Players Behind the Scenes: Common Ownership in the Hospital Industry

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Abstract

"Common ownership" is a measure of market concentration at the shareholder level. Since 2000, institutional investors have held large amounts of stock shares among publicly traded firms, and many natural competitors are jointly held by a small set of large institutional investors. The objective function under common ownership is for directors to maximize the profits of shareholders' portfolios, and these portfolios include other firms, including sometimes the firm's competitors. Thus, higher common ownership concentration will result in higher product prices and eventually harm the consumer's interests. In this paper, I empirically test the common ownership theory in the hospital industry. I use panel regressions and find a positive relationship between common ownership concentration and hospital prices. Furthermore, I use panel regressions with lags and a difference-in-differences method to find causal impacts of common ownership concentration on hospital prices. Specifically, this paper finds that after the financial acquisitions of 2009, hospital service prices for more concentrated regions (at the investor level) increased by 12% compared to the control regions. My results are consistent when I use the exogenous shocks that occurred in 2006 and 2008.

1 Introduction

1.1 Institutional investors

Since 2000, investors have been purchasing large portions of publicly traded firms' outstanding shares of stocks, especially for the "big three" (BlackRock, Vanguard, and State Street). According to Backus et al. (2019), the "big three" owned an average of 6% of the $S\&P$ 500 in 2000, and the percentage increased to 21% in 2017. These investors are called "institutional investors" in general. Specifically, they include mutual fund managers such as Fidelity, index funds such as Vanguard, and exchange-trade funds such as BlackRock and StateStreet. This phenomenon raises severe concerns of anticompetitive behaviors by publicly traded firms. In traditional industrial organization theories, we measure the market concentration by measuring the number of firms and their market shares. However, the rise of institutional investors makes scholars and lawyers worry about a new antitrust phenomenon: If fewer investors own larger portions of stock shares of publically traded firms, especially firms from the same industry, the market may become more concentrated, because these investors become common owners of the competing firms. This could lead to anti-competitive structure, conduct and performance, including raising product prices. This topic has recently been related back to the common ownership theory introduced by Bresnahan and Salop (1986).

The concept of common ownership is very simple. In traditional industrial organization theories, we know firms' goals are to maximize their own profits. When firms offer public shares to institutional investors who own these publicly traded firms,

these new owners have new goals, which are to maximize their diversified portfolio profits. This portfolio not only includes one firm, but also includes the other competing firms. Although these institutional investors are adopting passive investment strategies, literature such as Brav et al. (2018) provides evidence that institutional investors have active roles in corporate governance. Hartzell (2003) also provides evidence that the involvement of large institutional investors may affect the relationship between owners and managers. This provides further evidence that institutional investors are "actively" involved in corporate governance.

1.2 Oligopolies in Antitrust law

In the U.S. market, highly competitive markets are very difficult to organize into cartels because of the number of competing producers. At the same time, highly concentrated markets are hard to cheat because cheating can be detected through a drop in sales or by discovering price cutting behavior by a competitor. Either action can be punished by reciprocal action. However, competitive oligopoly is widespread. According to Horizontal Merger Guidelines reference "parallel accommodating behavior" section 7, firms in an oligopoly manage to achieve a noncompetitive outcome through legal parallel interdependent behavior: "tacit collusion" or "conscious parallelism". On the other hand, under the Clayton Act section 7, if they achieve the noncompetitive outcome through an agreement, tacit or otherwise, they have violated section 1. The difference between "tacit collusion" and "tacit agreement" is subtle, much litigated, and the subject of continuing debate.

Under common ownership, firms are sufficiently informed and conscious of their

competitor's behavior (and recognize that hard competition will be met with a hard response and affect all parties) that they manage successfully to achieve a "soft competition" equilibrium. Since Azar et al. (2018) found that common ownership raises airline prices, scholars and law makers began to call for antitrust laws that clarify the difference between "tacit collusion" and "tacit agreement."

1.3 Literature review on common ownership

Azar (2011) first relates the institutional investors' ownerships to the common ownership theory. In his paper, he develops an oligopoly model with shareholding voting: "Instead of assuming that firms maximize profits, the objective function of the firms is decided by majority voting." His model proposes an extreme condition in which all shareholders are diversified, the firms act as if they were owned by a single monopolist. This creates anti-competitive actions at the shareholders' level. In this scenario, although firms are competing at the firm level, their shareholders (owners) become more concentrated. This paper promped many researchers to test this theory.

Most of the literature tests the effects of common ownership on firms' pricing behaviors. Azar et al. (2018) is the most well-known paper on this topic. They test the common ownership theory in the U.S. airline industry: The major U.S. airlines are owned by very few institutional investors, and this concentration at the shareholder level creates market concentration much larger than traditional market power defined by antitrust authorities. This results in higher ticket prices. Specifically, the authors use the combination of two large asset managers as the exogenous shock,

and look at the relationship between within-route changes in common ownership concentration and within-route changes in ticket prices. They define a flight route (for example, Boston to Chicago) as a local market, and define different carriers (for example, United Airlines, American Airlines, etc.) as competing firms. They find strong evidence that higher common ownership concentration increases ticket prices at the route (market) level. These results lead me to study common ownership in the hospital industry.

Other literature also finds evidence in the relationship between common ownership and product prices. Azar et al. (2016) uses the growth of index funds as an arguably exogenous source of cross-sectional variation of county-level common ownership growth to suggest a causal link between common ownership and higher prices for banking products. Gramlich et al. (2017) examine the impacts of common ownership on bank rates and fees for various financial products and quantity of bank deposits.

Scholars have also studied the common ownership effects on other outcomes. Anton et al. (2018) find positive effects of common ownership on firms' innovation. Specifically, they find that common ownership of within-industry competitors can increase incentives to innovate when technological spillovers are relatively larger than the distances of firms to the product market. Therefore, technological spillovers to competitors under the common ownership make it easier and less expensive to innovate. Cici et al. (2015) find that "borrowers and lenders that are commonly held by an institutional blockholder tended to do more business together going forward than those that are not commonly held." He et al. (2017) find that commonly held firms

experience significantly higher market share growth than non-commonly-held firms. Their evidence indicates that common ownership by institutional blockholders offers strategic benefits by fostering product market coordination, such as within-industry joint ventures, strategic alliances, or within-industry acquisitions. Kwon (2016) finds that institutional investors with common ownership exert a strong influence on executive compensation in a positive way. Specifically, executives receive more rewards for outperforming peer firms if common ownership concentration increases.

Institutional investors affect product prices is through three channels: votes, managers' incentives, and doing nothing. Of course, institutional investors do not directly affect product prices; they affect firms' competitive strategies through these channels, and prices are in turn affected by firms' competitive strategies. The competitive strategies include expanding a firm's market share, developing $R\&D$, etc. More specifically, institutional investors affect firms' competitive strategies by affecting firms' directors.

Common ownership could affect product prices through institutional investors' voting power on firms' competitive strategies. Aggarwal, Dahiya and Prabhala (2013) used an event study of an uncontested director election to show that shareholders' votes can bring about changes in corporate governance and firm policy. More specifically, shareholders do not directly vote on competitive strategies; rather, they vote on director candidates. According to Charan, Useem, and Carey (2015), "boards now routinely vet director candidates with major shareholders before their names are placed on the proxy." Furthermore, Fos and Tsoutsoura (2014) showed empirically that director elections matter because of directors' career concerns.

Institutional investors also affect corporate strategic product market competition through top management incentives. Anton, Ederer, Gine, and Schmalz (2016) found that "Institutional investors aim to maximize the value of their entire stock portfolio, rather than the performance of individual firms within that portfolio. Because fierce competition between portfolio firms reduces the value of the entire portfolio, it is in the asset managers' interest to structure executive pay in such a way that managers have weakened incentives to compete aggressively against their industry rivals." Specifically, they showed that executives are paid less for their own firm's performance and more for their rival's performance if an industry's firms are more commonly owned by the same set of investors. Meanwhile, Melby and Ritcey (2016) and Melin (2016) found that "institutional investors claim to address the structure of management pay in 45% of engagement meetings, and this results in incentives that are often much less sensitive to relative performance than other investors' demand." In conclusion, a lack of relative performance incentives gives managers reduced incentives to compete.

Doing nothing can also be a mechanism by which common ownership causes higher prices. Once firms decide to increase market shares, costly managerial efforts are required. For example, attracting new customers might require $R\&D$, and entering new markets may require unpleasant price wars with incumbents. If investors are passive and lazy, they may not insist on implementing such expansion strategies. Therefore, Azar et al. (2018) describes firm managers under common ownership as "the omission on behalf of large diversified mutual fund families to push portfolio firms to compete aggressively against each other." Elhauge (2015) also found that

antitrust law explicitly recognizes that taking no action is a sufficient mechanism to implement anticompetitive outcomes.

At the same time, some literature shows evidence against the common ownership theory. After Azar, Schamlz and Tecu's paper (AST) started the debate of common ownership, some following literature proposed conflicting evidence. For example, Kennedy, O'Brien, Song, and Waehrer (2017) replicated the AST paper but replaced the measure of common ownership with common ownership incentive terms, and they found no evidence that common ownership raises prices. Edmans, Levit, and Reilly (2018) showed that governance through both voice (monitoring) and exit (the sale of assets) can strengthen rather than weaken corporate governance. This refutes the mechanism that institutional investors affect product prices by affecting firms' competitive strategies.

There are two further concerns toward the common ownership theory. First, how powerful are common owners (COs) compared to non-common owners (NCOs)? Second, what level of ownership is required for owners to be influential? Rock and Rubinfeld (2018) discussed this issue by using legal analysis. First, COs will have access to management of each firm in the industry through earnings calls, investor meetings, etc. Second, COs will have better incentives in influencing decision-making with respect to the determination of both overall price/output and individual firm price/output than the NCOs, and in monitoring that determination. Third, Because of the COs' knowledge and incentives, the firms are more likely to accept the COs' determination of price and output. Lastly, COs will be better able to punish uncooperative managers directly, by voting "no" on "say on pay," or by voting "no" in

director elections.

Common ownership at low levels is pervasive. Institutional investors such as BlackRock, Vanguard, and State Street each owns 5-7% of most public companies. However, Rock and Rubinfeld (2018) used legal analysis and found that although common ownership level is low, common owners still have incentives to raise prices than non-common owners.

1.4 Why the hospital industry?

There are two types of hospitals in the United States: for-profit hospitals and non-profit hospitals. According to the American Hospital Association (AHA), there are currently $6,210$ hospitals in the U.S. $1,322$ of which are for-profit hospitals. In this paper, I focus only on for-profit hospitals. The for-profit hospitals are owned by companies called health systems. Some large health systems such as HCA, Health South, and others, offer public stocks. Some large institutional investors invest in these health systems and thus become common owners of some health systems. Since these health systems own many for-profit hospitals in the U.S., the institutional investors become the indirect owners of these hospitals. This institutional investor-health system-hospital channel constitutes my hypothesis: The increase of market concentration caused by common ownership at the health system level will cause hospital prices to rise. Tables 1 and 2 show the statistics of publicly traded health systems owned by some large institutional investors. Table 1 shows the top six blockholders for six large health systems. We can see that BlackRock, Vanguard, and Fidelity are top blockholders in most of these health systems. In Table 2, I pick

five large institutional investors in the hospital industry and divide their investments in the hospital industry into percentage holdings for each health system. For example, BlackRock invests 27% of their total hospital industry investments into THC and 9% into SEM. This table shows that THC, SEM, HLS and UHS are BlackRock's preferred stocks in the hospital industry. In my analysis, I will study 12 publicly traded health systems: HCA, Health South (now called Encompass Health), Community Health Systems, Kindred Healthcare, Lifepoint Health Inc., Select Medical, Tenet Healthcare, Universal Health Service, Health Management Associates, Psychiatric Solutions, RehabCare Group, and Vanguard Health System.

There are more nonprofit hospitals than for-profit hospitals. In this paper, I examine the effects of common ownership concentration on for-profit hospitals' prices. I consider the behavior of nonprofit hospitals and patient flows across the two types of hospitals when there is an increase in price among the for-profit hospitals. In other words, if for-profit hospitals raise their prices because of common ownership, how do nonprofit hospitals in the same region respond? Ultimately, their behaviors lead to potential patient flows either across different types of hospitals, or across regions. In this paper, I solve this concern by citing previous literature and providing empirical strategies.

A paper by Melnick et. al. (1999) reviews empirical evidence suggesting that mergers of hospitals that reduce competition will lead to price increases at both merging hospitals and their competitors, regardless of ownership status. It illustrates that anticompetitive behaviors of some hospitals in the market would affect the market equilibrium price of the whole market. In my paper, the anticompetitive behaviors

are caused by the common ownership among for-profit hospitals in the market. According to the Melnick et. al. (1999), this will result in a price increase in the whole market, which consists of both for-profit hospitals and non-profit hospitals. Thus, there is no need to worry that patients flow from for-profit hospitals to nonprofit hospitals in the context of common ownership market concentration.

The next concern is whether patients flow to other regions if the market price increases. According to Tenn (2011), "based on patient flow data, one might conclude that consumers could turn to many other hospitals for care." However, the author analyzes the hospital mergers in the Oakland-Berkeley region of the San Francisco Bay Area and finds that travel costs are high enough to prevent patient flow to other regions. As a result, the presence of other hospitals does not prevent an anticompetitive price increase.

Empirically, I include the region fixed effect in my regressions, which can capture the variations of hospital prices caused by patient flow to other regions. Moreover, I calculate the ratio of non-profit hospital discharges divided by for-profit hospital discharges in each region and in each year from 2005 to 2015, then include this ratio as a control variable in my regressions. This variable will control the variations of hospital prices caused by patient flow from for-profit hospitals to nonprofit hospitals in the same region. In summary, the mean of this ratio is 33.04, and the standard deviation is 103.72.

Therefore, previous literature in hospital consolidations and my empirical strategies solve the concerns that patients flow out of hospital types or out of regions when prices increase. If I can find any impact of common ownership concentration on

hospital prices among for-profit hospitals; at the same time, non-profit hospitals also respond to this price change and the whole market is affected. My findings could proxy for the impacts of common ownership concentration on hospital prices in the whole market.

In the broad literature of common ownership, previous empirical studies have looked at common ownership in the bank industry and the airline industry (Azar et al. 2016; Azar et al. 2018). These studies examined the impact of common ownership on county-level banks' financial product fees and within-route airline ticket prices, respectively. When measuring common ownership at the local market level, they use county level and within-route level as local markets respectively. Following their methodologies, I study the impact of common ownership on hospital prices, and I use the hospital referral regions (HRR) as local markets. The HRR code was invented by the Dartmouth Atlas Project. They define HRR as:

> *Hospital referral regions (HRRs) represent regional health care markets for tertiary medical care. Each HRR contains at least one hospital that performs major cardiovascular procedures and neurosurgery. HRRs were defined by assigning local hospital care markets to the region where the greatest proportion of major cardiovascular procedures were performed, with minor modifications to achieve geographic contiguity, a minimum population size of 120,000, and a high localization index.*
>
> *It is also a collection of ZIP codes whose residents receive most of their hospitalizations from the hospitals in that area. They were defined by assigning ZIP codes to the hospital area where the greatest proportion of*

their Medicare residents were hospitalized. Minor adjustments were made to ensure geographic contiguity.

According to the Dartmouth Atlas Project, I divide my total sampled hospitals into 170 hospital referral regions (HRR) in the U.S. I treat the HRRs as local hospital markets, and look at how the market concentration caused by common ownership in a specific market affects the hospital prices in that market.

1.5 How to measure traditional market concentration?

Market concentration is a key factor in studies on industrial organization. In early industrial organization literature, Bain (1951) asserted that market concentration is a measure of competition, and it is a function of the number of firms and their market shares. Meanwhile, Bain also related the firms' profit rates to the market concentration, which provides further evidence that market concentration could influence industry structure, conduct, and performance.

In the 1940s, Albert O. Hirschman and Orris C. Herfindahl invented the Hirfindahl-Hirschman Index (HHI), an index to measure market concentration, calculated as the sum of the squares of the market shares of each firm in a market. It ranges from 0 to $10,000$, where 0 means no competition and $10,000$ means there is a one-firm monopoly in the market, whose market share is 100%. There are many ways to calculate market shares using revenues or sales; in this paper, I use the number of hospital beds to calculate the hospital's market share.

1.6 Market concentration in hospital industry

An increase in market concentration may lead to decreasing competition, and the hospital industry is no exception. Dafny et al. (2016), Connor et al. (1998), and Dranove et al. (2003) have provided evidence showing that hospital mergers lead to decreasing costs and decreasing competition. This ultimately results in raised hospital charges, and thus patients are paying more. Gaynor and Vogt (2003) find that the hospital industry in San Luis Obispo County, "where the merger creates a near monopoly, prices rise by up to 58%." Gowrisankaran et al. (2015) also supports this conclusion.

Mergers and acquisitions are different for the hospital industry compared to other industries because many for-profit hospitals belong to large health systems (HCA, Community Health Systems, Health South, etc.) Some hospital mergers involve two hospitals that belong to the same health system, and some involve different health systems. Dranove et al. (2003) explained these two scenarios specifically in their paper. When two hospitals belonging to the same health system merge, "two or more hospitals in the same geographic market have common ownership, but maintain separate physical facilities, do business under separate licenses, and keep separate financial records." On the other hand, for some mergers: "two or more hospitals in the same local market have common ownership, do business under a single license, report unified financial records, and may or may not consolidate some physical facilities."

Mergers can also occur at the health system level, which may affect hospital costs and behaviors. There are 12 health systems in my dataset in 2005; however, during

my analysis period from 2005 to 2015, three systems were acquired by others. Health Management Associates was acquired by Community Health Systems in 2014. According to Dafny et. al. (2016), "the $3.9 billion acquisition of Health Management (71 hospitals) by Community Health Systems (135 hospitals) in 2014." Psychiatric Solutions was acquired by the Universal Health Service in 2009. In a news release from May 17, 2010, UHS states "PSI is the largest standalone operator of owned or leased freestanding psychiatric inpatient facilities with 94 facilities in 32 states, Puerto Rico, and the U.S. Virgin Islands. Today, UHS owns or operates 25 acute care hospitals and 102 behavioral health care facilities and schools located across 32 states, as well as in Washington, D.C. and Puerto Rico." RehabCare Group was acquired by Kindred Healthcare in 2011. According to a news release by Kindred Healthcare on June 1, 2011, "as a result of the Merger, Kindred is the largest and most diversified post-acute healthcare services company in the United States based upon revenues with operations in 46 states. On June 1, 2011, the combined company operated 121 long-term acute care ("LTAC") hospitals, 118 inpatient rehabilitation facilities ("IRFs") (primarily hospital-based units), 224 nursing and rehabilitation centers and is the largest provider of rehabilitation therapy contract services with approximately 1,870 rehabilitation therapy contracts."

Since health systems own many for-profit hospitals across the U.S., these system-level mergers have larger impacts on hospital costs and behaviors than mergers at the hospital level. Dafny et al. (2016) concluded that "the mechanism operates within state boundaries: cross-market, within-state hospital mergers yield price increases of 7-9 percent for acquiring hospitals." Meanwhile, a recent paper by Lewis and Pflum

(2017) finds that "independent hospitals acquired by out of market systems raise prices by about 18%, and the effects are larger when the acquiring system is larger or when the acquired hospital is smaller (by number of beds)."

1.7 How to measure financial market concentration?

In traditional markets, HHI is a key standard to measure the market concentration. However, the HHI only concerns market concentration at the firm level. Reynolds and Snapp (1986) modified the Cournot model to allow firms to own shares in their competitors. In terms of the econometric measure of financial market concentration, Bresnahan and Salop (1986) introduced the modified Herfindahl-Hirschman Index (MHHI) to quantify the competitive effects of horizontal joint ventures. Later, O'Brien and Salop (2000) separate the $MHHI$ into two parts: HHI and $MHHIdelta$.

In traditional literature on market concentration, scholars always use HHI to represent the market concentration and analyze its impacts on firms' anti-competitive behaviors. In common ownership literature, scholars use $MHHIdelta$ to represent the common ownership concentration (market concentration at the firms' shareholders' level) and analyze its impacts on firms' anti-competitive behaviors. Therefore, $MHHI$ represents the summation of market concentration at the firm level and market concentration at the shareholder level. In this paper, I follow the previous common ownership literature and use $MHHIdelta$ to represent the common ownership concentration, and include the HHI to capture the traditional market concentration effects.

The equation of $MHHI$ is:

$$MHHI = HHI + MHHIdelta \tag{1}$$

In this equation, HHI is well known to measure traditional market concentration. However, once the firms' shareholders get involved in the industry, the market might become more concentrated if shareholders hold stock shares in both firms themselves and their competitors. Therefore, O'Brien and Salop (2000) allow shareholders to hold stock shares in competitors and measure this concentration by $MHHI$. The difference between $MHHI$ and HHI is $MHHIdelta$, which represents the market concentration at the shareholders' level. Therefore, Bresnahan and Salop (1986) were the first to introduce the idea of common ownership ("joint ownership"). O'Brien and Salop (2000) was the first paper introducing the measure of common ownership ("joint ownership"), which is $MHHIdelta$. Recently, Azar et al. (2018) related the idea of common ownership to the empirical world with financial acquisitions and institutional investors.

The formula of MHHI is:

$$\sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{ij} \beta_{ik}}{\sum_i \gamma_{ij} \beta_{ij}} \tag{2}$$

In this formula, s_j and s_k represent market shares of companies j and k. β_{ij} represents holding shares from institutional investor i in health system j, and γ_{ij} represents control shares by institutional investor i in health system j. The holding shares is the total shares held by investors, and it equals to the sum of control shares and non-

control shares. Control share means that investors have proportional control rights to vote on firms' operational and managerial decisions, such as anti-competitive strategies or replacing managers such as chief executive officers.

In this formula, the numerator and the denominator of the fraction term are differentiated by second terms. They are holding shares by shareholders i invested in systems k and j. In this formula, notations k and j could represent either the same system or different systems. If k and j represent the same system, the numerator and the denominator in this fraction will be cancelled out, and the MHHI will equal to the HHI. If k and j represent two systems, this results in market concentration caused by common ownership:

$$\sum_{j} \sum_{k \neq j} s_j s_k \frac{\gamma_{ij}\beta_{ik}}{\gamma_{ij}\beta_{ij}} \tag{3}$$

Therefore, the equation of calculating these indices is:

$$\sum_{j} \sum_{k} s_j s_k \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}} = \sum_{j} s_j^2 + \sum_{j} \sum_{k \neq j} s_j s_k \frac{\gamma_{ij}\beta_{ik}}{\gamma_{ij}\beta_{ij}} \tag{4}$$

In this equation, the left hand side is the MHHI. The first term of right hand side is the HHI, and the second term on the right hand side is the MHHI delta. Both MHHI and HHI range from 0 to 10,000, where 0 indicates a perfectly competitive market, and $10,000$ indicates a monopoly. MHHI is always greater or equal to HHI, which means that $MHHIdelta$ is always a non-negative number. Table 4 shows the summary statistics of $MHHIdelta$ and HHI.

In order to better interpret the idea of common ownership, Table 3 shows an intu-

itive example of common ownership. In the first scenario, suppose there is only one health system in the market, so the market share of the system is 100%, and the HHI equals to $10,000$. Meanwhile, there is no market concentration caused by common ownership, so the $MHHIdelta$ equals to 0. Therefore, $MHHI$ equals to $10,000$. In the second scenario, suppose there are two systems in the market, and each of them owns 50% of market share and their shareholders are independent from each other (i.e., they do not own two systems at the same time.) so, the HHI equals to $5,000$. This traditional market concentration measure decreases because the market is more competitive after another player gets involved. Since firms' shareholders are independent, there is no common ownership, so the $MHHIdelta$ is still 0, and the $MHHI$ equals to $5,000$. In the third scenario, suppose these two systems' shareholders swap 50% of their ownerships with each other. Now, shareholder A owns 50% of firm 1 and also owns 50% of firm 2, and shareholder B has the same portfolio. When calculating the traditional market concentration, the HHI still equals to $5,000$. However, since these two systems have common ownership now, $MHHIdelta$ equals to $5,000$. Therefore, $MHHI$ equals to $10,000$. This scenario tells us that the market becomes less competitive again because systems' shareholders are common owners of both systems, which enhances the market concentration caused by common ownership.

1.8 Hospitals' pricing behavior measures

In this paper, I test this hypothesis: The increase of market concentration caused by common ownership at the hospital referral region level would result in higher hospital prices in the region. According to Lewis and Pflum (2017), "prices are

negotiated between health systems and insurers." Brooks et al. (1997) find that "greater hospital concentration improves hospitals' bargaining position." As a hospital improves its bargaining position, hospital prices rise. Therefore, I measure the hospitals' pricing behaviors using hospital charges. In order to scale the size of hospitals, I divide hospital charges by patient discharges. Thus, hospital charges divided by discharges is the outcome variable in my empirical analysis.

In the robustness check section, I will also show results obtained using other measures of hospital size, such as number of beds, total payroll expenses, total inpatient days, and number of full time personnel.

1.9 Theoretical models

In the traditional theoretical model, scholars usually assume that a firm's objective function is to maximize its profit. When firms offer public stock shares, their objective functions change slightly. Hart (1979) supports this hypothesis by saying that, "when large shareholders hold stocks in more than one firms, their objective functions may change." When firms maximize their profits, managers such as chief executive officers play key roles to achieve their goals. Previous literature has studied the delicate relationship between managers and shareholders (Dewatripont et al. (1994), Bertrand et al. (2003), Cornett et al. (2003), etc.) and all indicate that the congruence between managers and shareholders is important in corporate finance (Dewatripont et al. (1994)), and once managers pursue goals that are not in shareholders' interests, "overall productivity and profitability decline" (Bertrand et al. (2003)). Thus, managers now become the "employees" of shareholders instead

of employees of firms. At the same time, managers' goals are to maximize their shareholders' profits instead of the firms' profits. So, what is the difference between shareholders' profits and firms' profits? Currently, large shareholders and especially blockholders own stock shares in many firms. For some local markets, a few competitors in a specific industry are owned by the same blockholder. In this case, the blockholder has a portfolio of ownerships in these competing firms. Managers of each firm maximize their blockholder's profit so that they need to enhance their own profits, but they do not want to harm their competing firms' benefits since their competitors are also in the portfolio of their blockholder. Therefore, it is reasonable to say that managers not only value their own profit, but also value their competitors' profits as long as their competitors are in the portfolio of their shareholders. This logic constitutes the following common ownership theory.

In this paper, I follow the common ownership model introduced by Backus et al. (2018) and apply it to the hospital industry. Specifically, following firm behaviors in Rotemburg (1984), common ownership profit weights in Bresnahan and Salop (1986), and the notation of O'Brien and Salop (2000), Backus et al. (2018) generate a theoretical model to illustrate common ownership in the context of the Bertrand and Courtnot competition.

Suppose there are many institutional investors, and I index them by i. Their portfolios include shares of many hospital systems, which I index by s. Now, let β_{is} be investor i's ownership share in hospital system s. Note that the total profit of a hospital system is π, so the fraction of profits owned by investor i is $\beta_{is}\pi_s$. Therefore, the value of the investor's portfolio is:

$$\sum_{s} \beta_{is}\pi_s \tag{5}$$

As I said at beginning of this section, managers intend to maximize their investors' portfolio under common ownership. According to the proportional control assumption, firms' managers value their investors differently in terms of the amount of stock shares held by investors, since investors holding more stock shares have more votes to determine corporate executives, and thus have more power on a firm's corporate governance. Although most institutional investors claim that they are passive investors, broad literature has found evidence that they are "active" in corporate governance (see McCahery et al. (2016), Aggarwal et al. (2013), and Brav et al. (2015)). In this scenario, Backus et al. (2018) find that firms' managers place weights on investors. Here, I denote these weights as γ_{is}, which means the weights that manager of system s place on institutional investor i.

Therefore, systems' objective functions (executed by managers in reality) are maximizing:

$$\sum_{i} \gamma_{is} \sum_{r} \beta_{ir}\pi_r \tag{6}$$

Where both s and r both represent systems included in the portfolio of investor i. In order to interpret this objective function, we can think of $\beta_{ir}\pi_r$ as the value of the investor's real portfolio profits, and when I multiply γ_{is} with its real portfolio profits, I find the proportional value of firms' managers on the real portfolio profits of investors. After I make the double summation of these values, I find that the proportional value

of firms' managers on all real portfolio profits by all of their investors. Separating this double summation formula into two parts so that managers of system s maximize:

$$\sum_{s} \gamma_{is}\beta_{is}\pi_{s} + \sum_{r} \gamma_{is}\beta_{ir}\pi_{r}$$

Where s denotes the manager's system, and r denotes other systems included in investor i's financial portfolio. Re-arrange this formula so that systems are maximizing:

$$\pi_{s} + \sum_{r} K_{sr}\pi_{r} \qquad \text{where } K_{sr} \equiv \frac{\sum_{i} \gamma_{is}\beta_{ir}}{\sum_{i} \gamma_{is}\beta_{is}}$$

This objective function is different from the traditional model where a system only aims to maximize its own profit, which is π_s alone. Instead, under the common ownership background, Backus et al. (2018) conclude "K_{sr} represents the value to hospital system s of a dollar of profit generated for a competing system r." They also state that "back in the 19th century, it was unbelievable that firms generate profits for their competitors. It is believable now, because of common ownership." Firms generate profits for their competing firms because they have the common owners and they want to maximize their owners' portfolio profits.

I will relate this common ownership hypothesis to economic outcomes, which in my paper is hospital price. According to Backus et al. (2018), "the canonical case of differentiated Bertrand price competition with single product firms where firms

compete by setting prices, as in O'Brien and Salop (2000)." In the hospital industry, suppose hospital systems set a price p_s, and demand for hospital services is given by the function D_s that maps all hospital prices into services sold, i.e. $q_s = D_s(p_1, ..., p_f)$. Denoting the marginal costs as c_s, I have:

$$\pi_s = (p_s - c_s) D_s(p_1, ..., p_f), \tag{7}$$

In a traditional market without common ownership, hospital systems choose p_s to maximize π_s. In case of common ownership, hospitals solve:

$$\text{Choose } p_s \text{ to max } \pi_s + \sum_r K_{sr} \pi_r$$

To characterize the prices hospital system s will set in equilibrium, following the mathematics in Backus et al. (2018), I use the first order condition of hospital system s's optimization problem. Plugging equation 7 into this new objective function and taking the derivative with respect to p_s yields

$$0 = D_s(p_1, ..., p_s) + (p_s - c_s) \frac{\partial D_s(p_1, ..., p_s)}{\partial p_s} + \sum_r K_{sr} (p_r - c_r) \frac{\partial D_r(p1, ..., p_s)}{\partial p_s} \tag{8}$$

According to Backus et al. (2018), the first two terms on the right hand side of this equation are inframarginal and marginal effects of raising prices. Inframarginal customers always buy the products, so when price increases, profits rise. For marginal

customers, when price increases they no longer buy the products, so profits decline. Therefore, these two terms are usually countervailing. The third term is a new term. According to Backus et al. (2018), "it captures the profits generated by sales that are diverted to hospital system s's competitors when they raise their price." If products are net substitutes, then this third term in the first-order condition is always positive, and the first order condition of this objective function is greater than zero, which indicates that prices under common ownership will be strictly higher than they would be in a market in which firms maximize only their own profit.

This conclusion is the key concept of common ownership theory. It encourages scholars to test this hypothesis in the empirical world; that is whether consumers face higher product prices if the common ownership exists in the market.

1.10 Empirical methods

The straightforward way to test the impacts of common ownership on hospital prices is using the ordinary least squares panel regression. The outcome variable will be hospital prices scaled by hospital size. The main independent variables will be market concentration caused by common ownership, measured by the MHHI, and traditional market concentration, measured by HHI, on the right hand side of regressions to capture the effect of traditional market concentration on price variations. In order to control for the variation in hospital prices caused by other factors, I include the year fixed effects, HRR (region) fixed effects, and a set of control variables. The summary statistics of control variables are presented in Table 4.

Although a large number of potential omitted variables are captured via fixed

effects in panel regressions, there are two limitations in the linear regressions of common ownership on prices, primarily driven by some endogeneity concerns. The first concern is reverse causality; that is, if hospitals raise prices, institutional investors may be enticed to start investing in them, resulting in an increase in market concentration caused by common ownership.

The second concern is the calculation of $MHHIdelta$. When calculating $MHHIdelta$, there are two factors involved: market share, and ownership stakes held by investors. Although I use $MHHIdelta$ to represent the common ownership and test its impact on hospital prices, I cannot tell whether it is the ownership or the market share that has the decisive effects on hospital prices. Thus, I need another method to determine the "true" effect of common ownership on hospital prices. Based on these two concerns, it is necessary to find an exogenous independent variable to difference out these potential endogenous factors.

I then provide two robustness tests to examine the empirical validity of concerns regarding reverse causality and functional form. In my linear regressions, I take the lags of $MHHIdelta$ to solve the reverse causality. I also use a difference-in-differences identification strategy base on the financial acquisition of BlackRock and Barclays Global Investors in 2009. This identification strategy uses only variation in common ownership across regions that is implied by the hypothetical combination of the two parties' portfolios as of the year before the announcement of the acquisition. Since hospital stocks constituted only a small fraction of the merging parties' portfolios, it is unlikely that this variation is driven by expected changes in hospital prices. Comparing these two empirical strategies, the difference-in-differences approach uses

much less variation than the panel regressions, but the estimates from this strategy are arguably less affected by endogeneity of market shares.

2 Data

In this paper, I create a unique dataset by merging three datasets: American Hospital Association (AHA) data, healthcare cost report from the Centers for Medicare & Medicaid Services' (CMS) Healthcare Cost Report Information System (HCRIS), and data from the 13-F statement of Thompson Reuters in Wharton Research Data Services (WRDS).

The American Hospital Association (AHA) data includes many hospital characteristics for over 6,000 hospitals across the United States. These include whether hospitals and their systems provide obstetric care or not, whether they provide rehab care or not, whether they provide ultrasound care or not, total admissions, total inpatient days, total births, total surgical operations, total payroll expenses, and total full-time personnel. In my paper, these hospital characteristics are very useful. I can treat them as control variables in my regressions, and I can also scale the hospital size by some of these variables. More importantly, the AHA dataset gives me the code to distinguish for-profit hospitals and non-profit hospitals, and it also gives me the HRR code to divide over 6,000 hospitals into 170 local markets across the U.S.

The healthcare cost report comes from the Centers for Medicare & Medicaid Services' (CMS) Healthcare Cost Report Information System (HCRIS) dataset. It includes many cost variables as well as hospital characteristics for almost the same

number of hospitals as the AHA dataset; for example, whether hospitals are rural or urban, whether hospitals are teaching hospitals or not, whether hospitals are critical access hospitals or not, and total number of beds in hospitals. I can use these hospital characteristics to study the heterogeneous effects of common ownership concentration on various interesting outcomes. More importantly, this dataset gives me my main outcome variable of empirical analysis. It gives me the total chargers and total discharges of each hospital to scale the hospital prices by hospital size.

Both of these datasets have the hospital ID number, which allows me to merge them. After merging , I have about 5,800 hospitals.

The 13-F statement of Wharton Research Data Services (WRDS) includes financial variables of health systems and their institutional investors including institutional investor ID, total shares held by each institutional investor, sole voting shares held by each institutional investor, no voting shares held by each institutional investor, shared voting shares held by each institutional investor, and total shares outstanding for each health system. I use these statistics to calculate the index of MHHIdelta (common ownership concentration measure).

3 Empirical results

3.1 Panel Regressions

In this section, I will apply panel regressions to test the correlation between the common ownership concentration index (MHHIdelta) and hospital charges per patient discharge by using the ordinary least squares (OLS) panel regressions. The

regression is:

$$Log((Charges/discharges)_{iht}) = \alpha + \beta * Log(MHHIdelta_{ht}) + \gamma_1 * Log(HHI_{ht}) + \gamma_2 * Log(HHIstar_{ht}) + \delta_t + \lambda_h + \eta_{it} * X_{it} + \epsilon_{iht} \quad (9)$$

In this regression, my outcome variable is the hospital charges scaled by hospital discharges in hospital i in region h in year t. The independent variables of interests are $MHHIdelta$ and HHI in region h in year t. Specifically, the coefficient of $MHHIdelta$ captures the effects of market concentration caused by common ownership on hospital charges, the coefficient of HHI captures the effects of market concentration caused by traditional firms' mergers and acquisitions on hospital charges, and the coefficient of HHIstar captures the effects of market concentration caused by traditional firms' mergers and acquisitions on hospital charges considering both for-profit and non-profit hospitals. I include the year fixed effects, region fixed effects, and a set of hospital characteristic control variables in this regression. The year fixed effects capture the variations of hospital charges over the years, and the region fixed effects capture the variations in hospital charges across regions. If patients flow out of regions because of price increases, the region fixed effects also captures this variation. Further, hospital characteristics include the number of beds, urban dummy variable, teaching hospital dummy variable, critical access hospital dummy variable, whether hospital provides obstetrics services, whether hospital provides rehab services, whether hospital provides ultrasound services, total number of births, total surgical operations, total inpatient days, total payroll expenses, total full time

personnels, total part time personnels, and the ratio of total numbers of non-profit hospitals' discharges over total numbers of for-profit hospitals' discharges. Table 4 shows the summary statistics of all variables in my regression. The number of observations is at the hospital-HRR(region)-year level. In all linear regressions, I cluster standard errors three ways at HRR(region) level in order to solve the potential serial correlation problems among samples. Meanwhile, I take logs of my outcome variable and independent variables in order to better interpret the results.

Table 5 shows the results of linear regressions. In the first specification, I include the year fixed effects and region fixed effects without hospital characteristic control variables. The coefficient of MHHIdelta is positive and statistically significant at the one percent level. The coefficient is 0.10, which means that every one percent increase of MHHIdelta will result in a rise of hospital charges per discharge by 0.10 percent. Considering the mean value and the standard deviation of MHHIdelta and charges per discharge in Table 4, the economic significance also seems large. From the summary statistics, the mean value of MHHIdelta is about $4,500$, and the standard deviation is $2,460$. The mean value of charges per discharge is 100,000. Therefore, economically speaking, for every increase of MHHIdelta by one standard deviation, hospital charges per discharge will likely increase by $550. The coefficient of HHI is positive and statistically significant at the one percent level in this specification, and the coefficient of HHIstar is negative and statistically significant at 1 percent level.

In the second specification, I include the year fixed effects, region fixed effects, and hospital characteristic control variables, and find that the coefficients of MHHIdelta, HHI, and HHIstar are all statistically significant and have similar magnitudes to the

first specification. In general, both specifications of linear regressions show a positive relationship between common ownership concentration and hospital prices.

Of course, I do not infer a causal effect from this raw correlation. Many factors could impact the level of hospital prices across regions that may also be correlated with common ownership in a given region. In my baseline result I address various of such omitted variable concerns with explicit controls and a large number of fixed effects. For example, I include HHI to capture the effect of traditional market concentration on hospital prices; I also include various hospital characteristics that HHI fails to capture: whether hospital is in urban or rural, whether it is a teaching hospital or not, whether the hospital has a critical access, the number of beds, total admissions, total inpatient days, total surgical operations, total payroll expenses, and total full-time personnel.

3.2 Limitations of the baseline analysis

An attractive feature of the baseline analysis so far is that a large number of potentially omitted variables are differenced out via fixed effects. Nevertheless, two other significant limitations remain at this stage, driven by the potential endogeneity of market shares, as well as the misspecification of functional form of MHHIdelta. I first address reverse causality, specifically the idea that ownership changes could be driven by price changes, rather than the other way around. Second, I consider variations in how I compute $MHHIdelta$. Therefore, I perform two robustness tests to solve these two concerns: distributed-lag regressions and difference-in-differences regressions.

3.3 Panel regressions with lags and leads of MHHIdelta and HHI

If common ownership causes higher prices, but higher prices do not cause common ownership, one would expect higher prices to follow increases in common ownership, but not vice versa. To test these hypotheses against each other, I implement dynamic panel regressions that include leads and lags of MHHI deltas.

Table 6 shows the results of panel regressions with lags and leads. In the first specification, I include the region fixed effects and year fixed effects into my regression. The coefficients of MHHIdelta, the lag of MHHIdelta, and HHI are positive and statistically significant. In the second regression, I add hospital characteristic control variables in my regression. The coefficients of MHHIdelta, the lag of MHHIdelta, and HHI are still positive and statistically significant. These results indicate that there are two main effects of common ownership concentration: timely common ownership concentration effects and delayed common ownership effects (lag of MHHIdelta). In other words, my results show that common ownership concentration causes higher hospital prices, and some of these causal effects result from the timely emergence of common ownership, while the others result from delayed emergence of common ownership. However, the statistically insignificant coefficients of leads of MHHIdelta indicate that managers cannot foresee the emergence of common ownership. This conclusion is supported by the results from Table 6. Both specifications show that the coefficients of MHHIdelta and the lag of MHHIdelta are positive and statistically significant. The economic significance is also large among these coefficients. Specifically, every one percent increase in common ownership concentration results

in a 0.1 percent increase in hospital charges per discharge. To use more meaningful numbers for this context, every one standard deviation increase in MHHIdelta will result in $550 in hospital charges per discharge. The coefficients of HHI are positive and statistically significant in both specifications, but the lags and leads of HHI are not statistically significant.

The results of panel regressions with lags and leads yield two important conclusions. First, the statistically significant coefficients of lags of common ownership concentration show that common ownership concentration has delayed effects on hospital prices, helping to eliminate the suspicion of reverse causality. Second, the statistically insignificant coefficients of leads of common ownership concentration could be a good placebo test indicating that there are no effects of expectations of common ownership on hospital prices. In other words, managers will not act strategically to raise prices until the emergence of common ownership.

3.4 Difference-in-differences

3.4.1 Background on BlackRock's acquisition of Barclays Global Investors

According to Azar et al. (2018), following the financial crisis that began in 2007, Barclays tried for several months to strengthen its balance sheet. On March 16, 2009, Barclays had received a $4 billion bid by CVC Capital Partners for its iShares family of exchange-traded funds, along with an option to solicit competing offers. BlackRock announced a bid to acquire iShares' parent division Barclays Global Investors (BGI) for $13.5 billion on June 11, 2009. The bid was successful and the acquisition was formally completed in December 2009.

The history of Barclays' attempt to sell iShares to investors other than BlackRock suggests the divestment decision was not primarily driven by considerations regarding how the iShares portfolio would combine with BlackRock's in terms of potential product market effects. Moreover, health system stocks comprised only a small share of BGI's portfolio. This fact makes it unlikely that hospitals were pivotal in BlackRock's decision to acquire BGI, much less regional variation in expected hospital price changes, thus alleviating reverse causality concerns. More formally, the exclusion restriction is that the cross-sectional distribution across hospital referral regions in the implied increase in common ownership from a hypothetical, pre-merger combination of BLK and BGI's equity portfolios is uncorrelated with errors of the hospital price regression, conditional on controls.

Table 7 presents all the large acquisitions among institutional investors from 2005 to 2015. In 2009, there were two acquisitions in the financial industry, both of which involved large institutional investors: Bank of America acquired Merrill Lynch in January, and BlackRock acquired Barclays Global Investors in December. Table 8 presents the summary statistics of these institutional investors before the acquisitions. Specifically, these numbers represent the percentages that investors own in the health systems. For example, before the acquisition of Barclays Global Investors and BlackRock, Barclays owned 7.5% of total shares outstanding of UHS, and BlackRock owned 0.34% of total shares outstanding of UHS. In summary, Table 8 shows that both Bank of America and Merrill Lynch had similar top holding stocks in the hospital industry before the acquisition: LPNT, CYH and PSYS. At the same time, Bank of America held a large portion of shares in these stocks. Table 8 also shows

that both BlackRock and Barclays Global Investors had similar top holding stocks before the acquisition: LPNT, UHS, and CYH. Meanwhile, Barclays held a large portion of shares in these stocks. From the statistics, we know that both financial mergers affected ownership stakes in the hospital industry, resulting in an increase of market concentration caused by common ownership. The stock shares involved were large because either the acquiring firm or the target firm held a large portion of stock shares in these health systems.

3.4.2 Difference-in-differences design

Although panel regressions with lags and leads solve the concern of reverse causality, the designs of common ownership concentration measure also involve another endogeneity problem. Specifically, the calculation of $MHHIdelta$ includes both the market shares of health systems and the ownership stakes held by institutional investors. Regressing MHHIdelta on hospitals prices cannot reveal the "true" effect of common ownership. In order to disentangle the effect of common ownership from the effect of market shares, I introduce the difference-in-differences design.

I exploit the variation in ownership generated by BlackRock's acquisition of Barclays BGI as follows. I start by calculating the MHHI delta in the year before the acquisition was announced, 2009, for each hospital referral region. I then calculate a counterfactual MHHI delta for the same year and region, but I treat the holdings of BlackRock and Barclays as if they had already been held by a single entity. I call the difference between the latter and former MHHI delta the "implied change in MHHI delta." The null hypothesis is that the acquisition, as with any other ownership

change, had no effect on portfolio firms' product market behavior. The alternative hypothesis is that markets more affected by the acquisition – those with a higher implied change in MHHI delta – experience higher price changes compared to less affected markets.

The DiD regression is:

$$\begin{aligned} Log((Charges/discharges_{iht})) = \alpha + \beta * Post_t * Treat_h + \gamma_1 * Log(HHI)_{ht} \\ + \gamma_2 * Log(HHIstar_{ht}) + \delta_t + \lambda_H + \eta_{it} * X_{it} + \epsilon_{iht} \end{aligned} \tag{10}$$

In this regression, the outcome is hospital charges per discharge for hospital i in region h in year t. I take the log of outcome variable for two reasons: Hospital charges are usually large numerical values, and the percentage change of hospital charges is easier to interpret. The DiD term is the interaction of Post dummy variable and Treat dummy variable. The Post dummy equals to one if the year is 2009 or later and zero if it is before 2009. The Treat dummy equals to one for the top ten regions with the highest increases of implied change of MHHIdelta, and it equals to zero otherwise.

Table 9 and 10 show the summary statistics of the treated group and control group. The summary statistics show that the treated group has similar hospital characteristics compared to the control group.

The other regressors include the HHI in region h in year t, which captures the effect of traditional market concentration on hospital prices; the HHIstar in region h in year t, which captures the effect of traditional market concentration on hospital

prices when including both for-profit hospitals and non-profit hospitals; the year fixed effects, the region fixed effects, and hospital characteristic control variables. ϵ_{iht} is the error term, and I cluster standard errors at the regional levels in order to solve the potential serial correlation problem in samples.

3.4.3 Results

The results of DiD regression are presented in Table 11. In the first specification, I include the year fixed effects and region fixed effects but not a set of hospital characteristic control variables. The coefficient of $Post*Treat$ dummy is positive and statistically significant. The coefficient of HHI is positive, the coefficient of HHIstar is negative, and they are all statistically significant. The economic significance is a little larger than linear regressions. This indicates that for treated regions after the financial acquisitions in 2009, hospital charges per discharge increased by 12% compared to control regions. The second specification adds hospital characteristic controls into my DiD regression, and the results are similar to the first specification.

In summary, the results of last two specifications are reasonable and economically sizable. Specifically, applying the difference-in-differences design improves my empirical efficiency and accuracy. This method solves two stubborn endogeneity issues and provides a comprehensible causal inference: The financial acquisition of 2009 caused hospital prices for treated regions to increase by 16% compared to the control regions.

3.4.4 Event Study

In the event study, I explore the dynamic change of the effect of common ownership on hospital prices:

$$\begin{aligned} Log((Charges/discharges_{iht})) = \alpha + \sum_{t=-3}^{t=7} \beta_{DiD}^{t} * Treat_{h}^{t} + \gamma_1 * Log(HHI)_{ht} \\ + \gamma_2 * Log(HHIstar_{ht}) + \delta_t + \lambda_H + \eta_{it} * X_{it} + \epsilon_{iht} \end{aligned} \tag{11}$$

where $Treat_{h}^{t}$ is an interaction of the treatment dummy with year fixed effects; that is, it is equal to one for treated regions in period t, and zero otherwise. I drop the year of 2008, so that year serves as the base period, with the estimated β_{DiD}^{t} coefficients representing the change in the difference between treatment and control regions between 2008 and the given year.

The results are shown in Figure 1. In this figure, the x-axis shows the year relative to 2008. The y-axis shows the change in the difference between treatment and control regions between 2008 and the given year. For example, the first observation in this figure is the 2005 dummy * Treat dummy, and it captures the effect of 2005 relative to 2008 interacting with the treatment group relative to the control group on hospital prices. In the graph, the bar around the dot indicates the 95% of confidence interval. The difference between treatment and control fluctuates around zero to some extent during the pre-period; the overall trend before the acquisition is flat. The trend changes after the acquisition, and the cofficients are significantly positive for some periods after the completion of the acquisition. Thus, the sign of the effect, based on

variation in common ownership generated by the BGI acquisition is consistent with our previous results.

3.5 Comparing the coefficients among three identification strategies

So far, I have used three identification strategies: ordinary least squares linear regressions, panel regressions with leads and lags, and difference-in-differences. As I explained above, the linear regression provides a basic positive correlation between common ownership concentration and hospital prices. Further, panel regressions with leads and lags solve the reverse causality problem. Lastly, the difference-in-differences method solves the reverse causality and endogeneity problems caused by the measure of common ownership. Now, I summarize and compare the magnitudes of these coefficients of interest.

Results indicate that the signs of major coefficients are all positive for all methodologies. Moreover, the coefficients of MHHIdelta are all statistically significant. In the OLS linear regressions and distributed-lag regressions, every increase of one standard deviation of MHHIdelta results in an increase of about$550 in hospital price. In the difference-in-differences strategy, treated regions after the 2009 acquisitions experienced an increase of 12% compared to control regions, which represents about $\$10,000$.

In summary, the difference-in-differences approach uses much less variation than the panel regressions, but the estimates from this strategy are arguably less affected by endogeneity of market shares, even though both strategies solve the reverse causal-

ity problem. All three strategies show consistent results and prove the empirical validity of common ownership theory. Next, I will offer some robustness tests to further confirm my hypothesis.

3.6 Multiple exogenous shocks

Table 7 presents all financial acquisitions from the year of 2005 to 2015. In my main analysis of the difference-in-differences method, I use the two financial acquisitions of 2009 because they involve four large institutional investors, which may affect more health systems and cause larger impacts on hospital prices. However, there were five other financial acquisitions from 2006 to 2008. I use these three exogenous years to analyze the effects of market concentration caused by common ownership on hospital prices.

Empirically, I use the same design applied in my difference-in-differences methodology. The main independent variable of interest is the interaction term of two dummy variables. The first dummy variable is the $Post$ dummy, where I set it equal to one if the year is the exogenous year or after, depending on which exogenous year I use, and set it equal to zero if before the exogenous years. The other dummy variable is the $Treat$ dummy, which equals to one if the regions are in in the treated group, and zero if in the control group. I choose the regions that experienced the top ten highest increases of implied change of common ownership as my treated group, and the rest of regions as my control group. The regressions are:

$$\sum_{j=2006}^{2008} Log(Charges/discharges_{iht}) = \alpha + \beta * Post_t * Treat_h + \gamma_1 * Log(HHI)_{ht} + \gamma_2 * Log(HHIstar_{ht}) + \delta_t + \lambda_H + \eta_{it} * X_{it} + \epsilon_{iht} \quad (12)$$

In this design, there are three separate regressions by applying three different exogenous years. They are 2006, 2007, and 2008 according to the Table 7. Because of the different exogenous years, the values of $Post$ dummy and $Treat$ dummy are different in every regression.

Table 12 shows the results of these exogenous shocks. Using financial acquisitions in 2006 as the exogenous shock, the coefficient of $Post * Treat$ is positive and statistically significant at the 5 percent level. The economic significance is also large. This indicates that after the financial acquisitions in 2006, the hospitals charges per discharge increased by 9% in treated regions compared to control regions. The coefficient of HHI is positive and statistically significant. Using financial acquisitions in 2007 as the exogenous shock, the coefficient of $Post * Treat$ is positive but becomes statistically insignificant. The coefficient of HHI is still positive and statistically significant. Using financial acquisitions in 2008 as the exogenous shock, the coefficient of $Post * Treat$ is positive and becomes statistically significant again. This indicates that after the financial acquisitions in 2008, hospital charges per discharge increased by 20% in treated regions compared to control regions. The coefficient of HHI is still positive and statistically significant.

From Table 12, results show that the exogenous years of 2008 and 2006 have

significant impacts of common ownership concentration on hospital prices while the exogenous year of 2007 does not. Table 13 could explain this result. From the table, the total stock shares involved by acquisitions are huge for 2008 and 2009, and relatively smaller for 2006 and 2007. Especially for 2007, total stock shares involved by the acquiring firm is especially small, which indicates that the change of market concentration caused by common ownership for treated regions is very small. Therefore, the coefficient of $Post * Treat$ is statistically insignificant when using the financial acquisitions in 2007 as the exogenous shock. In summary, when applying these exogenous shocks, there are two important factors. First, the total stock shares involved by financial acquisitions must be large. Secondly, the total stock shares involved by both acquiring firms and target firms should not be too small. By satisfying these two factors, the change in market concentration caused by common ownership can be captured by the difference-in-differences methodology.

In these difference-in-differences regressions, my non-tabulated results also show that the hospital characteristics are similar for the treated group and control group in each of these regressions.

3.6.1 Robustness check

In addition to using hospital discharges, I also try some other measures to represent the scale of hospitals, such as the number of beds, total payroll expenses, total inpatient days, the number of full time personnel, and total admissions. Table 15 shows the results of replacing these measures in my difference-in-differences method.

From the table, all five specifications indicate similar results. The coefficients of

$Post * Treat$ are all positive and statistically significant. The economic significance is large as well. No matter what measures of hospital size I apply, they indicate that after the financial acquisitions of 2009, there was approximately a 15% increase in hospital charges for treated regions compared to control regions. The coefficients of HHI are still not statistically significant. In summary, my difference-in-differences analysis is robust when using different measures of hospital sizes.

3.6.2 Falsification tests

After the financial acquisitions of 2009, some hospital referral regions experienced declines of $MHHIdelta$, which means that these regions have lower market concentration caused by the common ownership after 2009; some hospital referral regions retained the same MHHI before and after the exogenous financial shocks in 2009. Therefore, I propose two false hypothesis and test their validity.

The first false hypothesis is that the lower market concentration caused by common ownership would result in higher hospital prices. The empirical method is to change the treated group in my main difference-in-differences analysis by selecting bottom ten regions which experienced lowest increases of the implied change of common ownership from 2008 to 2009, while other settings remain the same. Therefore, the null hypothesis is still $\beta = 0$, but I expect to see statistically insignificant coefficients of DiD dummy and thus not reject my null hypothesis.

Results are presented in the left panel of Table 16. In the first specification, the coefficient of $Post * Treat$ is not statistically significant, so I cannot reject the null hypothesis. It further indicates that after financial acquisitions in 2009, for regions

experiencing bottom changes of implied changes of common ownership, there were no impacts on hospital prices for treated regions compared to control regions. I also test this false hypothesis by using the other three exogenous years and find consistent results. The coefficients of HHI are all positive and not statistically significant.

My second false hypothesis is that the unchanged market concentration caused by common ownership would result in higher hospital prices. The empirical method is to change the treated group in my main difference-in-differences analysis by selecting the middle ten regions that experienced the middle increases of implied change of common ownership from 2008 to 2009, while other settings remain the same. Therefore, the null hypothesis is still $\beta = 0$, but I expect to see statistically insignificant coefficients of DiD dummy and thus do not reject my null hypothesis.

Results of my second false hypothesis test are presented in the right panel of Table 16. In the first specification, the coefficient of $Post * Treat$ is not statistically significant. This indicates that after the financial acquisitions of 2009, for regions that experienced middle increases of implied changes of common ownership, there were no impacts on hospital prices for treated regions compared to control regions. I test this second false hypothesis by using the other three exogenous years and find consistent results. The coefficients of HHI are all positive and not statistically significant.

3.6.3 Other interesting outcomes

It is also worth studying the effects of common ownership concentration on different types of for-profit hospitals. In this section, I include four pairs of different types

of hospitals to study the effects of common ownership concentration on their pricing behaviors: 1) whether common ownership concentration affects urban hospitals' prices compared to rural hospitals', 2) whether common ownership concentration affects teaching hospitals' prices compared to non-teaching hospitals', 3) whether common ownership concentration affects larger hospitals' prices compared to small hospitals, I define large hospitals as having more than 100 beds and small hospitals as having less than 100 beds, and 4) whether the common ownership concentration affects critical access hospitals' prices (CAH) compared to non-CAH hospitals'. These four indicators are all dummy variables. Table 17 shows the results.

In the first panel of this table, results show that the common ownership concentration has a positive and statistically significant effects on rural hospitals. The economic significance is large. Specifically, it indicates that after the financial acquisitions in 2009, rural hospitals' prices increased by 19% for treated regions compared to control regions. The coefficient of HHI is also positive and statistically significant. However, the coefficient of $Post * Treat*$ is positive but not statistically significant. The coefficient of HHI is also not statistically significant. On the other hand, I find no impacts of common ownership concentration on urban hospitals' prices.

The second panel of this table shows that the common ownership concentration has positive and statistically significant impacts on both teaching hospitals' prices and non-teaching hospitals' prices. The economic significance is also large. This indicates that after the financial acquisitions in 2009, prices rose by about 16% for both teaching hospitals and non-teaching hospitals in treated regions compared to control regions. The third panel shows that the common ownership concentration has

positive and statistically significant impacts on large hospitals but positive and not statistically significant impacts on small hospitals. The fourth panel shows that the common ownership concentration has positive and statistically significant impacts on non-CAH hospitals but no impacts on CAH hospitals.

In general, most coefficients show that market concentration caused by common ownership results in higher hospital prices. Although some coefficients are not statistically significant, the signs are all positive. The only exception is the coefficient for CAH hospitals. One reason may be that the unit of observations is very small, which can lead to unexpected results. These interesting outcomes further confirm the positive effects of common ownership on hospital prices, and suggests further research into how common ownership concentration affects hospital behaviors depending on different hospital characteristics.

4 Conclusion

In this paper, I test the common ownership theory raised by Backus et al. (2018) and Azar (2011) and further confirm the validity of this theory. Most importantly, I test this theory in an empirical way in the hospital industry, which is novel and contributes to the broad literature in both the field of common ownership and the field of market competition in the hospital industry. My results show that common ownership concentration causes higher hospital prices. Specifically, I use OLS linear regressions to find a positive relationship between common ownership concentration and hospital prices. However, two limitations of this method require me

to apply better empirical designs: the question of reverse causality, and the fact that the measure of common ownership involves market shares. Then, I run the panel regressions with lags and leads and find that the lags of common ownership concentration have significant impacts on hospital prices, but the leads of common ownership concentration do not. This indicates that common ownership concentration has both timely and delayed impacts on hospital prices, but hospital managers cannot foresee the common ownership benefits to take precautionary actions. Thus, panel regressions solve the reserve causality issue but the second limitation remains. Later, I use the difference-in-differences strategy and this design takes care of both limitations. I use the financial acquisitions of 2009 as the exogenous shock and I find both statistically significant and economically significant results by running the DiD regressions. Specifically, I find that after the financial acquisitions in 2009, hospital prices increased by 12% in treated regions compared to control regions. In order to corroborate my results, I run difference-in-differences regressions using three other exogenous shocks in 2006, 2007 and 2008 and find consistent results when large stock shares are involved in financial acquisitions. I also find robust results when I measure hospital size by hospital characteristics other than hospital total discharges. The falsification tests of common ownership theory also passed in my analysis. Last but not least, I find some interesting and consistent results when I compare rural versus urban hospitals, teaching hospitals versus non-teaching hospitals, large hospitals versus small hospitals, and CAH hospitals versus non-CAH hospitals.

The findings in this paper are novel in both common ownership literature and hospital competition literature. Anti-competitive conduct at the institutional in-

vestor's level is underway in the hospital industry, but this paper finds common ownership concentration effects on hospital prices, while the mechanism of this behavioral change is not tested here. This paper encourages me to study how common owners influence hospital managers to increase hospital prices; for example, hospitals may convert to profitable service lines under the emergence of common ownership.

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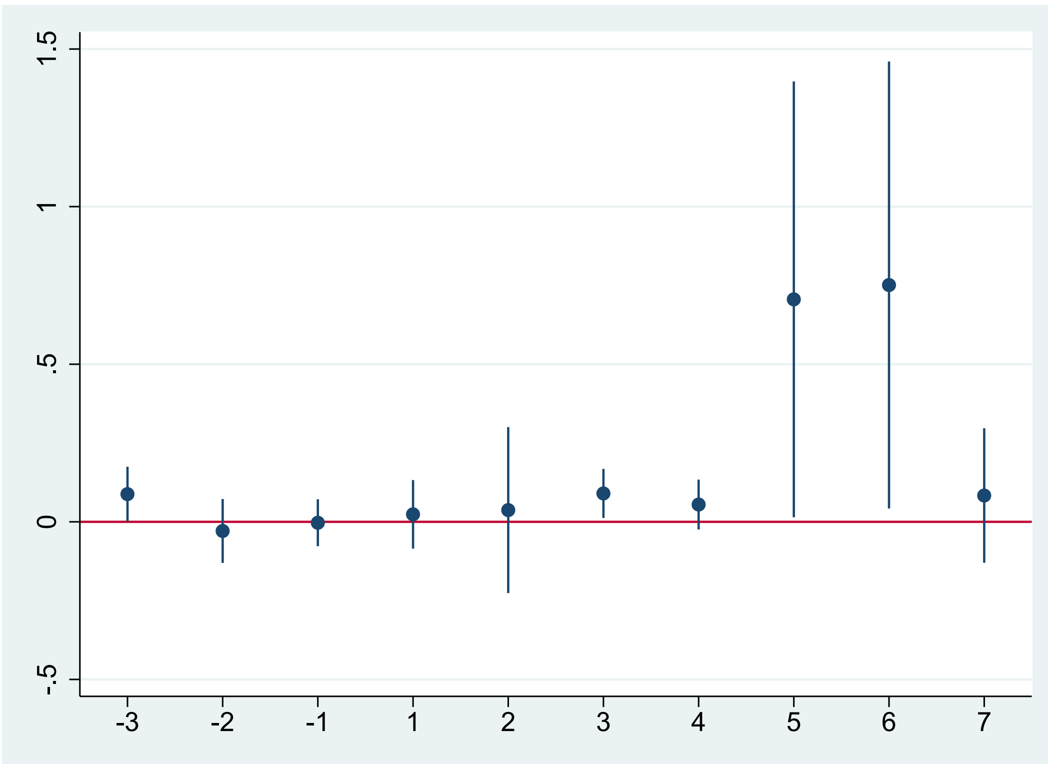
Universal Health Services to Acquire Psychiatric Solutions for $3.1 Billion in Cash. (2010, May 17).

Figure 1: Event Study



The X-axis is from year of 2005 to 2015, and the Y-axis shows the hospital charges per discharge. The solid line is the trend for treated regions, and the dash line is the trend for control regions. The vertical reference line is the year of 2009, when the exogenous shock happens.

Table 1: Summary statistics 1

Community Health Systems (CYH)	[%]	Health South Corp. (HLS)	[%]	Kindred Healthcare (KND)	[%]
Franklin Resources Inc.	11.63	Fidelity MGMT	9.25	BlackRock Inc.	8.56
T. Rowe Price Associates Inc.	9.54	T. Rowe Price Associates Inc.	8.91	Dimensional Fund Advisors	8.30
Bamco Inc.	8.66	BlackRock Inc.	5.18	Fidelity MGMT & Wellington MGMT Co.	6.53
TPG-AXON Capital MGMT, L.P.	4.97	Amvescap PLC	4.76	Columbia MGMT Inv. Advisors	5.69
BlackRock Inc.	4.74	Vanguard Group Inc.	4.73	Vanguard Group Inc.	4.22
Vanguard Group Inc.	4.04	Osterweis Capital MGMT Inc.	3.56	Acadian Asset MGMT	3.90

Universal Health Service (UHS)	[%]	Selected Medical (SEM)	[%]	Tenet Healthcare (THC)	[%]
Wellington MGMT Co.	8.05	Amvescap PLC	2.97	Franklin Resources Inc.	10.47
BlackRock Inc.	4.92	T. Rowe Price Associates Inc.	2.91	Fidelity MGMT	8.30
Fidelity MGMT	4.30	Adage Capital MGMT	1.36	Vanguard Group Inc.	5.65
Vanguard Group Inc.	3.76	Vanguard Group Inc.	1.35	BlackRock Inc.	4.02
Viking Global Investors	3.46	Omega Advisors	1.10	Oracle Investment MGMT	3.27
Sirios Capital MGMT	3.29	BlackRock Inc.	1.05	State Street Corp.	3.27

Notes: This table shows the largest six stock shareholders of each public traded health care system in the fourth quarter of 2010.

Table 2: Summary statistics 2

Adage Capital MGMT	[%]	BlackRock Inc.	[%]	Fidelity MGMT	[%]
THC	58.6	THC	27.1	THC	13.7
SEM	19.4	SEM	9.0	CYH	2.6
HLS	11.2	CYH	5.2	HLS	2.6
UHS	10.8	HLS	5.1	UHS	2.5

T. ROWE PRICE ASSOCIATES, INC.	[%]	Vanguard Group Inc.	[%]
THC	10.8	THC	8.9
SEM	3.6	SEM	3.0
CYH	2.1	CYH	1.6
HLS	2.1	HLS	1.6

Notes: This table shows the investment distributions of five large institutional investors in the hospital industry in the fourth quarter of 2010.

Table 3: Intuitive example of common ownership

	MHHI	HHI	MHHI delta
formula	$\sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}}$	$\sum_j s_j^2$	$\sum_j \sum_{k \neq j} s_j s_k \frac{\gamma_{ij}\beta_{ik}}{\gamma_{ij}\beta_{ij}}$
scenario 1: 1 firm	10,000	10,000	0
scenario 2: 2 firms with independent owners	5,000	5,000	0
scenario 3: 2 owners swap 50% of their ownerships	10,000	5,000	5,000

Table 4: Summary statistics of all variables

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
charges	17,699	4.168e+08	6.645e+08	2.390e+06	7.765e+09
discharges	17,699	5,910	8,394	1	82,036
charges/discharges	17,699	100,244	378,848	6,394	5.985e+06
MHHIdelta	17,699	5,894	2,460	1	8,555
Log(MHHIdelta)	17,699	8.327	1.569	0	9.054
HHI	17,699	2,804	1,762	1,232	10,000
Log(HHI)	17,699	7.800	0.493	7.116	9.210
HHIstar	17,699	1,332	744.9	471.8	7,909
Log(HHIstar)	17,699	7.054	0.534	6.157	8.976
number of beds	17,699	149.5	122.8	7	1,492
operating expenses	17,699	8.668e+07	1.210e+08	1.634e+06	1.178e+09
urban hospital dummy	17,699	0.826	0.379	0	1
teaching hospital dummy	17,699	0.106	0.308	0	1
critical access hospital dummy	17,699	0.0253	0.157	0	1
admissions	17,699	6,061	8,219	20	79,612
total inpatient days	17,699	33,907	40,180	47	428,809
inpatient surgical operations	17,699	1,679	3,106	0	32,283
outpatient surgical operations	17,699	2,447	3,636	0	39,418
total surgical operations	17,699	4,126	6,518	0	71,477
total payroll expenses	17,699	2.942e+07	3.928e+07	785,319	4.355e+08
full-time personnel	17,699	467.7	601.3	21	5,899
part-time personnel	17,699	119.7	144.4	0	1,800

Notes: The number of observations is at the hospital-HRR(region)-year level. My sample years are from 2005 to 2015. e+08=10,000,000, so 6.07e+08=607,000,000.

Table 5: Linear regressions

Dependent variable: hospital charges per discharge		
VARIABLES	(1)	(2)
MHHIdt	0.10***	0.10***
	(0.03)	(0.03)
hhi	0.34***	0.36***
	(0.05)	(0.05)
hhistar	-0.24***	-0.25***
	(0.04)	(0.04)
beds		0.00***
		(0.00)
urban		0.15***
		(0.02)
teach		-0.01
		(0.02)
cah		0.14***
		(0.03)
suroptot		0.00***
		(0.00)
ipdtot		-0.00***
		(0.00)
paytot		0.00***
		(0.00)
fttot		0.00
		(0.00)
pttot		-0.00
		(0.00)
vtot		-0.00***
		(0.00)
ratio		0.00
		(0.00)
Year fixed effects	✓	✓
Region fixed effects	✓	✓
Observations	17,699	17,699
R-squared	0.19	0.24

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Linear regressions with leads and lags

Dependent variable: hospital charges per discharge		
VARIABLES	(1)	(2)
MHHIdt - lead	0.05	0.06
	(0.05)	(0.05)
MHHIdt	0.11**	0.09*
	(0.05)	(0.05)
MHHIdt - lag	0.05**	0.04*
	(0.02)	(0.02)
HHI - lead	0.03	0.09
	(0.12)	(0.12)
HHI	0.39**	0.37**
	(0.16)	(0.16)
HHI - lag	-0.04	-0.04
	(0.07)	(0.07)
HHIstar	-0.29**	-0.31**
	(0.13)	(0.13)
beds		0.00
		(0.00)
urban		0.14
		(0.10)
teach		-0.06
		(0.07)
cah		0.14
		(0.10)
suroptot		0.00**
		(0.00)
ipdtot		-0.00***
		(0.00)
paytot		0.00***
		(0.00)
fttot		0.00
		(0.00)
pttot		-0.00
		(0.00)
vtot		-0.00**
		(0.00)
ratio		0.00*
		(0.00)
Year fixed effects	✓	✓
Region fixed effects	✓	✓
Observations	2,047	2,047
R-squared	0.28	0.31

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Exogenous shocks

Acquiring firm	Target firm	Effective date
J.P. Morgan Chase & Co.	BNY-Consumer Business	10/2/2006
Morgan Stanley Group Inc.	FrontPoint Partners, L.L.C.	12/4/2006
Bank of NY Trust Co.	Mellon Bank	7/2/2007
Barclays Bank PLC	Lehman Brothers Inc.	9/22/2008
RiverSource Investments	J. & W. Seligman & Co., Inc.	11/7/2008
Bank of America Corporation	Merrill Lynch & Co Inc.	1/1/2009
BlackRock Inc.	Barclays Global Investors	12/1/2009

Table 8: Summary statistics of acquired investors before acquisitions

Bank of American Corp.	[%]	Merrill Lynch & Co. Inc.	[%]
LPNT	4.87	PSYS	0.69
KND	3.71	CYH	0.59
CYH	1.72	LPNT	0.30
PSYS	1.71	THC	0.13
BlackRock	[%]	Barclays Global Investors	[%]
KND	1.10	UHS	7.52
LPNT	0.85	PSYS	6.47
UHS	0.34	LPNT	5.35
CYH	0.11	CYH	5.03

Notes: The statistics in the table above were on 2008, which were before the acquisitions happened. The table shows the top four holding stocks of the four institutional investors involving in the acquisitions on 2009.

Table 9: Summary statistics of hospital characteristics for treated group

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
beds	1,372	144.7	85.32	25	568
op_exp	1,372	9.036e+07	1.013e+08	4.940e+06	5.751e+08
urban	1,372	0.856	0.351	0	1
teach	1,372	0.125	0.331	0	1
cah	1,372	0.0295	0.169	0	1
hospbd	1,372	146.5	123.2	0	668
obhos	1,372	0.368	0.483	0	1
obsys	1,372	0.152	0.359	0	1
rehabhos	1,372	0.281	0.450	0	1
rehabsys	1,372	0.0719	0.258	0	1
pethos	1,372	0.0817	0.274	0	1
petsys	1,372	0.0659	0.248	0	1
ultsnhos	1,372	0.467	0.499	0	1
ultsnsys	1,372	0.0522	0.222	0	1
admtot	1,372	6,144	6,537	179	36,389
ipdtot	1,372	33,947	32,213	1,878	198,167
births	1,372	609.4	1,021	0	6,617
suropip	1,372	1,593	2,374	0	15,548
suropop	1,372	2,317	3,033	0	25,304
suroptot	1,372	3,910	5,182	0	36,804
paytot	1,372	2.956e+07	3.380e+07	1.387e+06	2.233e+08
fttot	1,372	470.4	470.2	42	2,609
pttot	1,372	122.5	137.3	0	1,118
n_f_ratio	1,372	5.301	0.477	4.647	6.333

Table 10: Summary statistics of hospital characteristics for control group

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
beds	2,118	132.0	116.8	7	1,492
op_exp	2,118	7.447e+07	1.109e+08	1.634e+06	1.178e+09
urban	2,118	0.798	0.401	0	1
teach	2,118	0.103	0.305	0	1
cah	2,118	0.0219	0.147	0	1
hospbd	2,118	134.6	150.6	0	1,604
obhos	2,118	0.293	0.455	0	1
obsys	2,118	0.152	0.359	0	1
rehabhos	2,118	0.247	0.432	0	1
rehabsys	2,118	0.0613	0.240	0	1
pethos	2,118	0.0495	0.217	0	1
petsys	2,118	0.0418	0.200	0	1
ultsnhos	2,118	0.403	0.491	0	1
ultsnsys	2,118	0.0446	0.206	0	1
admtot	2,118	5,065	7,477	20	79,612
ipdtot	2,118	29,552	37,270	47	428,809
births	2,118	559.7	1,275	0	11,324
suropip	2,118	1,405	2,812	0	32,283
suropop	2,118	2,297	3,579	0	39,418
suroptot	2,118	3,702	6,157	0	71,477
paytot	2,118	2.618e+07	3.598e+07	785,319	4.355e+08
fttot	2,118	411.6	550.5	21	5,899
pttot	2,118	123.5	143.6	0	1,800
n_f_ratio	2,118	5.336	0.472	4.647	6.333

Table 11: Difference-in-differences regressions

Dependent variable: hospital charges per discharge		
VARIABLES	(1)	(2)
Post*Treat	0.12***	0.12***
	(0.02)	(0.02)
HHI	0.27***	0.30***
	(0.05)	(0.04)
HHIstar	-0.25***	-0.27***
	(0.04)	(0.04)
beds		0.00***
		(0.00)
urban		0.16***
		(0.02)
teach		-0.02
		(0.02)
cah		0.14***
		(0.03)
suroptot		0.00***
		(0.00)
ipdtot		-0.00***
		(0.00)
paytot		0.00***
		(0.00)
fttot		0.00
		(0.00)
pttot		-0.00**
		(0.00)
ratio		0.00
		(0.00)
Year fixed effects	✓	✓
Region fixed effects	✓	✓
Observations	17,699	17,699
R-squared	0.20	0.24

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Multiple exogenous shocks

Dependent variable: hospital charges per discharge			
Exogenous year	2006	2007	2008
$Post * Treat$	0.09**	0.13	0.20***
	(0.04)	(0.03)	(0.03)
HHI	0.30***	0.29**	0.27***
	(0.04)	(0.04)	(0.04)
HHIstar	-0.25***	-0.23**	-0.18***
	(0.04)	(0.04)	(0.04)
beds	0.00	0.00*	0.00*
	(0.00)	(0.00)	(0.00)
urban	0.15**	0.11	0.11
	(0.08)	(0.08)	(0.08)
teach	-0.10*	-0.04	-0.04
	(0.06)	(0.06)	(0.06)
cah	0.01	0.13	0.13
	(0.08)	(0.08)	(0.08)
suroptot	0.00**	0.00***	0.00***
	(0.00)	(0.00)	(0.00)
ipdtot	-0.00**	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)
paytot	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)
fttot	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
pttot	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
ratio	-0.59***		
	(0.05)		
Year fixed effects	✓	✓	✓
Region fixed effects	✓	✓	✓
Observations	17,699	17,699	17,699
R-squared	0.24	0.25	0.25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Total stock shares involved by institutional acquisitions

Exogenous year	2009	2008	2007	2006
Total stock shares involved by acquisitions	50,700,000	41,000,000	18,758,000	11,800,000
Total stock shares involved by acquiring firm	10,300,000	38,400,000	2,700	10,700,000

Notes: The units of these numbers are dollars.

Table 14: Exogenous shocks

Acquiring firm	Target firm	Effective date
J.P. Morgan Chase & Co.	BNY-Consumer Business	10/2/2006
Morgan Stanley Group Inc.	FrontPoint Partners, L.L.C.	12/4/2006
Bank of NY Trust Co.	Mellon Bank	7/2/2007
Barclays Bank PLC	Lehman Brothers Inc.	9/22/2008
RiverSource Investments	J. & W. Seligman & Co., Inc.	11/7/2008
Bank of America Corporation	Merrill Lynch & Co Inc.	1/1/2009
BlackRock Inc.	Barclays Global Investors	12/1/2009

Notes: I simply copy the table 7 here in order to better interpret the table 13.

Table 15: Robustness check with similar outcomes

	Outcome variable: Hospital charges / X				
X	number of beds	total payroll expenses	total inpatient days	the number of full time personnel	total admissions
$Post * Treat$	0.12**	0.14***	0.20***	0.15***	0.17***
	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
HHI	0.09	0.07	0.12	0.07	0.10
	(0.08)	(0.06)	(0.08)	(0.06)	(0.08)
HHIstar	-0.20	-0.12	-0.08	-0.23	-0.13
	(0.17)	(0.11)	(0.14)	(0.15)	(0.11)
urban	0.06	-0.08*	-0.28***	0.08	0.17**
	(0.09)	(0.05)	(0.08)	(0.05)	(0.07)
teach	0.18**	0.10*	0.11	0.04	-0.04
	(0.09)	(0.06)	(0.08)	(0.07)	(0.07)
cah	-1.09***	-0.37***	0.21	-0.39***	-0.03
	(0.23)	(0.12)	(0.19)	(0.12)	(0.18)
obhos	0.50***	0.16***	0.28***	0.19***	-0.08
	(0.09)	(0.05)	(0.08)	(0.06)	(0.06)
rehabhos	-0.30***	-0.28***	-0.44***	-0.31***	-0.30***
	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
ultsnhos	0.33***	0.29***	0.58***	0.34***	0.31***
	(0.07)	(0.05)	(0.08)	(0.05)	(0.07)
births	-0.00*	-0.00**	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
suroptot	0.00	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ipdtot	-0.00*	-0.00		-0.00**	-0.00***
	(0.00)	(0.00)		(0.00)	(0.00)
paytot	0.00***		0.00***	0.00***	0.00***
	(0.00)		(0.00)	(0.00)	(0.00)
fttot	-0.00	-0.00	-0.00***		-0.00
	(0.00)	(0.00)	(0.00)		(0.00)
pttot	0.00	-0.00**	-0.00*	-0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ratio	-0.27***	-0.21***	-0.31***	-0.30***	-0.30***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
beds		0.00***	0.00***	0.00***	0.00***
		(0.00)	(0.00)	(0.00)	(0.00)
Year fixed effects	✓	✓	✓	✓	✓
Region Fixed effects	✓	✓	✓	✓	✓
Observations	17,699	17,699	17,699	17,699	17,699
R-squared	0.63	0.54	0.59	0.55	0.31

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Falsification tests

False hypothesis	(1)				(2)			
Exogenous years	2009	2008	2007	2006	2009	2008	2007	2006
$Post * Treat$	0.00	-0.00	-0.07	-0.04	-0.04	0.02	-0.01	-0.04
	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)	(0.04)	(0.04)
HHI	0.12	0.12	0.13	0.13	0.12	0.12	0.12	0.13
	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
HHIstar	-0.13	-0.21	-0.08	-0.14	-0.12	-0.07	-0.21	-0.14
	(0.14)	(0.11)	(0.13)	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)
beds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
urban	0.15**	0.15**	0.15**	0.15**	0.15**	0.15**	0.15**	0.15**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
teach	-0.10*	-0.10*	-0.10*	-0.10*	-0.10*	-0.10*	-0.10*	-0.10*
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
cah	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
obhos	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
rehabhos	-0.35***	-0.35***	-0.35***	-0.35***	-0.35***	-0.35***	-0.35***	-0.35***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
ultsnhos	0.26***	0.26***	0.26***	0.26***	0.26***	0.26***	0.26***	0.26***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
births	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
suroptot	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ipdtot	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
paytot	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
fttot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
pttot	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ratio	-0.48***	-0.48***	-0.64***	-0.48***	-0.49***	-0.47***	-0.63***	-0.64***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Region Fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Observations	3,887	3,887	3,887	3,887	3,887	3,887	3,887	3,887
R-squared	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: * means statistically significant at 10 percent level.

Table 17: Other interesting outcomes

	(1)		(2)		(3)		(4)	
Outcomes	Urban	Rural	Teach	Non-teach	Large	Small	CAH	non-CAH
$Post * Treat$	0.06	0.19***	0.17*	0.16**	0.14**	0.16	-0.08	0.17***
	(0.06)	(0.07)	(0.09)	(0.06)	(0.07)	(0.10)	(0.14)	(0.06)
HHI	-0.17	0.23*	0.01	0.17	0.19	0.13	-0.18	0.16
	(0.09)	(0.13)	(0.19)	(0.13)	(0.16)	(0.17)	(0.27)	(0.11)
HHIstar	-0.14	-0.23	-0.05	-0.16	-0.11	-0.07	-0.20	-0.14
	(0.10)	(0.10)	(0.13)	(0.12)	(0.13)	(0.11)	(0.12)	(0.11)
beds	0.00	0.00	0.00	0.00			0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)			(0.00)	(0.00)
urban			-0.31*	0.16**	-0.04	0.23*	0.20	0.15*
			(0.16)	(0.08)	(0.09)	(0.13)	(0.17)	(0.08)
teach	-0.01	-0.08			-0.03	0.10		-0.10*
	(0.06)	(0.06)			(0.05)	(0.27)		(0.06)
cah	0.13*	-0.04		0.02	0.18	-0.02		
	(0.07)	(0.16)		(0.09)	(0.13)	(0.12)		
obhos	-0.06	-0.12**	-0.09	-0.10	-0.14**	-0.07	-0.55***	-0.09*
	(0.06)	(0.06)	(0.08)	(0.06)	(0.06)	(0.09)	(0.15)	(0.05)
rehabhos	-0.13**	-0.36***	-0.13**	-0.37***	-0.12**	-0.51***	-0.22	-0.35***
	(0.07)	(0.06)	(0.06)	(0.05)	(0.05)	(0.07)	(0.24)	(0.05)
ultsnhos	0.09	0.27***	0.16*	0.26***	0.31***	0.11*	0.37**	0.26***
	(0.07)	(0.06)	(0.08)	(0.06)	(0.07)	(0.07)	(0.15)	(0.05)
births	0.00	-0.00*	-0.00	-0.00**	-0.00	-0.00	0.00	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
suroptot	0.00	0.00*	0.00	0.00**	0.00	0.00	-0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ipdtot	-0.00	-0.00**	-0.00	-0.00**	-0.00	-0.00	-0.00	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
paytot	0.00	0.00***	0.00	0.00***	0.00	0.00***	-0.00*	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
fttot	-0.00	0.00	0.00	0.00	0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
pttot	0.00	-0.00**	-0.00	-0.00	0.00	-0.00*	-0.00**	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ratio	-0.43***	-0.43***	-0.38***	-0.19**	-0.33***	-0.14*	-1.25***	-0.20***
	(0.06)	(0.05)	(0.11)	(0.08)	(0.11)	(0.08)	(0.14)	(0.08)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Region Fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Observations	725	3,162	424	3,463	1,859	2,028	93	3,794
R-squared	0.81	0.37	0.73	0.36	0.41	0.45	0.90	0.36

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1