean private price data on skilled nursing services. For example, private-pay price in California is calculated as the revenues from the skilled nursing care (SNC) dividing by SNC resident days. Because the cost reporting forms have slightly different classifications of

service lines and payers, direct comparison across states should be taken with caution⁴. Because some states define report periods and dates different from the calendar year, when this discrepancy presents, we also weight price data by the numbers of calendar days in each reporting year. About 15% of facilities do not have private-pay residents, or have incomplete price information. These facilities are excluded from the price analysis. To account for potential reporting and administrative errors, we also exclude the observations with the highest and lowest 1% of private prices and percentages of price change. The analytic sample includes about 4,400 unique nursing homes per year, 30.4% of U.S. freestanding facilities. Overall, our price measure excludes sub-acute care and ancillary services and it most closely represents the out-of-pocket expenditures borne by patients who are not eligible for Medicaid.

The price information is then merged with quality ratings downloaded from the Nursing Home Compare website. The quality ratings include four measures: overall quality, health inspection, staffing, and resident-based quality outcomes. The analytical dataset also incorporates the LTC Focus dataset maintained by Brown University and the Area Health Resources Files (AHRF), maintained by the Health Resources and Services Administration. All facility- and market-level variables are matched by Medicare provider numbers and by county code respectively.

The key dependent variables are private price per day and percentage change in private price over a year. Large price variations exist across geographic areas. For example, the 2010 median nominal private prices (per resident day) are \$310, \$205, and \$124 in New York, California, and Texas. To measure market concentration, we calculate the conventional

⁴ The report forms are consistent within states during our study period. The detailed report form of each state is available from authors upon request.

Herfindahl-Hirschman Index (HHI) based on the number of residents⁵ and using the county as the geographic market boundary⁶. While our analytic sample only includes freestanding facilities, the calculation of HHI includes facilities that are located in hospitals and those do not have private-pay residents because these facilities can still compete with other facilities within the same market. To account for the simultaneity issue between market share and outcome variables, we use the one year-lagged HHI values. Because chain-affiliation is a common organization form in the nursing home industry (mean= 54% in our sample), we adjust the HHI measure by chain-affiliation. We assume that facilities with the same chain-affiliations may not directly compete with each other, so we calculate the adjusted HHI values by combining facilities with the same affiliation in the same market. We use the chain-adjusted HHI as the primary proxy for market concentration through the paper⁷. We define the market to be less (more) concentrated if its HHI is smaller (greater) than 0.15⁸. Table 1 shows the distribution of markets and facilities by concentration level. 460 and 140 unique markets are identified as more concentrated and less concentrated and 1,433 and 3,013 unique facilities are in each category.

Table 1. Distribution of Markets and Facilities by Concentration Level

	# of Markets	# of Facilities
More Concentrated (HHI $\geq$ 0.15)	460	1,433
Less Concentrated (HHI < 0.15)	140	3,013

Note: Based on year 2009 number and chain-adjusted HHI value.

⁵ We also construct an alternative HHI index based on the number of nursing home beds. The results are insensitive to this alternative definition.

⁶ County is widely used in literature as the primary market boundary; Grabowski and Town (2011) use the fixed-radius approach and find no significant difference in their results.

⁷ We run analysis on both adjusted- and unadjusted- HHI and the results are not qualitatively different.

⁸ Federal Trade Commission defines markets are moderately concentrated if their HHIs are above 0.15.

4.2 Empirical Strategy

Our analysis strategy is based on two modeling approaches. In both, we narrow the analysis period to 2008 and 2009, the years before and after the implementation. We limit the study period to account for the concerns of serial correlation after policy implementation (Bertrand et al., 2003) and unobservable changes on the supply-side (e.g., the availability of assisted-living facilities as a substitute for skilled nursing facilities). The first approach uses ordinary least squares (OLS) regression to test the hypothesis of differential price changes by star rating. A limitation of that approach is that it cannot rule out the possibility that better facilities would have higher price increases even without the new reporting system. That is, modeling the change in price rather than the level of price allows for the possibility that better facilities have higher prices at each point in time, but still requires as an identifying assumption that better and worse facilities would have had similar growth in prices over time absent the new reporting. To address this limitation, we employ a second approach that uses CMS and OSCAR data to simulate what each facility's star rating would have been at the beginning of 2008 and 2009. Using that approach, the primary variable of interest is the interaction between star rating and the post-implementation dummy estimates the differential price effect of top rating after quality rating has been implemented. In this way, we address the concerns of unobservable secular trends that top-ranked facilities have larger price growth (relative to the bottom-ranked facilities) regardless of public reporting and more directly test the incremental effect of the star rating above and beyond the effect of the prior releases of higher dimensional, unsummarized quality measures. The limitation of the latter approach (detailed in Section 4.2.2) is that due to data reporting issues the simulated rating predicts the actual rating well, but not perfectly.

4.2.1 Baseline Model

As a first step, we run the basic (OLS) analysis to illustrate the association between private-pay prices and star ratings:

$$P_{i,2009} = \alpha + \beta_r * Rating_{2009} + \beta_f * x_{f,2008} + \beta_p * x_{p,2008} + \beta_m * x_{m,2009} + \beta_s * x_{s,2009} + \varepsilon_i \quad \text{Eq(1)}$$

where P is the set of private-price variables, including the log price in 2009 and the percentage change in price between 2008 and 2009. *Rating* is the five-star quality rating reported by CMS in January 2009. Because of data availability, we use this rating to proxy the initial rating in December 2008⁹, on the assumption that quality does not change drastically in one month. To avoid the simultaneity between private-pay prices and control variables (e.g., payer-mix, occupancy rates), we use the 2008 values for the facility characteristics. x_f is a vector of standard facility-level characteristics, including for-profit status, payer-mix, number of beds, occupancy rate, and chain affiliation. Because patients with severe conditions may require more care resources, we include aggregated patient characteristics to account for different intensity in treatments among facilities. x_p represents important patient characteristics that are aggregated at the facility level, like racial and gender composition and average activities of daily living (ADL) index. x_m is a vector that includes county-level control variables, including the standard HHI based on the market share in the county, log-transformed median household income, and the density of the elderly population (thousands of 65 + years old per square mile). x_s includes

⁹ Although CMS began five-star rating in December 2008, the earliest publicly available dataset only dates back to January 2009.

several state-specific variables, such as state dummies and the average Medicaid reimbursement rates.

One obvious concern is that the error term in equation (1) may be correlated with quality rating leading to biased inferences. In particular, high-quality facilities may consistently increase prices more than the low-quality facilities, even before reporting. If this is true, the observed price change may not be attributable to the quality rating system. Therefore, we simulated the star ratings prior to their becoming public.

4.2.2 Simulated Rating and Pre-Post Analysis

We first collect the underlying health deficiencies reported by CMS prior to the rollout of the five-star rating system and then follow the CMS' algorithm to calculate the equivalent star rating. This equivalent rating serves as our best estimate of what the star rating would have been in each year based on the information that was reported on the NHC. Because all the quality information was publicly available prior to the rollout of five-star rating, this pre-post analysis enables use to tease out the effects of synthesizing high-dimensional information into simple star ratings. We use both market and facility fixed-effect models. The specification is described in the following equation (2):

$$P_{i,t} = \alpha + \beta_r * Rating_{i,t} + \beta_p * post + \beta_r * Rating_{i,t} * post + \beta_x * X_{(i,m,s),t} + \theta_{i,m} + \varepsilon_{i,t} \quad \text{Eq(2)}$$

where $Rating_{i,t}$ is the simulated ratings that we calculate as of December 2007 and December 2008, respectively. $Post$ is a dummy variable indicating the period after the launch of five-star rating system in December 2008. Therefore, for each facility we have two observations: the

prices in 2008 and 2009, as well as the percentage change of price from 2007 to 2008 and from 2008 to 2009. The coefficient of the interaction term, β_i , represents the difference in the effects of ratings, before and after the ratings were publicly calculated and reported. If the summarization of the higher dimensional quality data into publicly reported star rankings did not enhance consumers' responses to quality rating, this interaction term would be zero (that is, consumers would respond the same way to the simulated star ranking before and after the actual star ranking became available). X is the same vector of time varying variables included in the OLS model. $\theta_{i,m}$ represents the time-invariant unobservable variables at the facility and/or market level. Because health inspection is the domain with most influence on the final quality rating (CMS, 2008) and more objective than other two self-reported domains, our analysis focuses on and mainly uses simulated ratings based on inspections. The simulation works well, but not perfectly. We know the facility's survey data, but there is a variable lag of up to three months between the survey and when those data become available to CMS to calculate the star rating. Using the actual 2009 star ratings, we determine that assuming a two-month lag maximizes the match between simulated and actual ratings. Because our simulated ratings are most reliable for the five-star and one-star ratings (93% and 84% agreement, respectively, vs. about 76% in the middle groups), we regroup the four-, three-, and two-star ratings into a middle-rated group. The reference group is the bottom-rated (one-star) facilities.

4.2.3 Market Concentration, and Effects on Private Pay Days and Revenues

To assess the impact of market structures on price changes, we estimated several models stratified by market structures and proxies of capacity constraints. In addition, we also estimate

the effects on the volume of private-pay days and total private-pay revenues to provide a more complete picture of the effects of reporting on the private-pay market for SNC.

5. Results and Discussion

5.1 Descriptive Data on Price Changes in Response to Quality Rating

After adjusting for inflation¹⁰, private prices remained relatively stable between 2004 and 2008 but rose significantly in 2009 in all seven states, coincident with the rollout of the five-star quality rating system in December 2008. The average prices by state and year are reported in Table 2. Year-to-year growth in real private-pay price per day is shown in Figure 2. This one-time price adjustment is similar to the volume response to the five-star rating in Medicare Advantage markets (Darden and McCarthy, 2014). Note that the price increase diminishes quickly after 2009 and becomes stable again. Comparing nominal and real prices, we find that the drastic price change only occurred in real prices but not in nominal prices. The discrepancy suggests that the significant price hike in 2009 may be because nominal prices did not reflect the negative inflation due to recession (3.8% in 2008 and -0.4% in 2009). Therefore, we focus on the price differentials between providers with good and poor quality instead of absolute price changes. Descriptive statistics for the regression sample are reported in Table 3.

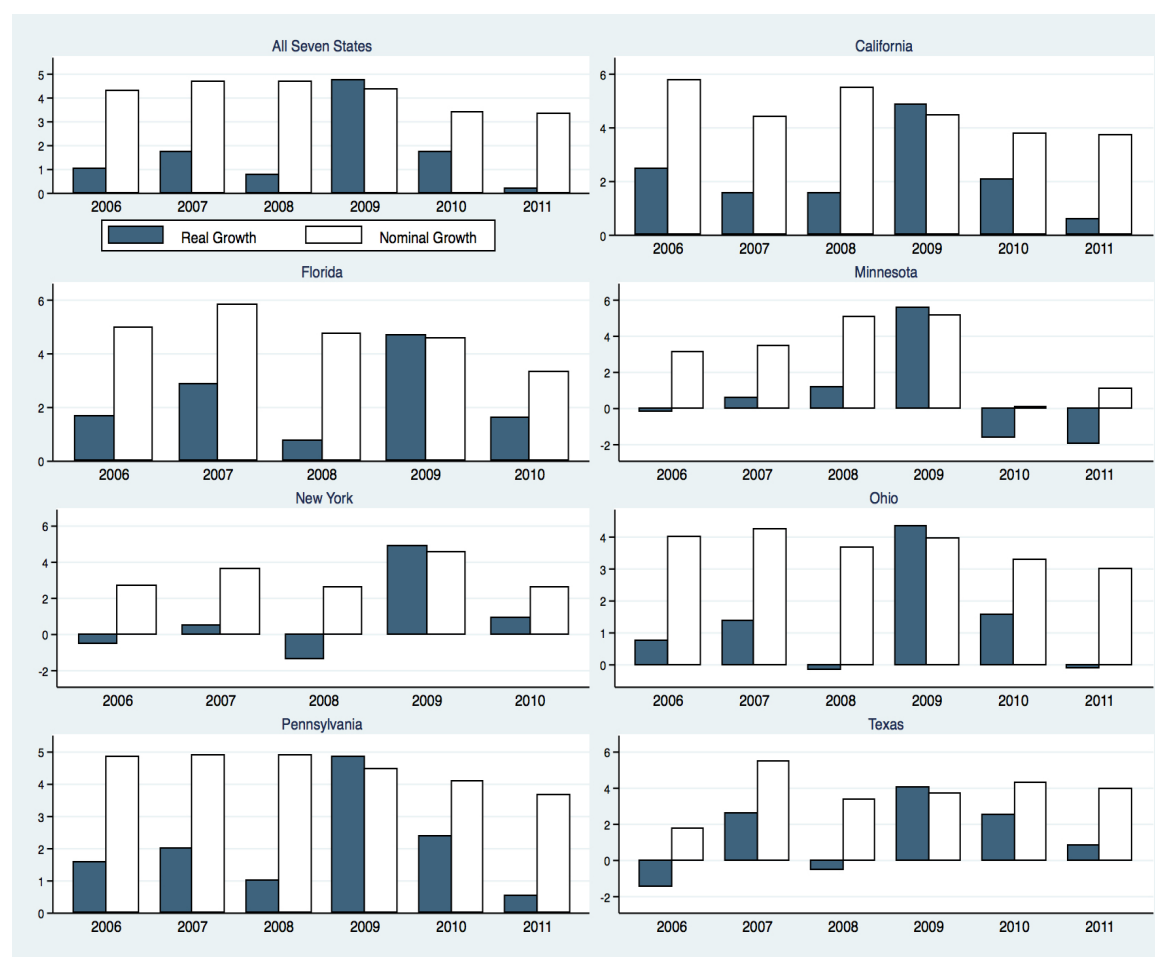
¹⁰ We adjust inflation using the annual average consumer price index from the Bureau of Labor Statistics.

Table 2. Median Price per Day by Years and by States (Inflation adjusted)

	CA	FL	MN	NY	OH	PA	TX
2005	157.77	166.06	144.15	255.95	163.32	192.00	104.02
2006	162.47	167.28	144.42	254.76	163.34	195.69	101.39
2007	167.06	174.90	146.99	263.53	168.83	199.73	104.55
2008	169.57	177.20	147.69	259.00	169.03	204.10	104.98
2009	178.17	183.43	158.05	273.86	178.03	213.97	110.45
2010	183.36	185.73	155.35	271.12	181.81	219.39	111.18
2011	186.70		151.82		180.04	217.53	111.92

Note: All prices are adjusted by consumer price index that pegged to 2005 price level. The highest and lowest 99% and 1% are excluded.

Figure 2. Median Price Growth (%) from 2006-2011



Note: Inflation adjusted. Florida and New York prices are not available in 2011.

Table 3. Summary Statistics¹¹

	2008			2009		
	Median	Mean	Std	Median	Mean	Std
Outcome Variables						
Private Price	168.72	177.75	64.30	177.55	189.25	78.46
% Change of Private Price	0.75	1.92	16.13	4.72	6.54	18.90
Private Day	3774	5186	5021	3448	4788	4761
Private Revenue	677701	1094155	1346291	643605	1050613	1311373
Facility Controls						
For-Profit	1.00	0.73	0.44	1.00	0.73	0.45
Government	0.00	0.03	0.17	0.00	0.03	0.17
Occupancy Rate	90.34	86.83	12.11	89.55	86.00	12.42
# of Beds	104.00	117.39	68.10	104.00	117.20	67.41
Chain Affiliation	1.00	0.54	0.50	1.00	0.54	0.50
Medicaid-Pay Share (%)	65.45	62.83	18.89	66.00	63.59	18.60
Medicare-Pay Share (%)	11.93	13.84	10.39	11.76	13.68	10.13
Patient Controls						
Hypertension (%)	58.49	56.61	15.25	60.00	58.18	15.09
Female (%)	71.72	68.82	15.21	71.08	68.47	14.81
White (%)	89.01	77.89	26.67	88.51	77.90	26.18
Hispanic (%)	0.00	5.17	14.48	0.00	5.23	14.48
Avg. Age	81.76	79.37	11.42	81.62	79.42	10.94
Avg. ADL	16.87	16.49	3.41	17.13	16.75	3.32
Acuity Index	11.45	11.45	1.33	11.53	11.52	1.37
Market/State Controls						
HHI	0.09	0.15	0.19	0.08	0.15	0.19
perSqueMile65	0.07	0.23	0.68	0.07	0.21	0.60
Ln(Household Income)	10.83	10.84	0.23	10.76	10.81	0.23
Unemp Rate	5.90	6.13	1.49	9.20	9.55	2.29
State Medicaid Rate	164.23	162.69	31.83	167.25	169.71	29.11
California	0.00	0.23	0.42	0.00	0.22	0.42
Pennsylvania	0.00	0.14	0.34	0.00	0.14	0.34
Minnesota	0.00	0.07	0.26	0.00	0.07	0.26
New York	0.00	0.10	0.30	0.00	0.10	0.30
Ohio	0.00	0.19	0.39	0.00	0.19	0.39
Texas	0.00	0.17	0.38	0.00	0.17	0.38
Florida	0.00	0.10	0.30	0.00	0.11	0.31
Observations	4377			4446		

¹¹ The summary statistics include all freestanding nursing facilities that reside in seven states and have meaningful price information in both 2008 and 2009.

5.2 Regression Results for Private-Pay Price Change

Table 4 reports the OLS results (Equation 1), for the both the overall star ranking and the health inspection domain (the other two domains did not show significant relationships between price and ratings). For both overall and health inspection-based rankings, five star facilities had significantly larger price increases than one-star facilities in the log-models (column (1) and column (3)) and have insignificantly larger price increases in percentage change models (column (2) and column (4)). Two, three and four-star facilities' price increases did not differ significantly from those of one-star facilities. Table 5 reports the results for estimates from the pre-post analysis using the simulated star ratings (Equation 2), with separate specifications using either market or facility fixed effects. In these regression models, we replace actual ratings in 2009 with the simulated inspection ratings for consistent comparison in the pre- and post-implementation periods. The positive and significant coefficients on the interaction term between the top rating and the post indicator provide consistent evidence that price effects on ratings are mostly from the top-rated facilities. The magnitudes are quite large given the low-end of estimates are 3-4% higher than the facilities with the lowest rating, with larger effects in models that restricted the sample to facilities averaging at least 5 or 10 private-pay patients over the year. Because ratings can differ between the pre- and post- years, in Table 6, we limit the sample to only the facilities with consistent rating ranks in both years. This specification rules out the effects of relative quality improvement (deterioration) and may provide a more robust evaluation of the rating on prices. The results are quite consistent with those in Table 5. We also repeat the analysis replacing the real price with the nominal price to address the concerns that our findings might be driven by the negative inflation in 2009 due to the great recession. The results are very similar and are not reported for brevity.

Table 4. OLS Model of the Effect of Star-Rating on 2009 Price Change

Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively. Coefficients on resident characteristics and state fixed effects are not shown for brevity.

	Overall Quality		Inspection Quality	
	ln(\$) (1)	Pct Pric Chg (2)	ln(\$) (3)	Pct Pric Chg (4)
5 Star	0.053*** [0.0172]	1.766 [1.1441]	0.052*** [0.0188]	1.89 [1.2686]
4 Star	-0.005 [0.0145]	0.323 [0.8333]	-0.007 [0.0155]	-0.888 [0.8742]
3 Star	-0.008 [0.0139]	0.276 [0.8120]	0.003 [0.0142]	0.055 [0.8630]
2 Star	-0.003 [0.0126]	0.349 [0.8271]	0 [0.0146]	-1.07 [0.8142]
For-Profit (t-1)	-0.039** [0.0171]	-0.744 [0.8819]	-0.041** [0.0169]	-0.8 [0.8650]
Government (t-1)	-0.042 [0.0271]	-1.408 [1.7737]	-0.043 [0.0272]	-1.37 [1.7673]
Occupancy Rate (t-1)	0 [0.0005]	-0.028 [0.0333]	0 [0.0005]	-0.028 [0.0336]
# of Beds (t-1)	0.000*** [0.0001]	0.001 [0.0048]	0.000*** [0.0001]	0.001 [0.0048]
Chain Affiliation (t-1)	-0.013 [0.0113]	-0.374 [0.6302]	-0.014 [0.0113]	-0.431 [0.6372]
Medicaid-Pay Share (%) (t-1)	-0.001* [0.0005]	0.02 [0.0242]	-0.001* [0.0004]	0.019 [0.0240]
Medicare-Pay Share (%) (t-1)	0.002*** [0.0006]	0.023 [0.0360]	0.002*** [0.0006]	0.021 [0.0361]
HHI (t-1)	-0.107*** [0.0317]	-1.584 [1.8304]	-0.106*** [0.0314]	-1.612 [1.8259]
65+ per square Mile ('000s)	0.045*** [0.0124]	1.39 [1.1308]	0.045*** [0.0123]	1.398 [1.1310]
Ln(Household Income)	0.208*** [0.0341]	1.31 [2.0804]	0.210*** [0.0344]	1.405 [2.1178]
Unemp Rate	-0.004 [0.0040]	0.03 [0.2145]	-0.004 [0.0040]	0.029 [0.2163]
State Medicaid Rate	0.005*** [0.0005]	-0.032 [0.0242]	0.005*** [0.0005]	-0.032 [0.0243]
R2	0.421	0.012	0.421	0.013
N	4444	4444	4444	4444

Table 5 Results from Simulated Rating

This table includes four sets of regression results. Panel A and Panel B have regression results from market- and facility- fixed effects. For each panel, we run the analysis on three specifications: (1) all sample (2) facilities with at least 1,825 private days (5 private-pay patient) and (3) facilities with at least 3,650 private days (10 private-pay patients). Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively. We include all other control variables as in the baseline regression.

Panel A. Market Fixed Effect

	Log(\$)			% Price Change		
	<u>All</u>	<u>> 5 R</u>	<u>> 10 R</u>	<u>All</u>	<u>> 5 R</u>	<u>> 10 R</u>
	(1)	(2)	(3)	(4)	(5)	(6)
Top-ranked	0.020 [0.015]	-0.012 [0.015]	-0.019 [0.020]	-0.688 [0.986]	-1.169 [1.098]	-2.445* [1.452]
Mid-ranked	0.023** [0.011]	0.000 [0.011]	0.007 [0.013]	0.618 [0.645]	-0.005 [0.779]	-0.258 [0.883]
Post	0.078*** [0.015]	0.073*** [0.018]	0.071*** [0.022]	8.715*** [1.771]	6.919*** [1.679]	4.891*** [1.789]
Top X Post	0.038** [0.018]	0.064*** [0.019]	0.075*** [0.024]	2.291 [1.781]	4.302** [1.935]	5.682** [2.551]
Mid X Post	-0.015 [0.011]	-0.007 [0.012]	-0.001 [0.016]	-1.139 [1.047]	-0.725 [1.037]	0.514 [1.283]
R-squared	0.068	0.067	0.09	0.028	0.031	0.038
Observation	8801	6551	4370	8801	6551	4370

Panel B. Facility Fixed Effect

	Log(\$)			% Price Change		
	<u>All</u>	<u>> 5 R</u>	<u>> 10 R</u>	<u>All</u>	<u>> 5 R</u>	<u>> 10 R</u>
	(1)	(2)	(3)	(4)	(5)	(6)
Top-ranked	0.054*** [0.011]	0.052*** [0.011]	0.055*** [0.011]	8.073*** [1.795]	6.823*** [1.817]	6.592*** [2.024]
Mid-ranked	-0.025* [0.013]	-0.034** [0.014]	-0.038** [0.016]	-4.315** [2.172]	-6.000*** [2.093]	-5.220** [2.575]
Post	-0.015* [0.008]	-0.017* [0.009]	-0.009 [0.011]	-1.272 [1.305]	-1.662 [1.394]	-0.317 [1.628]
Top X Post	0.021* [0.012]	0.041*** [0.013]	0.042*** [0.016]	2.526 [1.935]	5.638*** [2.178]	5.676* [2.964]
Mid X Post	0 [0.007]	-0.002 [0.007]	-0.001 [0.009]	-1.25 [1.218]	-1.278 [1.247]	-1.081 [1.669]
R-squared	0.1	0.108	0.129	0.047	0.059	0.076
Observation	8801	6551	4370	8801	6551	4370

Table 6. Results from Limited Sample with Consistent Ratings

We restricted the sample to those nursing homes with the same rating in the pre- and post- reporting years. We run the analysis on three specifications: (1) all sample (2) facilities with at least 1,825 private days (5 private-pay patient) and (3) facilities with at least 3,650 private days (10 private-pay patients). Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively. In Panel B, the coefficients of Top-ranked and Mid-ranked drop out.

Panel A. Market Fixed Effect

	Log(\$)			% Price Change		
	<u>All</u>	<u>≥ 5 R</u>	<u>≥ 10R</u>	<u>All</u>	<u>≥ 5 R</u>	<u>≥ 10 R</u>
	(1)	(2)	(3)	(4)	(5)	(6)
Top-ranked	0.060*** [0.019]	0.029 [0.022]	0.031 [0.030]	0.725 [1.144]	0.484 [1.532]	-0.556 [1.866]
Mid-ranked	0.036*** [0.013]	0.018 [0.014]	0.027 [0.018]	1.587** [0.794]	0.929 [0.916]	0.47 [1.111]
Post	0.058*** [0.012]	0.047*** [0.014]	0.033* [0.018]	8.656*** [1.943]	7.188*** [1.983]	5.468** [2.226]
Top X Post	0.021 [0.015]	0.041** [0.018]	0.048* [0.029]	3.547 [2.379]	6.056** [2.740]	7.742** [3.864]
Mid X Post	0.001 [0.008]	0.006 [0.010]	0.02 [0.015]	-1 [1.260]	-0.913 [1.291]	0.803 [1.639]
R-squared	0.092	0.092	0.112	0.033	0.044	0.054
Observation	6549	4902	3288	6549	4902	3288

Panel B. Facility Fixed Effect

	Log(\$)			% Price Change		
	<u>All</u>	<u>≥ 5 R</u>	<u>≥ 10R</u>	<u>All</u>	<u>≥ 5 R</u>	<u>≥ 10 R</u>
	(1)	(2)	(3)	(4)	(5)	(6)
Top-ranked	--	--	--	--	--	--
Mid-ranked	--	--	--	--	--	--
Post	0.060*** [0.012]	0.062*** [0.012]	0.067*** [0.013]	8.246*** [1.946]	7.670*** [2.062]	8.174*** [2.466]
Top X Post	0.025* [0.015]	0.046*** [0.017]	0.046** [0.022]	3.551 [2.413]	7.291** [2.847]	6.906* [3.949]
Mid X Post	-0.001 [0.008]	-0.004 [0.008]	-0.002 [0.010]	-1.029 [1.271]	-1.294 [1.299]	-1.015 [1.852]
R-squared	0.11	0.126	0.147	0.05	0.072	0.095
Observation	6549	4902	3288	6549	4902	3288

Tables 7 and 8 provide a more detailed view of the role of market concentration. Overall, these results show that a simulated rating of five stars increased prices after reporting only for facilities in low concentration markets. Again, effects are more significant among facilities have at least 5 private-pay resident year equivalents (1,825 private-pay days). A triple difference model has a negative and significant coefficient on the triple interaction term ($top \times Post \times HHI_{t-1}$), providing results consistent with those in the base specifications (results available from the authors).

We further stratify the sample by CON and occupancy rates in Table 9. In Panel A, we find significant results of the interaction terms only in CON states using all markets (column 1) and these results are only significant for the facilities facing more competition in markets with CON regulation (column 3). In Panel B, only facilities with occupancy rates higher than 90% (the median) have positive and significant effect (column 1) and particularly in markets that are less concentrated (column 3).

Using the low-end of the estimates, on average, the price effect of five star facilities can be translated into \$2,705 per resident per year (median = \$71,175/year based on 2009 prices). For a five-star facility in less-concentrated markets, the price effect can be \$3,153 per resident per year (median = \$75,067/year). Overall, our results suggest that the price effects have substantial economic impacts on both the consumers and providers.

Table 7 Role of Market Concentration

We define markets to be less concentrated if their system-adjusted HHIs are below 0.15. We replicate the analysis on the entire sample, and the sample with at least 5 private-pay residents. Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively.

Panel A. Market Fixed Effect

	Log (\$)				% Price Change			
	Less Concentrated		More Concentrated		Less Concentrated		More Concentrated	
	All (1)	> 5 R (2)	All (3)	> 5 R (4)	All (5)	> 5 R (6)	All (7)	> 5 R (8)
Post	0.061***	0.059**	0.110***	0.104***	8.857***	7.234**	8.532***	7.632***
	[0.023]	[0.027]	[0.023]	[0.028]	[2.836]	[2.956]	[2.197]	[1.953]
Top X Post	0.059**	0.095***	-0.016	0	2.7	5.210*	1.113	1.994
	[0.025]	[0.027]	[0.023]	[0.024]	[2.358]	[2.720]	[2.458]	[2.202]
Mid X Post	-0.01	0.004	-0.032**	-0.032*	-0.771	0.101	-2.193	-2.518
	[0.014]	[0.017]	[0.016]	[0.017]	[1.344]	[1.400]	[1.693]	[1.535]
R-squared	0.074	0.077	0.064	0.056	0.028	0.033	0.039	0.045
Observation	5909	4165	2892	2386	5909	4165	2892	2386

Panel B. Facility Fixed Effect

	Log (\$)				% Price Change			
	Less Concentrated		More Concentrated		Less Concentrated		More Concentrated	
	All (1)	> 5 R (2)	All (3)	> 5 R (4)	All (5)	> 5 R (6)	All (7)	> 5 R (8)
Post	0.041**	0.040**	0.075***	0.074***	7.462***	5.351*	8.227***	9.341***
	[0.018]	[0.019]	[0.013]	[0.012]	[2.775]	[3.106]	[2.299]	[2.166]
Top X Post	0.027	0.055***	0.004	0.013	2.262	6.923**	2.298	2.547
	[0.016]	[0.019]	[0.019]	[0.019]	[2.628]	[3.213]	[2.902]	[2.649]
Mid X Post	0.011	0.01	-0.022*	-0.019*	-0.543	0.306	-2.747	-3.915**
	[0.010]	[0.010]	[0.011]	[0.011]	[1.647]	[1.752]	[1.851]	[1.761]
R-squared	0.098	0.105	0.131	0.133	0.048	0.061	0.075	0.084
Observation	5909	4165	2892	2386	5909	4165	2892	2386

Table 8 Role of Market Concentration (with Consistent Ratings)

We repeat the same analysis as in the Table 6, but limit the sample to only the facilities with the same simulated rating in both 2008 and 2009. Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively.

Panel A. Market Fixed Effect

	Log (\$)				% Price Change			
	Less Concentrated		More Concentrated		Less Concentrated		More Concentrated	
	All (1)	> 5 R (2)	All (3)	> 5 R (4)	All (5)	> 5 R (6)	All (7)	> 5 R (8)
Post	0.057*** [0.021]	0.049** [0.023]	0.073*** [0.016]	0.060*** [0.016]	8.888*** [3.036]	6.297* [3.327]	8.426*** [2.496]	9.382*** [2.258]
Top X Post	0.044** [0.021]	0.068** [0.027]	-0.02 [0.023]	-0.001 [0.023]	4.664 [3.283]	7.930* [4.152]	2.212 [3.155]	3.125 [2.794]
Mid X Post	0.012 [0.011]	0.018 [0.014]	-0.023* [0.013]	-0.019 [0.012]	-0.076 [1.689]	0.928 [1.807]	-2.694 [1.914]	-3.972** [1.728]
R-squared	0.098	0.106	0.086	0.079	0.035	0.049	0.047	0.06
Observation	4347	3063	2202	1839	4347	3063	2202	1839

Panel B. Facility Fixed Effect

	Log (\$)				% Price Change			
	Less Concentrated		More Concentrated		Less Concentrated		More Concentrated	
	All (1)	> 5 R (2)	All (3)	> 5 R (4)	All (5)	> 5 R (6)	All (7)	> 5 R (8)
Post	0.055*** [0.020]	0.058*** [0.022]	0.076*** [0.015]	0.078*** [0.014]	8.242*** [2.956]	6.587* [3.466]	7.925*** [2.554]	9.921*** [2.463]
Top X Post	0.042** [0.020]	0.071*** [0.025]	-0.01 [0.022]	0.003 [0.021]	4.43 [3.384]	9.450** [4.445]	1.75 [3.234]	3.204 [2.964]
Mid X Post	0.012 [0.011]	0.008 [0.011]	-0.027** [0.012]	-0.023* [0.011]	-0.158 [1.717]	0.347 [1.855]	-2.692 [1.940]	-3.794** [1.814]
R-squared	0.116	0.134	0.131	0.136	0.056	0.082	0.071	0.086
Observation	4347	3063	2202	1839	4347	3063	2202	1839

Table 9. Capacity Constraints

We stratify the samples by CON presence (Panel A) and Occupancy Rates (Panel B), using market-fixed effects. In both panels, columns 1 and 2 represent the results including all facilities in all markets. We then further split the sample by the level of concentration and results are shown from column 3 to column 6. Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively.

Panel A: Stratify Markets by CON regulation ($y=\log(\text{\$})$)

	All Markets		Less Concentrated		More Concentrated	
	CON (1)	w/o CON (2)	CON (3)	w/o CON (4)	CON (5)	w/o CON (6)
Post	0.027 [0.034]	0.037*** [0.013]	-0.031 [0.058]	0.035* [0.018]	0.116*** [0.042]	0.042* [0.021]
Top-ranked	-0.04 [0.026]	0.004 [0.015]	-0.058* [0.032]	-0.011 [0.021]	-0.012 [0.046]	0.029 [0.020]
Post X Top-ranked	0.114*** [0.032]	0.027 [0.020]	0.173*** [0.042]	0.044 [0.028]	-0.025 [0.049]	0.005 [0.025]
R-squared	0.079	0.134	0.094	0.153	0.083	0.125
Observation	2724	3827	1942	2223	782	1604

Panel B: Stratify Markets by Occupancy Rates ($y=\log(\text{\$})$)

	All Markets		Less Concentrated		More Concentrated	
	$\geq 90\%$ (1)	$< 90\%$ (2)	$\geq 90\%$ (3)	$< 90\%$ (4)	$\geq 90\%$ (5)	$< 90\%$ (6)
Post	0.106*** [0.026]	0.009 [0.034]	0.118*** [0.043]	-0.068 [0.044]	0.094*** [0.029]	0.118* [0.062]
Top-ranked	-0.024 [0.023]	-0.013 [0.020]	-0.036 [0.029]	-0.032 [0.026]	0.013 [0.026]	0.007 [0.036]
Post X Top-ranked	0.067*** [0.024]	0.056** [0.028]	0.098*** [0.031]	0.088** [0.039]	-0.029 [0.031]	0.012 [0.038]
R-squared	0.061	0.092	0.069	0.132	0.097	0.058
Observation	3689	2862	2524	1641	1165	1221

5.3 Private-Pay Volume and Revenue

To comprehensively assess the effects of quality rating on private-pay markets, we replicate the analysis on private-pay days and private-pay revenue. The regressions results are presented in Table 10. Overall, we find significant revenue response but no significant volume response. In fact, private-pay days decreased by 6% during the post-year, consistent with the declining trend over years, likely due to the ongoing growth of assisted living and home care options (Stevenson and Grabowski, 2010; Grabowski et al., 2012). On the other hand, the higher ranked facilities gained significant private-pay revenues relative to lower ranked facilities. Again, these effects are particularly strong in markets that are less concentrated. For example, in less concentrated markets, private revenues of top-rating facilities rose relatively by as much as 10.7 %. The results of private days and private revenues are consistent with our main price analysis. More importantly, the significant effects of rating on private-pay price and revenues but insignificant effect on private-pay day suggest that facilities prefer or are able to charge a higher price and maintain existing payer-mixes, at least in the short-term. This is consistent to the fact that consumers' transaction costs between facilities are high and actual transfer rates are very low (Hirth et al., 2000; Hirth et al., 2003). Research on nursing quality reporting prior to the star rating system also finds that the magnitudes of volume response are small (He and Konetzka, 2014). Future work to examine the long-term effect may be more likely to find stronger volume effects.

Table 10. Volume and Revenue Response

Standard errors are clustered at the county-level in all regressions. ***, **, and * represent significance at 1%, 5%, and 10% respectively. Results are estimated from the market-fixed effects model.

Panel A: Log (Private Days)

	All Markets	Less Concentrated	More Concentration
	(1)	(2)	(3)
Post	-0.060** [0.025]	-0.038 [0.036]	-0.075** [0.033]
Top-ranked	0.064** [0.030]	0.055 [0.040]	0.085** [0.042]
Post X Top-ranked	-0.004 [0.035]	0.009 [0.050]	-0.068* [0.040]
R-squared	0.558	0.57	0.543
Observation	6551	4165	2386

Panel B: Log (Private Revenue)

	All Markets	Less Concentrated	More Concentration
	(1)	(2)	(3)
Post	0.013 [0.028]	0.004 [0.043]	0.028 [0.040]
Top-ranked	0.052 [0.035]	0.027 [0.047]	0.102** [0.046]
Post X Top-ranked	0.06 [0.037]	0.107** [0.053]	-0.068 [0.045]
R-squared	0.541	0.557	0.509
Observation	6551	4165	2386

5.4 Limitations and Future Work

Relative small sample size is the primary limitation in our study. Although we are able to collect a large price dataset compared to prior studies, the sample size is insufficient to perform regression discontinuity analysis, comparing facilities just above a star cutoff to those just below. Our simulated ratings represent the actual ratings well for the five-star and one-star facilities, but are more noisy for the two through four-star facilities. Thus, we are unable to examine the price effects of the incremental rating change (e.g. from two to three stars). It also creates measurement errors that can lead to attenuation bias that can lead to underestimates of the true effect. We also do not observe the availability of outside options (e.g. assisted-living facilities) that could compete with nursing facilities for private-pay residents. However, Bowblis (2014) finds that the expansion of assisted-living facilities has no effect on private-pay prices and because our research design focuses on a narrow 1-year time frame, the supply of assisted-living facilities is unlikely to change drastically.

5.5 Welfare Implications

While the five-star system appears to alleviate information asymmetry and improve market efficiency, the welfare implications are less straightforward. Seeing effects primarily in less concentrated markets suggests that reporting causes prices to better reflect the marginal cost of different levels of quality and facilitates better sorting by consumers on the basis of willingness to pay for quality. Of course, some individual private-pay consumers, such as those who would have received care in a five-star facility at a lower price had reporting not occurred, would be worse off after reporting. Had price increases occurred primarily in highly concentrated markets, there would be greater concern that the increased price differentiation would reflect primarily

willingness to pay rather than marginal cost of production, and hence represent primarily a transfer from residents to facilities on the basis of enhanced price discrimination.

Reporting may create beneficial or detrimental spillovers for Medicaid residents. Within the nursing home, the level of quality is often assumed to be a public good shared by Medicaid and private-pay residents (Norton, 2000; Grabowski et al., 2008). On one hand, the top-ranked facilities can charge higher prices that may in turn be used to enhance quality that can be shared with public-pay residents within the facilities. Likewise, lower ranked facilities have a greater incentive to raise quality as the market can better reward those efforts under an effective reporting regime. Although we do not find a significant shift of private-pay days that may indicate that Medicaid residents are being crowded out of high-quality facilities, losses of private revenues by low-quality facilities may still impair quality.

A further evaluation of the access and quality disparity between top- and bottom-ranked facilities will provide a clearer assessment of the overall welfare impacts of quality rating.

6. Conclusion

In the context of nursing home markets, we show that quality rating has meaningful effects on private-pay prices and revenues. Private price and revenue differentials between the top- and bottom-ranked facilities substantially widened, particularly in less concentrated markets. We believe quality rating improves market efficiency, because it enables prices to reflect the marginal costs of differing qualities, allowing consumers to sort into facilities that offer the quality that maximizes their consumer surplus. In addition, compared to the original NHC quality reporting initiated in 2003, the five-star system enables consumers to use quality information more effectively. The greater responsiveness of prices to the star rating system than

found in prior research on the original NHC system may inform the design of information reports.

On the other hand, the difference in price response between more and less competitive markets suggests that regulations regarding quality rating and market structure are policy complements, not substitutes. Therefore, public reporting and competition regulation should be considered jointly. Like the nursing home industry, the market structure of other healthcare subsectors varies across the nation (e.g. concentration and demographics). Our results point out the limitation of quality rating in certain markets and supplementary initiatives may be necessary to mitigate market imperfections.

This paper adds to the literature by studying quality rating's effect on private-pay prices. We believe this paper provides encouraging results for efforts toward quality transparency. Due to increasing interest in using consumers to drive healthcare quality improvements and cost control, these findings may have broader implications for consumer engagement and price and quality transparency in settings other than nursing homes. For example, consumers in high-deductible health plans have a considerable financial stake in their care choices. Finally, as more detailed data become available, future research may be able to explore the price response to quality rating in other healthcare sectors.

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