# Hospital financial health and clinical choices: evidence from the financial crisis*

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**Abstract**

Financial constraints can cause firms to reduce product quality when quality is difficult to observe. We test this hypothesis in the context of medical choices at hospitals. Using heart attacks and child deliveries, we ask whether hospitals shift towards more profitable treatment options after a financial shock—the 2008 financial crisis. The crisis was followed by an unprecedented drop in hospital investments, yet the aggregate trends show no discrete shifts in treatment intensity post 2008. For cardiac treatment (but not for child deliveries), we find evidence that hospitals with larger financial losses during the financial crisis subsequently increased their use of intensive treatments relative to hospitals with smaller losses, consistent with the effects of financing constraints.

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# 1 Introduction

The question of how financing affects real choices has been central in corporate finance research. When external financing is costly, a firm experiencing a financial shortfall might resort to actions that boost its current (at the expense of future) cash flow (Fazzari, Hubbard and Petersen (1988)). Though most literature focuses on the consequences of financial frictions for capital investments, the same mechanisms can also affect product quality choice, pricing, output, or worker safety. A number of studies test related hypotheses in the context of public (mostly manufacturing and retail) firms and find evidence that financing constraints cause lower quality output and other adverse outcomes (Rose (1990), Maksimovic and Titman (1991), Phillips (1995), Chevalier (1995), Chevalier and Scharfstein (1996), Matsa (2011), Benmelech, Bergman, Seru (2011), Cohn and Wardlaw (2016)).

This paper focuses on the healthcare sector. Healthcare has become at least as large as manufacturing in terms of employment, but the sector has been largely ignored in corporate finance research.[1] The paper asks how a hospital's financial health affects the medical choices of its associated physicians. Based on studies in health economics, the more intensive treatment choices (such as heart surgery vs. drug-based therapy) are in many settings more profitable to healthcare providers. We test whether endowment losses associated with the 2008 financial crisis caused a shift towards more intensive (and profitable) treatment of patients in the context of heart attacks and child delivery.

We find that the large negative financial shock was followed by a discrete drop in capital investments, yet the aggregate trends show no significant shifts in clinical choices in either of the two settings we examine. In the case of cardiac treatment, however, the aggregate trend masks an interesting heterogeneity. Hospitals vary greatly in their use of intensive cardiac treatments, and during our sample period of 2005-2011, hospitals on either end of the intensity spectrum exhibit a steady convergence to the "industry norm". Controlling for this mean reversion, we find that hospitals that were hit harder by the 2008 financial crisis subsequently increased treatment intensity relative to hospitals that fared better in 2008. We do not find similar effects for C-sections. We also explore the role of hospital-physician arrangements in the transmission of the shock. We find that hospitals reporting tighter integration with physicians (via employment) experienced a larger overall increase in

[1] Healthcare and social services are projected to make up 13.6% of total employment in 2024 while the estimate for manufacturing is 7.1% (Bureau of Labor Statistics, (https://www.bls.gov/emp/ep_table_201.htm)). Recent corporate finance studies investigate hospital investment (Adelino, Lewellen, and Sundaram (2015)) and the strategic use of debt in hospitals' negotiations with insurers (Towner (2019)). See an overview of institutional details in Towner (2015). A related literature investigates the performance, payouts, allocation, and optimal size of university endowments (Lerner, Schoar, and Wang (2008), Brown et al. (2014), Goetzmann and Oster (2012), Gilbert and Hrdlicka (2015)).

catheterization rates post 2008 (however, the less integrated hospitals responded similarly to the magnitude of the endowment shock). Overall, our results suggest that medical treatment choices in nonprofit hospitals are not immune to the effects of financing constraints though the effects are limited to specific clinical settings and hospital types.

From a theoretical standpoint, it is unclear to what extent financial shocks to hospitals should affect the quality of medical choices. On the one hand, the key ingredient of models such as Maksimovic and Titman (1991) – the difficulty for customers to observe quality – is a first order concern in the healthcare setting, creating a potential for quality skimping. On the other hand, hospital organizational structure, particularly the nonprofit form, may counteract these incentives. In fact, many authors argue that nonprofits evolved precisely to address information asymmetry problems in the product markets (Arrow (1963), Easley and O'Hara (1983), Glaeser and Shleifer (2001)). This effect is likely reinforced in the hospital setting, where the key choices that determine quality are made by physicians and the extent to which hospital administrators can influence those choices – either directly or through incentive systems – is likely more limited than in other sectors.[2]

We focus on two clinical choices that have been widely researched in health economics: the choice of the intensive vs. drug-based treatment of heart attack (Acute Myocardial Infarction or AMI) patients, and the choice of the Cesarean section (C-section) vs. vaginal birth as a mode of child delivery. Child delivery and heart disease are the two most frequent diagnostic categories, together accounting for 24% of all hospital discharges in 2007 according to the National Hospital Discharge Survey. In addition, detailed data on the medical condition of patients allows us to control for many clinical reasons for the intensive treatment choice and thus focus on the use of these procedures that appear more discretionary. Another advantage of the two settings we analyze is that there is less concern over trends towards outpatient care over time, which would otherwise be missing from our dataset.

The main challenge is to identify a significant shock to hospitals' financial health. Our strategy is to use the financial crisis in 2008 as the source of such a shock, and to measure its magnitude using the hospital's return on financial assets in 2008. Most nonprofit hospitals hold large financial assets, such as endowments, and they rely on cash flows from these investments to finance operations and capital expenditures. Moreover, most nonprofit hospitals' spending rules tie the funds available for

[2] Anecdotal evidence suggests that such influence might be significant. In a recent Wall Street Journal (WSJ) article examining discharge patterns, former hospital employees state that "their corporate bosses exerted pressure to discharge as often as possible during the most lucrative days…" (Hospital Discharges Rise at Lucrative Times" by C. Weaver, A. Wilde Mathews, and T. McGinty, WSJ, 2/17/2015).

spending directly to the recent performance of their endowments. The stock market crash in 2008 caused a sharp drop in the value of financial assets, and thus directly affected the hospitals' financial health. The collapse of the credit market following the crash also meant that for many hospitals it was difficult to raise debt to cover financial shortfalls. Consistent with the large magnitude of the shock, we find that immediately following the crisis, hospitals experienced significant and sudden declines in capital investments (see also evidence in Adelino, Lewellen and Sundaram (2015), Dranove, Garthwaite, and Ody (2017), and, in the context of universities, Brown et al. (2014)).

In spite of the unprecedented shock to hospitals' financial condition, we find that the aggregate trends in the intensive treatment choices reveal no significant shifts around 2008 in either of the two settings we examine. In the case of the heart attack patients, catheterization rates increase somewhat during our sample period (from 52% in 2005 to 53% 2011), and hospitals on either end of the intensity spectrum show a steady convergence to the industry norm. When we control for this convergence, we find that hospitals with worse financial performance during the crisis subsequently increase their catheterization rates relative to hospitals with better performance. The effect is statistically and economically significant: a one standard deviation increase in the 2008 financial return is associated with a 0.8 percentage points decline in catheterization rates (or 2.3 percentage points when you move from the bottom to the top tercile of returns). Splitting hospitals into sub-samples based on their initial intensity levels shows that low-intensity hospitals that performed poorly during the crisis accelerated their shift towards the more profitable treatments post 2008 relative to the better performing hospitals. Mirroring this pattern, high-intensity hospitals slowed down their shift away from these treatments when their performance was poor. Both effects suggest a financial motive related to the 2008 endowment shock.

In contrast to the cardiac results, we find no (or weak) convergence to industry average for the use of C-sections in child delivery, and there is also no effect of the 2008 financial performance on the C-section use. During our sample period, particularly around 2009, consumer and physician groups increased pressure on hospitals to lower their C-section rates (see Section 2.2). These efforts may have influenced physicians' choices and counteracted any financial incentives for C-section use.

Taken together, our evidence suggests that medical treatment choices are not immune to the effects of the hospital financial constraints. However, compared to the evidence from the manufacturing and retail sectors, these effects are limited to specific contexts and affect a relatively small population of customers (patients). This raises the question of which mechanisms might be responsible for the more moderate response. One possibility is that the nonprofit organizational form "works well" in the sense that its weaker focus on profits helps to shield consumers from undesirable shifts in quality. Another factor might be the specific features of hospital governance, in particular, the often loose relationship between hospitals and the key workers (physicians) that directly affect quality. Finally, professional norms specific to physicians may make their behavior more resistant to organizational pressures in high-stakes treatment environments.

Our empirical strategy does not allow us to explore the importance of the for-profit status because for-profits have no endowments and rely less strongly on income from financial investments. We consider the role of hospital governance by splitting the sample based on contractual arrangements with physicians. This analysis shows that hospitals with stronger ties to physicians (via employment) experienced a larger overall shift towards the more intensive cardiac treatment post 2008, suggesting that hospital-physician integration played a role in how hospitals responded to the financial crisis. However we find no significant difference between the two hospital groups in the sensitivity of their post-2008 response to the magnitude of the 2008 financial loss. This is consistent with the arguments in prior literature that even the looser hospital-physician arrangements leave scope for physician influence when faced with a significant shock.[3] These results are notable given the current trend towards stronger physician-hospital integration nationwide (Scott et al. (2016)).

This paper merges two strands of literature. First, we contribute to the corporate finance research on the effects of financing frictions on product market choice. Rose (1990) finds that airlines' accident rates are negatively related to firms' past financial performance (see also Phillips and Sertsios (2013)). Similarly, Phillips (1995) finds that firms in less competitive industries shrink output and increase profit margins following leveraged recapitalizations. Chevalier and Scharfstein (1996) show evidence from the supermarket industry that liquidity constraints induce firms to increase markups (and short-run cash flows) and to underinvest in market share during recessions. Chevalier (1995) finds similar evidence for supermarkets engaged in leveraged buyouts. Matsa (2011) shows that financial leverage increases supermarkets' inventory shortfalls – a measure of reduced product quality. Cohn and Wardlaw (2016) report an increase in workplace accidents following negative shocks to firms' financial health while Kini, Shenoy, and Subramaniam (2017) find a similar effect on product recalls. In a related stream of research, Frakes and Wasserman (2013) provide evidence that the fee structure of the U.S. Patent and Trademark Office distorts the agency's decisions to grant patents (see also Frakes and

[3] Anecdotal accounts of such influence can be found, for example, in the 2008 Medicare Advisory Commission (MedPAC) "Report to the congress: reforming the delivery system." See also detailed analysis of these arrangements in Dynan, Bazzoli, Burns, and Kuramoto (1998).

Wasserman (2014 and 2015)). In this paper, we extend this literature to the healthcare sector, which is both economically important and highly relevant in this context.

Our paper also directly relates to the literature in health economics that examines medical choices, and how these choices respond to physician financial incentives such as reimbursements, patient demand, or malpractice insurance. For example, Clemens and Gottlieb (2014) show that physicians changed treatment in response to the 1997 changes in Medicare reimbursements. Similarly, Eliason et al. (2018) show that physicians disproportionately discharge patients after crossing a threshold for higher reimbursement (see additional examples specific to the cardiac and C-section choices in Section 2). In contrast to these studies, our focus is on financial constraints, so we test how medical choices respond to changes in the hospitals' overall financial condition rather than prices or demand for specific services. In that spirit, Dranove, Garthwaite, and Ody (2017) examine the effects of the 2008 financial crisis on hospitals' prices and the offerings of certain services. They find that an average hospital did not raise prices as a result of the financial shock, but that prices might have increased for hospitals with market power.[4] They also find that the crisis led some hospitals to discontinue unprofitable services such as trauma care, emergency psychiatric care, and drug and alcohol treatment while offerings of profitable services (e.g. the existence of cardiac centers) remained unchanged. Our paper differs in that we examine patient-level shifts in treatment choices rather than prices or investment. Such shifts are especially interesting in our context as they do not require hospitals to have market power, or to make significant investments in new services at the time when hospitals are financially constrained.

Finally, it is worthwhile to note that the effects on treatment choices and patient outcomes cannot be inferred from the aggregate financial results. For example, hospitals might compensate losses for some patients with more aggressive interventions for others, which would lead to small or no changes overall. We circumvent this issue by looking directly at procedure choice for individual patients in specific settings. This approach also allows us to control for changes in demand, insurance coverage, and other patient-level factors, which helps more cleanly identify the effect of the shock.

[4] See Frakt (2011) for a survey of related research on "cost shifting", defined here as "charging private payers more in response to shortfalls in public payments" (p.90). The survey concludes that cost shifting is not a pervasive phenomenon, consistent with the weak evidence of price increases in response to the financial crisis in Dranove et al.

## 2 Background on cardiac procedures and C-sections

### *2.1 Background on cardiac procedures*

A heart attack or acute myocardial infarction (AMI) is defined as a damage or death of part of the heart muscle caused by insufficient blood flow to the heart. The blood flow is usually impaired by a blockage of the coronary arteries. Heart attack patients may be treated non-invasively using drugs that dissolve possible blood clots (thrombolytics), or they may receive an invasive cardiac treatment to improve blood flow to the heart (revascularization), which includes a bypass surgery (Coronary Artery Bypass Graft, CABG) or angioplasty (Percutaneous Transluminal Coronary Angioplasty, PTCA). Patients who receive revascularization also receive an invasive diagnostic procedure (cardiac catheterization) that images blood flow and determines the location of the artery blockage. Numerous studies in health economics use catheterizations as the "well-understood marker for surgically intensive management of patients" (Chandra and Staiger (2007) p. 9; see also, McClellan et al. (1994), McClellan and Newhouse (1997), Currie, MacLeod, Van Parys (2016), and Molitor (2018)). Following this literature, we use catheterizations as a measure of AMI treatment intensity.

The choice between an invasive and a non-invasive treatment path involves many clinical factors, including the severity of the heart attack, patient age, and other diagnoses. Thus, some patients are medically more suitable to receive catheterizations than others. Our premise is that, for the marginal patient, the invasive treatment tends to be more profitable to hospitals than the non-invasive treatment.

Hospitals do not disclose true profits from specific procedures, and profits likely vary with the hospital's capacity, specialization, and patient mix. However, academic research and anecdotal evidence suggest that cardiac surgery is one of the most profitable medical services hospitals provide.[5] For example, Horwitz (2005) examines a variety of sources to determine the relative profitability of various hospital services and concludes that "cardiac surgery – including cardiac catheterization labs, angioplasty, and coronary artery bypass graft (CABG) – are widely known to be hospital profit centers."[6] (See also Dranove et al. (2017)). Consistently, the *New York Times* (*NYT*) reports evidence that doctors at a large for-profit hospital chain performed catheterizations on patients who did not

[5] Cutler et al. (2001) report that in their sample of Medicare patients in 1994, Medicare reimbursement was $36,564 for a bypass surgery, $26,661 for angioplasty, $15,887 for catheterization only, and $10,155 for a non-invasive treatment. However, hospitals do not disclose the costs associated with these procedures, so profits cannot be determined.

[6] Her sources include medical and social science literature, Medicare Payment Advisory Commission and Prospective Payment Assessment Commission reports to Congress, and interviews with hospital administrators and doctors.

need them, suggesting a profit motive ("Hospital Chain Inquiry Cited Unnecessary Cardiac Work," *NYT*, August 7th, 2012). Similarly, the *Wall Street Journal (WSJ*) quotes nonprofit hospital administrators arguing that for-profit providers "cherry pick" the lucrative cardiac services, which then hurts the nonprofits' bottom line (*WSJ,* June 22nd, 1999).

Extensive research in health economics investigates the medical and economic choices involved in the treatment of heart attacks. Several studies focus on understanding the effects of the invasive treatments on patient outcomes and healthcare costs. For example, McClellan and Newhouse (1997) examine hospitals that acquire capacity to provide intensive cardiac treatment, such as catheterizations or revascularizations. They find modest improvements in patient survival rates and substantial increases in treatment costs.[7] Cutler, McClellan, and Newhouse (2000) show that reimbursements for treatments of heart attacks vary substantially across insurance plans, but that services and patient outcomes are similar across plans. A number of studies examine geographic variation in treatment intensity and find limited evidence that the higher-spending areas achieve better health outcomes (see a review of this literature in Skinner (2012)). For example, Fisher et al. (2003) document large geographic variation in spending in multiple settings, including heart attacks, but no significant differences in mortality rates. Chandra and Staiger (2007) find that AMI patients receiving catheterizations in high-intensity areas are, on average, medically less appropriate for intensive treatment. While these areas exhibit higher survival rates from intensive treatment, they appear less effective in non-intensive treatment. However, Doyle (2011) finds better overall outcomes in high-intensity areas in a sample of AMI patients in Florida who experience an emergency while away from home. More broadly, the AMI setting has been used in other contexts, for example, to study physician practice styles (Molitor (2018)), technology adoption (Skinner and Staiger (2015)), patient choice (Chandra et al. (2016)), and the effects of medical malpractice standards (Frakes (2013)).

## *2.2 Background on C-sections*

Based on the 2007 National Hospital Discharge Survey, child delivery was the number one reason for hospitalizations in the U.S., accounting for 4.1 million of all hospital discharges in that year. Of those discharges, 1.4 million were for delivery by Caesarian section, making C-section one of the most frequently performed major surgical procedures in the U.S. The frequency of C-sections has increased

[7] McClellan and Newhouse find a 5 percentage point increase in day-one survival rates for AMI patients in hospitals adopting catheterization capabilities. However, the effect seems to result "not from catheterization or revascularization but from correlated beneficial technologies at catheterization hospitals" (p. 63). McClellan et al. (1994) arrive at similar conclusions using a different methodology.

dramatically over the past few decades. Gruber and Owings (1996) report that C-sections accounted for 5.5% of deliveries in 1970 and that the rate increased four-fold over the subsequent 30 years, reaching over 23% in 1991. The rise in C-sections continued at a slower pace over the subsequent two decades, and it is now close to 30%.

A widespread view among researchers and public health experts is that the current C-section rate in the U.S. is too high: though many C-sections are performed for medically good reasons (such as prior C-section, breech presentation, or fetal distress), it appears that a significant fraction do not improve health outcomes and may even increase certain risks to the mother and the infant (see Gruber and Ownings (1996), Currie and MacLeod (2008, 2017), and others). Citing these reasons, the U.S. Department of Health and Human Services, in collaboration with other federal agencies and groups, set an objective to reduce the C-section rate nationally by 10% (from 26.5% to 23.9%) by 2020.[8]

Financial incentives of healthcare providers are often cited as one of the key reasons for the high and rising C-section rates in the U.S. (along with malpractice lawsuits and technological improvements in the diagnosis of birth complications). Reimbursement rates for C-sections – by both Medicaid and private insurers – are typically much higher than those for vaginal deliveries. Though C-sections are likely more costly to providers (for example, they require longer hospital stays), in general, they are also more profitable (see, for example, Keeler and Brodie (1993)). This is the assumption we maintain throughout this paper.

Importantly for our analysis, a number of state and national agencies and advocacy groups have been encouraging health care providers to reduce C-section rates, and these pressures have intensified in recent years (*New York Times*, 3/12/2014).[9] In 2010, the Leapfrog Group began asking hospitals to voluntarily report statistics on early elective deliveries which are associated with higher C-section rates.[10] Also in 2010, the Joint Commission – a nonprofit organization that accredits and certifies health care organizations – recommended that hospitals report statistics on early elective deliveries and C-section rates among first-time mothers. In 2012, the commission announced that reporting will become mandatory for large hospitals in 2014.[11] In August 2009, the state of Washington equalized

[8] Healthy People 2020 Topics & Objectives: Maternal, Infant, and Child Health (https://www.healthypeople.gov/). Similar efforts were made by the Joint Commission – a nonprofit organization that accredits and certifies health care organizations ("Improving performance on perinatal care measures." The Source, July 2013) and by the American College of Obstetricians and Gynecologists, ACOG ("Induction of Labor." ACOG Practice Bulletin 107, August 2009).
[9] The *New York Times*, 3/12/2014, "Reducing Early Elective Deliveries" by Tina Rosenberg.
[10] That is, deliveries prior to the 39 week of gestation performed without a medical reason. The group cited recent clinical evidence that links these deliveries to worse health outcome for both mothers and infants. See also the Leapfrog Group Factsheet, March 2011.
[11] The Joint Commission, "Improving performance on perinatal care measures." The Source, July 2013.

Medicaid reimbursement rates for "uncomplicated" C-sections and vaginal deliveries in an effort to reduce financial incentives to perform C-sections. As we discuss in Section 2.2, these developments likely affected the overall trends in C-section rates during our sample period.

Like cardiac surgery, C-sections are one of the most frequently studied procedures in health economics. One of the pervasive findings is the large unexplained variation in C-section rates across geographic areas. For example, Baicker, Buckles, and Chandra (2006) find in their 1995-1998 sample of large U.S. counties that C-section rates for newborns with normal birth weight range from 13.4% to 26%, and much of this variation cannot be explained by the patient-level variables (such as complications of labor) or other county-, hospital-, and state-level factors.

Several studies investigate the importance of provider financial incentives in the choice of child delivery. In an early study, Stafford (1990) finds that C-section rates are higher for privately insured patients than Medicaid insured patients, suggesting a financial motive. Gruber and Owings (1996) show that within-state declines in fertility rates during 1970-1982 were associated with increases in C-section rates. They argue that this was caused by the negative income shock experienced by obstetrician/gynecologists who shifted towards the more highly reimbursed Cesarean delivery as demand for their services declined. Gruber, Kim, and Mayzlin (1999) find that higher Medicaid reimbursements for Cesarean delivery relative to vaginal delivery are associated with higher C-section rates, again consistent with physicians' choices responding to the fee differentials. Alexander (2017) reports consistent results looking at changes in Medicaid reimbursements. Johnson and Rehavi (2016) find that mothers that are physicians are less likely to have a C-section than other highly-educated mothers, and that the difference diminishes for hospitals owned by HMOs (that is, hospitals with weaker financial incentives to perform C-sections).[12]

In this paper, we test whether a negative shock to hospitals' financial condition causes a shift towards the more intensive, and arguably more profitable, treatments of patients, such as C-sections and invasive cardiac procedures.

[12] Besides shifts in demand and reimbursements, researchers have also explored the effects of changes in malpractice insurance on C-section rates. Currie and MacLeod (2008) show that, contrary to common belief, tort reforms that limit physician malpractice risk increase C-section rates. This is consistent with the marginal C-section being riskier than the marginal vaginal birth. Frakes (2013) also documents large shifts in C-section rates in response to state-level changes in malpractice standard rules.

## 3 Sample and data

### *3.1 Data sources*

Hospital financial statement data comes from the Healthcare Cost Report Information System (HCRIS). HCRIS contains information from cost reports submitted annually to the Center for Medicare and Medicaid Services (CMS) by all Medicare-certified institutional providers, including hospitals. The reports contain detailed data on facility characteristics, utilization, and cost allocations, and also include financial statement information, which we use in our tests. Data on physician arrangements comes from the American Hospital Association (AHA) Annual Survey Database and was provided to us by The Dartmouth Institute for Health Policy and Clinical Practice.

The patient level data come from The Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID). The HCUP databases have been developed through a partnership between the federal government, the states, and the healthcare providers sponsored by the Agency for Healthcare Research and Quality. The SID databases contain detailed patient discharge data for all community hospitals of the participating states. The data is translated into a common format to facilitate comparisons across states. All patients, including Medicaid, Medicare, privately insured and uninsured patients, are included in the database.

### *3.2 The HCRIS sample and data description*

We start with a sample of 3,272 nonprofit hospitals (19,838 hospital-year observations) from 2005-2011 available on HCRIS. To be included in the sample, we require that the hospital had a minimum of one million dollars in revenues and fixed assets above one million dollars. The descriptive statistics for the HCRIS sample are given in Table 1. In the full sample (top panel), the average nonprofit hospital had net revenues of 164 million dollars and fixed assets of 82.3 million dollars (the medians were 80.8 and 35), the average ratio of net debt to fixed assets was 0.25 and the average ratio of financial investments to fixed assets was 0.56 (the medians were 0.23 and 0.29). The mean ratio of operating income to fixed assets was -0.02 (the median was -0.01), and the mean annual growth rates in fixed assets and net revenues were both 0.06 (the medians were 0.00 and 0.05).

The bottom panel of Table 1 shows descriptive statistics for the sub-sample of hospitals in the seven states for which we have patient-level SID data: Arizona, California, Florida, Maryland, New Jersey, New York, and Washington. This sample consists of 739 hospitals and 4,380 hospital-year observations. The hospitals are somewhat larger than those in the full sample (for example, the average service revenue is 232 million dollars vs. 164 million dollars in the full sample), have somewhat higher financial leverage, and have lower ratios of financial investments to fixed assets. Measures of capital investments are similar across the two samples.

We show means for hospitals with above- and below-median performance of financial investments in 2008 in Appendix Table A1. The general message from the table is that hospitals that were more exposed to the 2008 shock were somewhat different on observable (and potentially unobservable) characteristics. This raises the concern that the two sub-samples may have experienced differential shifts in treatment intensity post 2008 for other (non-financial) reasons. We address this concern in Section 5.1.

### *3.3 Measure of income from financial investments*

Our measure of performance of financial investments is Income from Investments as reported in Statement of Revenues and Expenses, HCRIS Form G3, Line 7, scaled by lagged fixed assets (*Investment Income* in Table 1). Based on Table 1, investment income was 3% in our sample, with a median of 1%. According to the Statement of Financial Accounting Standards No. 124 (FAS 124), nonprofits are required to mark to market their investments in equity securities with readily determinable fair values and all investments in debt securities, with any gains and losses included in the statement of activities (i.e., the statement of revenues and expenses). CMS does not provide any additional guidelines concerning reporting of income from financial investments for HCRIS, other than stating that the amounts should come from the hospitals' "accounting books and/or records".[13]

To the extent that hospitals follow standard accounting rules in their reporting to HCRIS, *Investment Income* measures the hospitals' incomes from financial investments, including dividends, interest income, and realized and unrealized gains and losses from investments. While HCRIS does not contain information on the individual components of *Investment Income*, Adelino et al. (2015) report, based on IRS data for the 1999-2006 period, that a substantial portion consists of dividends and interest income, which are likely less strongly affected by the stock market crash.[14] Nevertheless, based on Figure 1, the mean investment income drops sharply from 5.4% of fixed assets in 2006 and 4.2% in 2007 to 1.1% in 2008 and then reverts to 3.9% in 2009, tracing a similar pattern in the level of

[13] See instructions for CMS Cost Reports (https://www.costreportdata.com/instructions/Instr_G300.pdf). Given the lack of specific instructions, we cannot be sure to what extent hospitals follow FAS 124 when reporting to HCRIS or include gains and losses from financial investments on Line 7 of Form G.

[14] Because of a change in IRS reporting requirements in 2008, this information is not available for the latter period. However, Adelino et al. report that the HCRIS and IRS measures have similar means and medians, in spite of the differences in reporting.

financial assets (the latter also reflects asset sales and acquisitions, so it is not directly comparable). The actual financial shock may have been larger than the figure suggests if not all financial assets were marked to market.

To put this magnitude in perspective, the average hospital's operating profitability, measured as the difference between service revenue and service expenses scaled by lagged fixed assets, was -2.5% during our sample period. This suggests that an average hospital relied heavily on income from financial investments to offset its operating losses, and that the three-percentage-points drop in investment income in 2008 constituted a significant shock.

### *3.4 The SID samples of child deliveries and heart attacks*

The tests involving patient-level information are based on a subsample of hospitals in the seven states for which we have SID data: Arizona, California, Florida, Maryland, New Jersey, New York, and Washington in the years 2005 through 2011. The diagnosis and procedure codes in SID are based on the International Statistical Classification of Diseases (ICD-9-CM).

The initial AMI sample includes 1,071,550 admissions to 451 nonprofit hospitals. As in Chandra and Staiger (2007), we measure the use of an intensive AMI therapy with an indicator for whether an AMI patient receives a cardiac catheterization, an invasive diagnostic procedure described in more detail in Section 2.1. We limit the cardiac analysis to hospital-years with at least 50 AMI admissions and an average catheterization rate during our sample period of at least 2%, which reduces the sample to 1,006,958 admissions to 317 hospitals. Finally, for regressions in Tables 3 and 4, we require that hospitals have non-missing investment income in 2008 and non-missing patient level controls, which results in 513,146 admissions to 179 hospitals (year 2008 is excluded).

The initial sample of child deliveries includes 4,853,365 admissions to 378 nonprofit hospitals. Following Baicker et al. (2006), Alexander (2015), and others, we exclude patients with previous C-sections, breech presentation and multiple deliveries because of high frequency of C-sections in these samples. We also limit the analysis to hospitals with at least 50 delivery patients and an average C-section rate during our sample period of at least 2%. These requirements result in 3,725,015 admissions to 356 hospitals. Finally, for regressions in Table 6, we require that hospitals have non-missing investment income in 2008 and non-missing patient level controls, which results in 1,868,777 admissions to 207 hospitals (year 2008 is excluded). We follow Frakes (2013) to identify risk factors and complications associated with the probability of obtaining a C-section such as maternal age, hypertension, or placenta previa, and we include indicators for these conditions as control variables in all regressions.

## 4 Financial crisis, hospital financial assets, and capital investments

Our main tests rely on the shock to nonprofit hospitals' financial conditions caused by the financial crisis of 2007-2008. The U.S. stock market declined nearly 50% by the end of 2009 from its peak in late 2007 and syndicated bank lending dropped by 47% in the fourth quarter of 2008 relative to the fourth quarter of 2007 (Ivashina and Scharfstein (2010)). The financial crisis affected nonprofit hospitals in three important ways.

First, nonprofit hospitals hold large financial assets, such as endowments, and rely on cash flows from these assets to finance investment and operations (see, for example, Schuhmann (2010)).[15] The value of hospital financial assets declined significantly as a result of the stock market crash. Figure 1 shows that the ratio of financial investments to fixed assets reported on HCRIS declined from 0.59 in 2007 to 0.48 in 2008, a 19% decline. This decline had a direct effect on the hospitals' cash flows and financial health. Most nonprofit hospital spending rules tie funds available for spending to the past market values of the nonprofits' endowments, so a decline in the endowment values in 2008 had a direct impact on those funds, potentially constraining spending and investment (National Association Of College And University Business Officers (2009)).[16] In addition, many hospitals hold financial assets outside of the donor-restricted endowments. These assets can be used directly as a funding source and can also serve as collateral when raising debt. Consistently, Adelino et al. (2015) find that hospitals' actual spending (e.g., on building and equipment) responds more strongly to the random fluctuations in the value of financial assets than their *funds available for spending* (as determined by the spending rule). An added consequence of the stock market crash for hospitals with defined benefit pension plans (if those plans are underfunded) is an increase in required pension contributions (Rauh, 2006).

Second, the credit crunch of 2008 increased borrowing costs and limited hospitals' access to credit. Nonprofit hospitals rely heavily on borrowing to finance investments and day-to-day

[15] In the three years leading up to the crisis, the average hospital in our sample reports a loss from patient services of 2.4% of fixed assets and income from investments of 4.5%.

[16] While we do not have systematic evidence on spending rules for hospitals, conversations with industry experts suggest that the typical spending rule defines the amount of funds available for appropriation each year as 3% to 4% of the three-year moving average of the endowment's market value. This range is consistent with the 2010 survey of colleges and universities conducted by the NACUBO-Commonfound Study of Endowments.

operations. The ratio of financial debt to fixed assets prior to the financial crisis (in 2007) was 0.58 for the average hospital in our sample (the ratio of financial debt minus temporary investments was 0.3). A report by Wells Fargo Securities (WFS, 2011) shows that there were close to 550 bond issues by nonprofit hospitals in 2007, accounting for over $40 billion in aggregate proceeds. A substantial fraction of hospital bond issues prior to the crisis were variable-rate bonds (47% of the issues in 2007 were fixed rate as reported by WFS (2011)), so many hospitals experienced a dramatic increase in borrowing costs as bond yields rose in 2008.[17]

Third, the economic downturn following the financial crisis likely led to a decline in the demand for hospital services and inpatient revenues. The Bureau of Labor and Statistics reports that the unemployment rate increased from 5% in December of 2007 to 9.9% in December of 2009, which meant that many Americans lost their employment-based health insurance. As a result, more patients might have scaled back demand for healthcare services, were unable to pay for those services, or sought coverage through Medicaid. According to the U.S. Census Bureau, the proportion of Americans with employment-based health insurance reached a bottom of 56.1% in 2009, declining from 59.8% in 2007. At the same time, the proportion of Americans insured through Medicaid increased from 13.4% in 2007 to 15.7% in 2009.[18] Reflecting these trends, operating profitability in our sample declined in 2008, but recovered to the pre-crisis levels in the subsequent year. Growth in service revenue exhibits a steady downward trend throughout our sample period with a somewhat larger decline in 2009 (see Figure 1).

Adelino, Lewellen and Sundaram (2015) show that hospitals tend to reduce capital investment in response to negative cash flow shocks. If the crisis caused a significant shock to hospital finances, we should observe large investment cuts post 2008. Figure 2 shows that this is, in fact, the case. The average investment rate – measured as the growth in fixed assets – increases from 6.5% in 2005 to 7.9% in 2007, and then declines abruptly, reaching 3.6% in 2009. There is a similarly large drop in

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[17] Consistent with these effects, a survey by the American Hospital Association reports that a significant fraction of the surveyed hospitals experienced some negative consequences of the credit crunch, including increased interest expense for variable-rate bonds (33% of hospitals), increased collateral requirements (12%), inability to issue bonds (11%), and difficulty refinancing auction rate debt or roll-over or renew credit (11% and 10%). Moreover, 60% of the surveyed hospitals with defined benefit pension plans (or 31% of all surveyed hospitals) reported a need to increase pension funding levels ("Rapid response survey, the economic crisis: impact on hospitals." American Hospital Association (November 2008)).

[18] To mitigate the effects of the recession on Medicaid, The American Recovery and Reinvestment Act (ARRA), enacted in February of 2009, provided financial relief of $103 billion to the state Medicaid programs. Based on the Kaiser Commission on the Medicaid and the Uninsured survey, the ARRA funds helped prevent reimbursement rate increases in several states (47 states report rate increases and 21 states reported rate reductions in 2009, and the numbers are 36 and 39 for 2010).

spending on equipment and salary growth. (Spending on buildings seems to decline more gradually, perhaps because large construction projects involve long-term planning and are more difficult to adjust in the short run.) It is worthwhile to note that declines in investment rates and salaries can translate into lower service quality in the long run, adding to the potential effects of the financial crisis. These long-run effects are beyond the scope of this paper.

As discussed earlier, the financial crisis and the subsequent recession could have affected hospital investments and product market choices through multiple channels. This includes the "financial channel", i.e., the immediate effect of the stock market crash and the credit crisis on hospitals' financial conditions and access to credit, and also the longer-term demand effects caused by the economic downturn and the rise in unemployment. In addition, the legal and regulatory uncertainties leading up to the signing of Obamacare in March of 2010 might have contributed to the decline in investment rates. The evidence in Adelino et al. suggests that the financial channel played at least some role: they show, using a hospital panel from 1999 to 2006, that hospital capital investment declines following poor performance of their financial assets. We find consistent results for the crisis period: the regressions in Table A2 in the Appendix show that growth rates in fixed assets and buildings declined significantly more strongly after the crisis for hospitals with low financial returns in 2008.

## 5 Financial crisis and patient treatment

### *5.1 Identification*

In this section, we ask whether the financial shock to hospitals associated with the 2008 financial crisis caused a shift towards more intensive treatment of patients. To do so, we test whether hospitals that suffered larger losses on their financial assets in 2008 increased treatment intensity more after 2008 relative to other hospitals. The key identifying assumption is that any differences in the post-2008 changes in treatment between high- and low-return hospitals are caused by these hospitals' financial performance. This assumption would be violated if returns on financial assets are associated with shifts in treatment intensity via other channels. To address this concern, we control for observable patient and hospital characteristics and their interactions with the post-crisis period. We also interact the 2008 return on financial assets with year indicators for 2005 through 2011 and show that the effect on cardiac treatment is close to zero prior to the crisis and increases thereafter. Finally, we investigate an alternative channel through which hospitals with low returns in 2008 might have increased intensity post 2008 (associated with changes in capital investments) and show that it does not explain our results.

### 5.2 Evidence on cardiac treatment

This section describes the evidence on the use of catheterizations as a function of hospital returns in the 2008 financial crisis. Our sample of 513,146 heart attack patients is described in Table 2, Panel A. Panel B shows the hospital-level variables used in the regressions. The average patient is 70 years old, 42% of patients are female, and 63% of patients are insured by Medicare (private insurance and Medicaid account for 24% and 6% of the sample). Of all admitted heart attack patients, 52% receive catheterizations. Consistent with previous evidence on the variation in treatment choice across regions, the catheterization rates in our data vary from 42% in New Jersey to 59% in Arizona. Based on Panel B of Table 2, our key independent variable, investment income as a percent of lagged fixed assets in 2008 (*Inv_Inc08*) is, on average, 0.5% with a standard deviation of 4.4% (the construction of this variable is explained in detail in Section 3.3). For comparison, investment income in the six years surrounding the crisis is on average 3.1%. As another point of reference, the average income from patient services during the three years leading up to the crisis was -2.5%. Based on these statistics, the loss of investment income was economically significant for many hospitals.

Figure 3a shows trends in average catheterization rates across all hospitals and for sub-samples split at the median based on the 2005 catheterization level. The overall catheterization rates increased somewhat during our sample period from 52% in 2005 to 53% in 2011, but the increase is concentrated among the low-intensity hospitals. Within this subsample, the catheterization rates increased by 12 percentage points from 28% in 2005 to 40% in 2011. In contrast, the high-intensity hospitals experienced a 3.5 percentage point decline in catheterization rates towards the lower industry mean (from 64% in 2005 to 60.5% in 2011). Neither group shows a substantial discrete change around 2008.

Table 3 shows our main results. The dependent variable equals one when a patient receives catheterization and zero otherwise, and the main dependent variable is the interaction of the post-crisis dummy with a measure of the 2008 investment return. *Post_Crisis* equals one for 2009-2011 and equals zero for 2005-2007. In the first two columns, the regressions use dummies for the second and the third terciles of investment returns in 2008; raw returns are used in columns (3) through (5). All regressions are clustered at the hospital level and include patient characteristics, year fixed effects, and hospital fixed effects. In addition, a subset of regressions includes interactions of *Post_Crisis* with measures of the hospital's catheterization rate and size in 2005 (*Intensity_AMI* and *Size*). This controls for the mean reversion in catheterizations during our sample period documented in Figure 3a.

Based on the interactions of the 2008 investment return with *Post_Crisis*, all regressions show that hospitals with higher returns had lower catheterization rates after the crisis relative to other hospitals. However, the effects are statistically significant only when we control for the interaction of *Post_Crisis* with the hospital-level cardiac intensity in models (2), (4), and (5). We explore the effects of cardiac intensity on our results in more detail below. Controlling for the interaction of *Post_Crisis* with hospital size in model (5) has no significant effect on the main result, and the result is also robust to the inclusion of interactions of *Post_Crisis* with a range of other patient and hospital characteristics (Tables A4 and A5 in the Appendix). Based on model (4), a one standard deviation increase in the 2008 investment return is associated with a 0.8 percentage point decline in the post-crisis catheterization rate, and the effect is statistically significant at the 5% level. Alternatively, model (2) shows that hospitals in the top tercile of returns exhibit lower catheterization rates after the crisis relative to hospitals in the bottom tercile by 2.3 percentage points.

To evaluate these magnitudes, it is worthwhile to note that the overall change in catheterization rates was close to one percentage point over the sample period of seven years, and it was 12 percentage points for the low intensity hospitals. Another interesting point of reference is the (approximately) five percentage point effect due to the state-level adoption of the national malpractice standards of care estimated by Frakes (2013).[19] In comparison, the one to two percentage points effect we estimate represents an economically meaningful change. In Table A3 in the Appendix, we rerun all regressions in Table 3 after including year 2008 in the pre-crisis period. This increases the statistical significance of the main effect in all regressions, leaving the magnitude of the interaction coefficients unchanged. Finally, in Table A7 in the Appendix, we scale investment income using the hospital's lagged operating costs rather than fixed assets and obtain similar though statistically weaker results.

In Panel B, we split the sample based on the patient's insurance status and find that the negative effect of returns on catheterization rates post crisis is present across all categories of insured patients, but it is close to zero for the small subset of patients in the "uninsured, self-pay and other" category, which are likely least profitable for the hospital.

[19] Frakes (2013) estimates the effect of the adoption of the national-standard law on the percent deviation of the state-level catheterization rate from the national average rate (scaled by the national average rate). Multiplying the estimated 13.64% effect (column (2) Table 4, p. 271) by the national average rate of 35.7% (Table 1, p. 262) yields 4.9 percentage points.

To examine the timing of the main effect, we repeat the regression in column (4) of Table 3, except that the investment return in 2008 is interacted with the individual year dummies instead of the dummy for the post-crisis years of 2009-2011 (the 2007 dummy is omitted). In Figure 4, we plot the coefficients on the interaction terms and their confidence intervals. The figure shows that the coefficients are close to zero throughout the pre-crisis period, so our results do not seem to be caused by the differences in the pre-2008 trends in catheterization rates. The figure also shows that the interaction coefficients are negative and increasing after the crisis, with the largest decline in 2010, suggesting a delayed and persistent response. (Some delay seems plausible, especially given that the stock market crash occurred at the end of 2008.)

The regressions in Table 4 explore the magnitude of our main effect across sub-samples of high- and low-intensity hospitals. We split the sample into quintiles based on the initial level of cardiac intensity measured in 2005 and estimate our main regression (model (3)) within each quintile. The table reveals that the negative effect of the 2008 return is concentrated among hospitals on either end of the intensity spectrum (the effect has the opposite sign and is close to zero in quintiles Q3 and Q4). Figure 5 illustrates these patterns. The top and the bottom figures suggest that the 2008 endowment shock affected the rate at which the high- or the low-intensity hospitals converged towards the industry mean: low-intensity hospitals increased their upward shift while high-intensity hospitals slowed down their downward shift when their financial assets performed poorly in 2008. In contrast, hospitals that operated close to the industry norm prior to the crisis (middle figure) exhibited no significant response to shock (see also Figure A1 in the Appendix that splits the middle figure into finer groups).

Finally, in the Appendix, we explore a potential alternative channel that could be responsible for our main results. It is plausible that increases in cardiac intensity are preceded by capital expenditures if hospitals purchase equipment or adapt facilities to make the change. If so, hospitals with larger capital investments might experience larger subsequent increases in catheterization rates, and any positive correlation between investments and returns on financial assets (our dependent variable) could bias our test. To address this concern, in Table A5, we include a measure of capital investment in 2007 and its interaction with *Post_Crisis* as additional controls. We find that doing so does not significantly affect our results. In addition, in Table A6, we regress catheterizations directly on lagged capital expenditures and find no evidence of positive association, suggesting that the investment channel is unlikely to explain our results.

Overall, the evidence in this section suggests that the financial crisis affected treatment decisions for AMI patients. However, the effects are concentrated among subsets of hospitals on either end of the intensity spectrum, with hospitals operating close to the industry norm showing no significant response. Even within the extreme sub-samples, it is unclear to what extent the effects we uncover are harmful to patients. Such harmful effects would occur if the financial shock moved hospitals away from their optimal intensity level (as in Chandra and Staiger (2007)). Since low-intensity hospitals start off with catheterization rates significantly below the national average, this assumption might not hold in this group.

### *5.3 Evidence on C-sections*

In this section we repeat the analysis in Table 3 using the choice of a C-section vs. vaginal birth as the more intensive treatment option. There is an important difference between the child delivery and the cardiac settings. In the case of child deliveries, our sample period coincided with a number of initiatives by various government agencies and advocacy groups aimed at reducing the nationwide rates of C-sections and early elective deliveries (these developments are summarized in Section 2.2). Thus, the overall trend in the use of C-sections during this period likely reflects the hospitals' responses to these efforts, in addition to any financial incentives caused by the financial crisis. Though the combined effect of these competing forces is ambiguous, our predictions remain unchanged: if a hospital's financial condition affects treatment choice, hospitals with poorer financial performance during the financial crisis should show less willingness to lower their C-section rates post 2008 in response to the non-pecuniary pressures. Moreover, the financial crisis is sudden and largely unexpected (in contrast to the ongoing pressures from the advocacy groups), so our time-series tests using trends and a post-2008 indicator should still be able to pick up sudden shifts in the C-section rates post 2008.

The time-series of C-section rates are depicted in Figure 3b. Based on the figure, the raw rates increased modestly from 16.4% in 2005 to 17.8% in 2009 (continuing an upward trend from the early 1970s (Gruber and Owings (1996)) and then declined slightly to 17.4% in 2011. Compared to the cardiac results, splitting hospitals into high- and low-intensity groups based on their 2005 C-section rates shows weaker convergence to the industry average for either sub-sample. For the high-intensity hospitals, C-section rates remain close to 20% throughout our sample period; for the low-intensity hospitals, they increase somewhat from 12.7% to 14%.

The regressions in Table 6 test whether hospitals that were more strongly affected by the financial crisis – as measured by their investment returns in 2008 – increased C-sections post 2008 relative to hospitals with better performance in 2008. As for cardiac procedures, we regress the C-section indicator on a *Post-Crisis* dummy and its interactions with the second and the third return tercile dummies (models (1) and (2)) or the raw return (models (3), (4), and (5)). In all regressions, the coefficients on the interaction terms are negative but small in magnitude and not statistically significant. Based on model (4), a one-standard deviation increase in the 2008 investment return lowers the C-section rate by 0.1 percentage points (standard error of 0.1 percentage points). The regressions using tercile dummies instead of raw returns (models (1) and (2)) produce similar estimates.

To mirror the cardiac results, we re-estimate the regression in column (4) of Table 6, but we interact the investment return in 2008 with the individual year dummies instead of the dummy for the post-crisis years of 2009-2011 (the 2007 dummy is omitted). Figure A2 in the Appendix plots the coefficients on the interaction terms and their confidence intervals. Consistent with the results in Table 6, the figure shows no significant increase in the coefficients after vs. before 2008. Finally, in Table A9 and Figures A3 and A4 in the Appendix, we split the sample into quintiles based on the hospital's treatment intensity in 2005, adjusted for patient risk factors for receiving a C-section (details are in the notes to Table A9). Again, in contrast to the cardiac sample, we find no systematic evidence that hospitals in the high- and low-intensity groups responded more strongly to the financial shock compared to the hospitals closer to the industry norm.

As we discuss in Section 2.2, the state of Washington equalized the Medicaid reimbursement rates for C-sections and vaginal deliveries in August of 2009 in an effort to reduce the use of C-sections. Since this likely lowered the hospitals' financial incentives to perform C-sections in the post-crisis period, we re-run the tests after excluding Washington in Appendix Table A10. The overall conclusions remain unchanged.

To summarize, we find no evidence that hospitals shifted towards the more intensive and more profitable modes of child delivery in response to the negative endowment shock in 2008. In fact, the overall C-section rate declined somewhat post 2008, likely reflecting the nationwide pressure to lower C-section use. This reinforces our conclusion in the previous section that, while we do find evidence of treatment choices responding to the 2008 financial shock, the response appears to be limited to specific clinical settings and hospital types.

## 6 Physician integration

One reason why treatment choices of some hospitals are unresponsive to their financial condition might be that physicians' incentives are only loosely aligned with those of the hospital. In this section we test this hypothesis by examining treatment responses at hospitals in which physicians are employees of the hospital and are therefore most closely integrated in the organization.

The data on physician arrangements with the hospital comes from the American Hospital Association (AHA) Annual Survey Database. The survey covers the universe of U.S. hospitals and includes, among other things, information on hospital organizational structure, services, staffing and physician arrangements. The survey reports hospital participation in eight types of physician arrangements, which are usually grouped into three major categories: no affiliation, employment affiliation, and contractual non-employment affiliation (Madison (2004), Scott et al. (2016)). The latter can take on a variety of forms: in some cases, the hospital enters into a contract with physicians who agree to perform services at the hospital but otherwise remain independent (e.g., they own independent practices, negotiate separate contracts with insurers, etc.). In other cases, the hospital forms a joint venture with physicians or establishes a separate legal entity that provides various services to physicians, including management or marketing services or negotiating contracts with insurers. Such entities might also set physician compensation or establish common standards of quality (Dynan, Bazzoli, Burns, and Kuramoto (1998)).

Based on Panel A of Table 7, 38% of hospitals in our sample report having no contractual or employment relationship with their staff physicians as of 2008. This compares with 36% reporting employment relationship and 32% reporting a contractual relationship.[20] Similar to prior studies, we find that integration increased during our sample period: the fraction of hospitals that report having an employment relationship in the cardiac sample increased from 28% in 2005 to 46% in 2011. One limitation of the physician arrangement indicators in Panel A is that they do not tell us the fraction of a hospital's physicians involved in each type of arrangement. However, starting in 2010, the AHA reports the number of privileged physicians (that is, physicians with privileges to refer a patient to the hospital and/or perform services at the hospital) that are employed by the hospital, have an individual

[20] We define these arrangements as follows. Hospitals reporting arrangements (a) through (e) in the AHA survey (Independent Practice Association, Group practice without walls, Open or Closed Physician-Hospital Organization, or Management Service Organization) are categorized as having a contractual arrangement. Hospitals reporting arrangement (f) (Integrated Salary Model) are denoted as having employment arrangement.

or a group contract with the hospital, or none of the above.[21] Based on Panel B in Table 7, on average, 15% of privileged physicians are employed, 8% have individual contracts, 22% have a group contract, and 49% have no contractual or employment relationship with the hospital.

Several authors argue that the higher-integration models, such as employment or some contractual arrangements, can align physician and hospital incentives.[22] This may happen through several channels. For example, hospitals might design compensation contracts that encourage physicians to offer more profitable services, hospital administrators might directly monitor the quality and the cost effectiveness of those services, or they might require that physicians adhere to certain quality standards. Moreover, physicians involved in hospital management or governance may have direct stakes in their organizations' financial health. Prior literature finds mixed evidence on the effects of hospital-physician integration. For example, Madison (2004) finds that hospitals that adopt the integrated salary model increase procedure rates in the treatment of heart attacks, though the effects are small, and that there is no change in patient outcomes. Similarly, Scott et al. (2016) find no effect of hospital switches to physician employment on mortality rates, readmission rates, or length of stay, and Ciliberto and Dranove (2006) find no effect on hospital charges. However, Baker, Bundorf, and Kessler (2014) find that increases in hospital-physician integration are associated with higher payments received for services to privately insured patients. These prices are distinct from hospital charges and represent actual payments made either by insurance companies or by patients in the form of copayments or deductibles. This finding could mean that integrated hospitals negotiate better terms with insurers, or that they are able to offer more highly compensated services to their patients.

In contrast to the previous studies, which examine changes in outcome variables around hospitals' decisions to strengthen physician integration, we test whether treatment of patients responds to an exogenous shock to the hospital's financial condition, and in particular, whether this response varies with the degree of integration. Our main hypothesis is that the more tightly integrated physicians are more likely to shift towards profitable treatments after the hospital experiences a financial shortfall.

As a starting point, we explore patterns in catheterization rates for the more integrated vs. less integrated hospitals around the financial crisis. To do so, we regress the catheterization dummy on the

[21] We find that the "fraction of physicians that are employed" is persistent in our sample, with autocorrelation of 73%. However, because we measure this variable after the crisis, we also report results using the coarser employment dummy, which comes from the 2008 AHA survey. We find consistent results using both measures.

[22] Baker, Bundorf, and Kessler (2014) argue that though legal restrictions prohibit hospitals from directly paying doctors for referrals, vertical integration allows them to circumvent these restrictions. By employing or contracting with physicians, hospitals can induce them to increase procedures, diagnostic testing, or other services at their facilities. Examples of such influence are also the 2008 MedPAC "Report to the congress: reforming the delivery system".

interaction of an integration measure with indicators for years 2005 through 2011 (year 2007 is omitted) and control variables. The coefficients on the interaction terms and their standard errors are plotted in Figure 6. The top figure measures integration using the coarser employment dummy; the bottom figure uses the fraction of privileged physicians that are employed. Both figures show increases in catheterization rates for the more integrated (vs. less integrated) hospitals post 2008. Based on the top figure, the integration effect is close to zero in the pre-crisis period, but it increases to 1.7% by 2009 and stays close to that level thereafter. Based on the bottom figure, catheterization rates *decline* for the more integrated (vs. less integrated) hospitals before the crisis, but they increase abruptly in 2009 and remain high thereafter.

To investigate these effects in more detail, Table 8, Panel A shows regressions of the catheterization indicator on the *Post_Crisis* dummy and its interaction with the different integration measures (the control variables match those in Table 3). The integration measures are employment dummy (columns (1) and (4)), the fraction of physicians that are employed (columns (2) and (5)), and indicators for this fraction being in the top quartile (columns (3) and (6)). We find that the interaction coefficients are positive in all regressions and are statistically significant in five out of the six regressions. In Panel B of Table 8, we limit the sample to private patients and find somewhat stronger results in spite of the significantly smaller sample, which is broadly consistent with Baker et al. (2014).

In Table 9, we test whether integrated hospitals responded more strongly to the magnitude of the 2008 endowment shock. This does not appear to be the case. In columns (2) and (3), we estimate our main catheterization regressions separately for subsamples split based on whether a hospital has an employment relationship with some of its physicians. Comparing the coefficients on the interaction of *Post_Crisis* with the 2008 investment return reveals no significant difference across the subsamples. Interestingly, the negative interaction coefficient is larger (in absolute value) and statistically more significant for the *less* integrated group. In column (1), we combine the samples into one panel and include a triple interaction of the 2008 investment return, *Post_Crisis*, and the employment dummy. The coefficient on the triple interaction is positive, indicating a smaller effect for the more integrated hospitals, and it is not statistically significant. The results are similar for the finer measure of integration (right panel).

To summarize, we find that more integrated hospitals experienced a stronger overall increase in catheterization rates immediately after the financial crisis, consistent with their greater alignment with physicians. This suggests that hospital-physician integration played a role in how hospitals responded to the financial crisis. However, we find no significant difference between the two hospital groups in the sensitivity of their post-2008 response to the magnitude of the 2008 financial loss. This is consistent with the arguments in prior literature that even looser physician arrangements leave scope for hospital influence on physicians when faced with a significant shock.

For completeness, we replicate the tests in this section for our child delivery sample. Based on the analysis thus far, we find no evidence that C-section rates increased after 2008, or that the response was stronger for hospitals with poor financial performance in 2008. Consistent with these results, Table A11 and Figure A5 in the Appendix show no significant difference in how C-section rates changed around 2008 for the more integrated vs. the less integrated hospitals. Similarly, Table A12 shows no evidence that the more integrated hospitals increased C-sections more strongly in response to poor financial performance in 2008. If anything, the regressions suggest the opposite effect, and are thus consistent with the results reported for the cardiac sample in Table 9.

## 7 Conclusions

A large corporate finance literature examines the interaction between firms' financing and their product market choices. One of the central findings is that, when quality is imperfectly observed by consumers, financially constrained firms have incentives to lower their product quality to increase cash flows in the short run. A number of studies find evidence of such "quality skimping" in manufacturing and retail firms. This paper focuses on the healthcare sector: it tests whether financial shortfalls at hospitals affect clinical choice. We examine two high-stakes medical settings that have been widely explored in health economics: heart attacks and child deliveries. In both cases, the more intensive treatment choice – heart surgery in the case of heart attack and C-section in the case of child delivery – tends to be more profitable to hospitals. We test whether physicians shift towards these more intensive treatment options when the hospital's financial condition deteriorates.

We use the 2008 financial crisis to identify the effects of a financial shock. We find that, in spite of the large magnitude of this shock, there is no significant shift in the average use of the more intensive treatment options in either of the two settings. However, in the case of cardiac treatment, we find that hospitals that experienced a more severe financial shock in 2008 subsequently increased their use of the more intensive treatment options. The effect is economically significant and it is concentrated among hospitals on either end of the cardiac intensity spectrum, with hospitals operating close to the industry norm showing no significant response.

One explanation for the lack of response for some hospitals might be the often loose relationship between a hospital's management and its key workers (physicians). Consistent with this explanation, we find that hospitals with closer ties to their physicians increased treatment intensity more post-2008 relative to hospital with looser ties (though the sensitivity of this increase to the magnitude of the 2008 financial loss was similar for both groups). Alternative explanations include the prevalence of the nonprofit status in the healthcare sector and, arguably, its stronger emphasis on ethical norms. Understanding the role of these factors in dealing with product market frictions remains a worthwhile goal for future research.

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**Fig. 1: Nonprofit hospitals' financial performance from 2005-2011.** The total sample consists 3,272 nonprofit hospitals from 2005 through 2011. *Fin. Investments* are financial investments scaled by fixed assets. *Investment Income* is income from investments from the statement of revenues in Schedule G scaled by lagged fixed assets (see details in Section 3.2). *Service Revenue* is revenue from medical services.

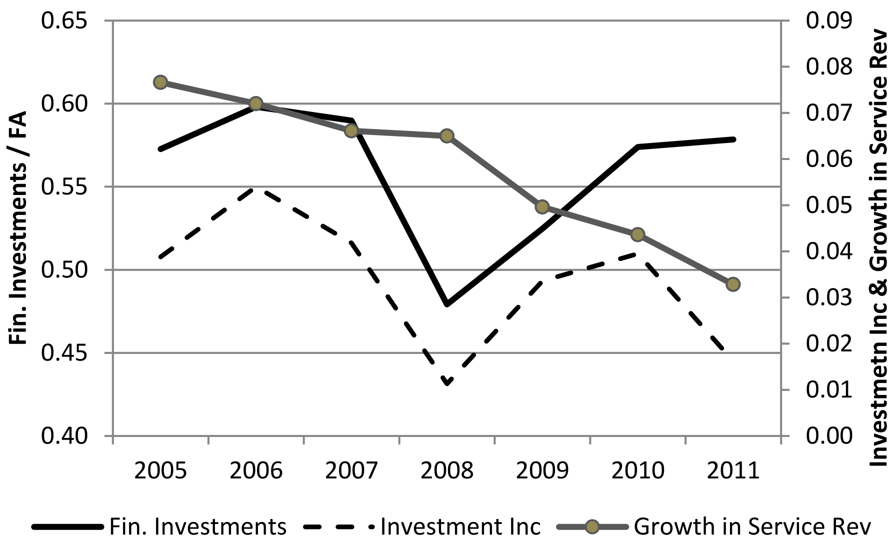



**Fig. 2: Nonprofit hospitals' investment from 2005-2011.** The total sample consists 3,272 nonprofit hospitals from 2005 through 2011. The figure shows growth rates in Fixed Assets, Equipment and Buildings, each scaled by lagged fixed assets, and growth in salaries. *Fixed Assets* is gross land, buildings, and equipment minus accumulated depreciation. *Equipment* includes cars and trucks, major movable equipment, minor equipment, and minor nondepreciable equipment.

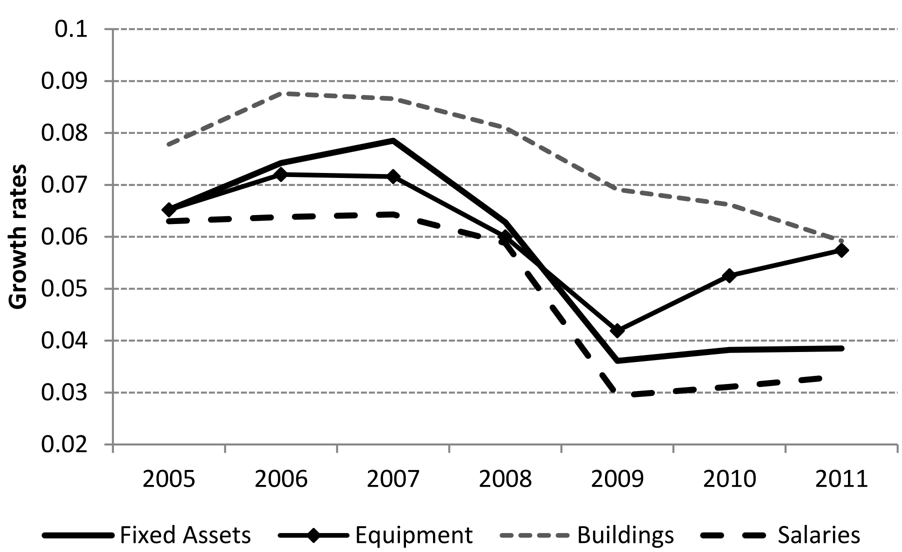


**Fig. 3a: Catheterizations frequency for heart attack patients from 2005-2011.** The sample consists of 1,006,958 heart attack admissions to 317 nonprofit hospitals in seven states (listed in Table 2) from 2005 to 2011. High intensity and low intensity hospitals are hospitals with above- and below-median catheterization rates in 2005.

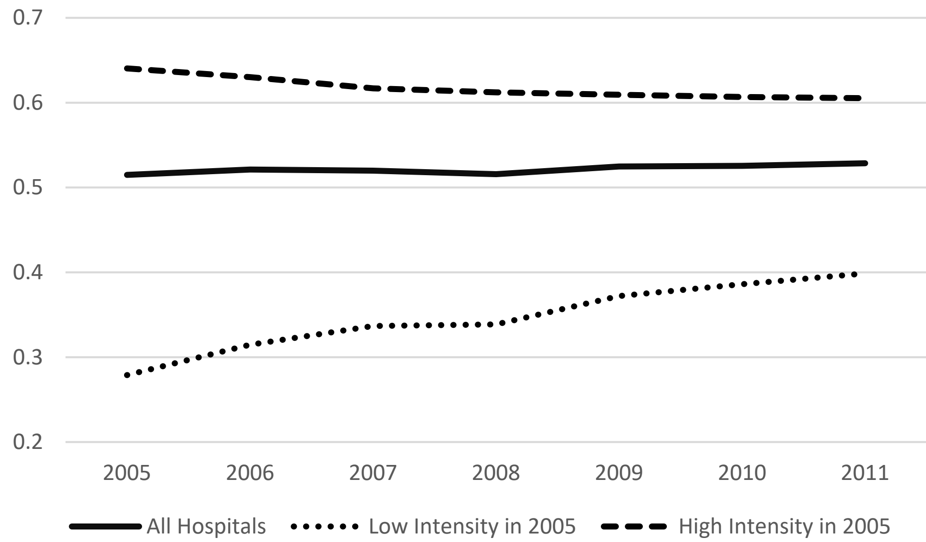



**Fig. 3b: C-section frequency for child delivery patients from 2005-2011.** The sample consists of 3,725,015 child delivery admissions to 356 nonprofit hospitals in seven states (listed in Table 5) from 2005 to 2011. High intensity and low intensity hospitals are hospitals with above- and below-median C-section rates in 2005.

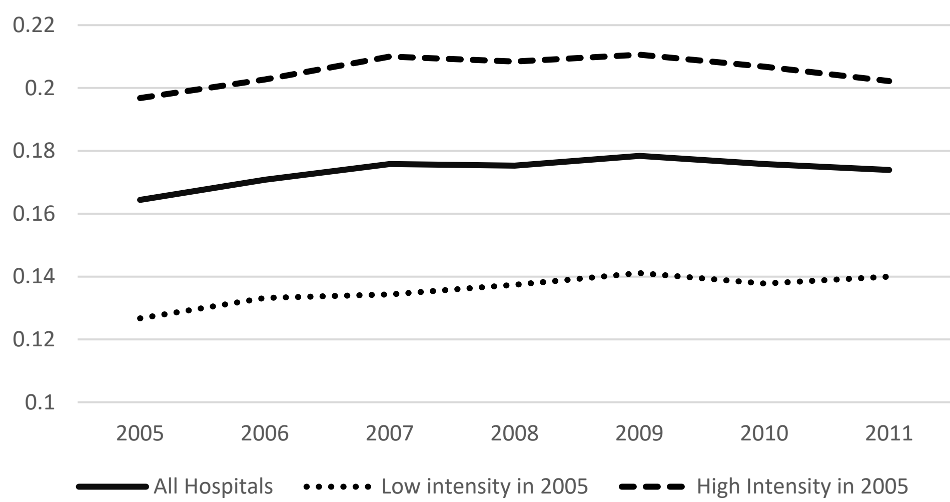


**Fig. 4: OLS estimates of the effect of the 2008 investment returns on catheterization choice for heart attack patients by year.** The sample includes hospital admissions for the Acute Myocardial Infarction (AMI). The figure shows coefficients from the OLS regression of an indicator variable for whether the patient received catheterization during the hospital stay on the interactions of year fixed effects with investment returns in 2008 (*Inv_Inc08*) and control variables. The figure plots the interaction coefficients for years 2005-2011 and their standard errors. The control variables include hospital fixed effects, year fixed effects, patient controls (indicators for the patient's race, sex, insurance status, and age group), and interactions of year fixed effects with the hospital's catheterization rate in 2005 (*Inensity_AMI*). Standard errors are clustered by hospital.

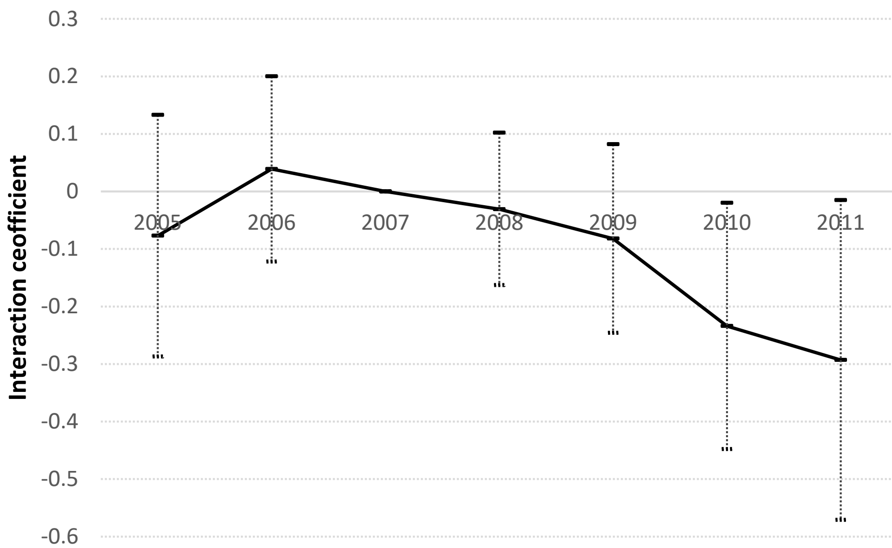


**Fig. 5: Catheterizations rates for hospitals with different levels of cardiac intensity and 2008 investment returns**
The sample includes hospital admissions for Acute Myocardial Infarction (AMI). Hospitals are sorted into quintiles based on their catheterization rate in 2005. Q1-Q5 denote quintiles one through five. Each figure shows catheterization rates for hospitals split by their 2008 investment return (*Inv_Inc08*) with *high return* defined as return above the top tercile.

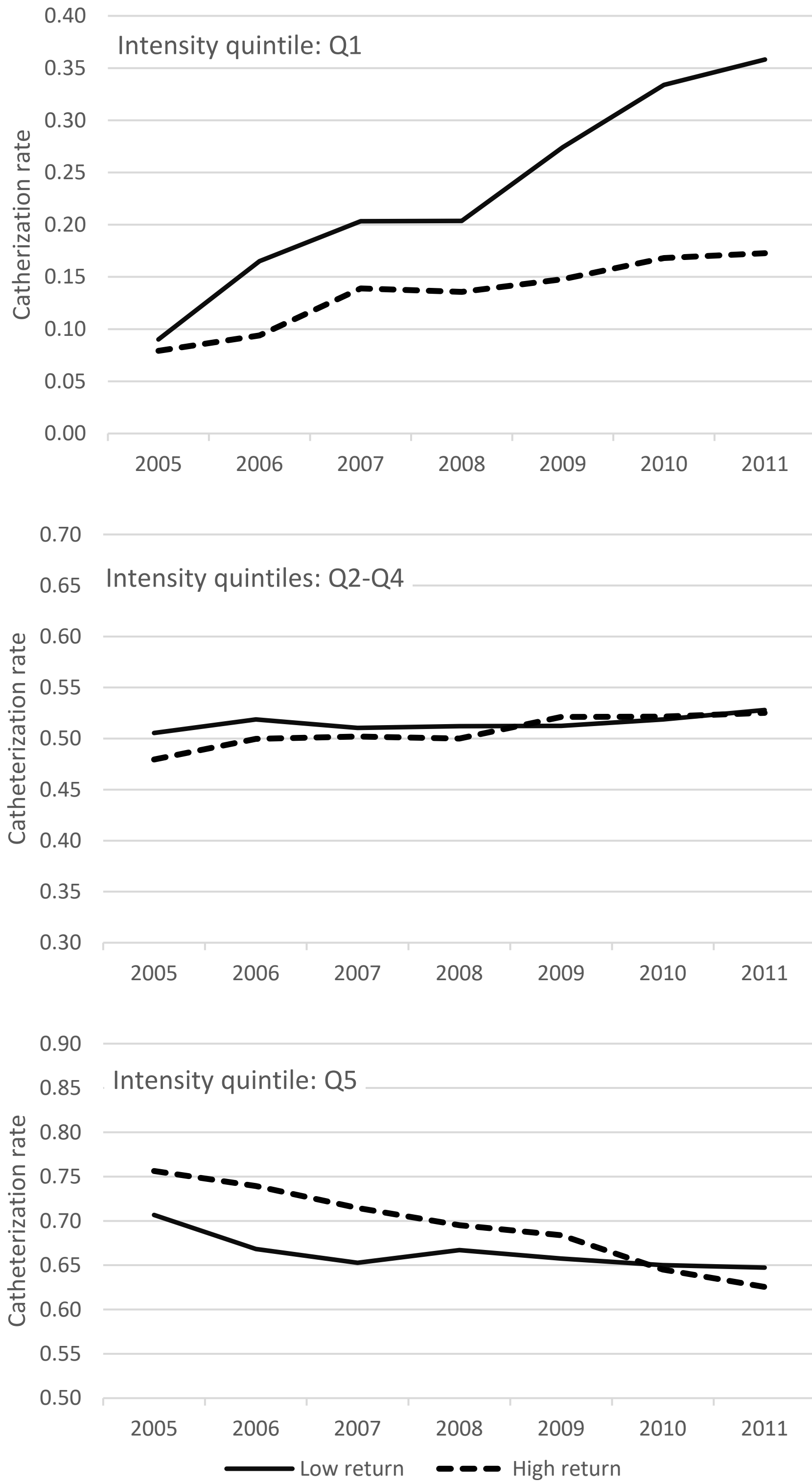
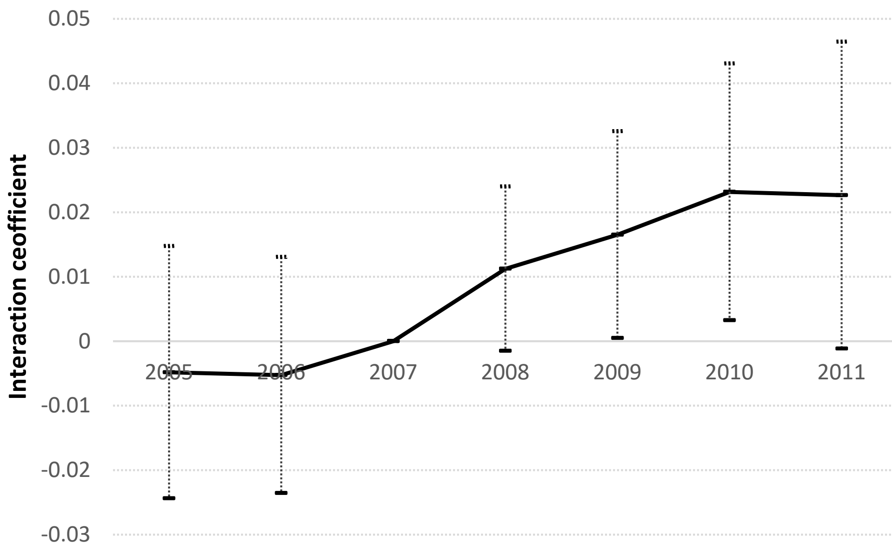


**Fig. 6: OLS estimates of the effects of hospital integration on catheterization choice for heart attack patients by year.** The sample includes hospital admissions for the Acute Myocardial Infarction (AMI). The figures show coefficients from the OLS regression of an indicator variable for whether the patient received catheterization during the hospital stay on the interactions of year fixed effects with a measure of hospital-physician integration and control variables. The figures plot interaction coefficients for years 2005-2011 and their standard errors. The control variables include hospital fixed effects, year fixed effects, patient controls (indicators for the patient's race, sex, insurance status, and age group) and interactions of year fixed effects with the hospital's catheterization rate in 2005 (*Inensity_AMI*) and log of patient revenues in 2005 (*Size*). Standard errors are clustered by hospital.

Panel A: Integration measured using an indicator for hospitals with employment relationship with at least some physicians




Panel B: Integration measured using the fraction of privileged physicians employed by the hospital

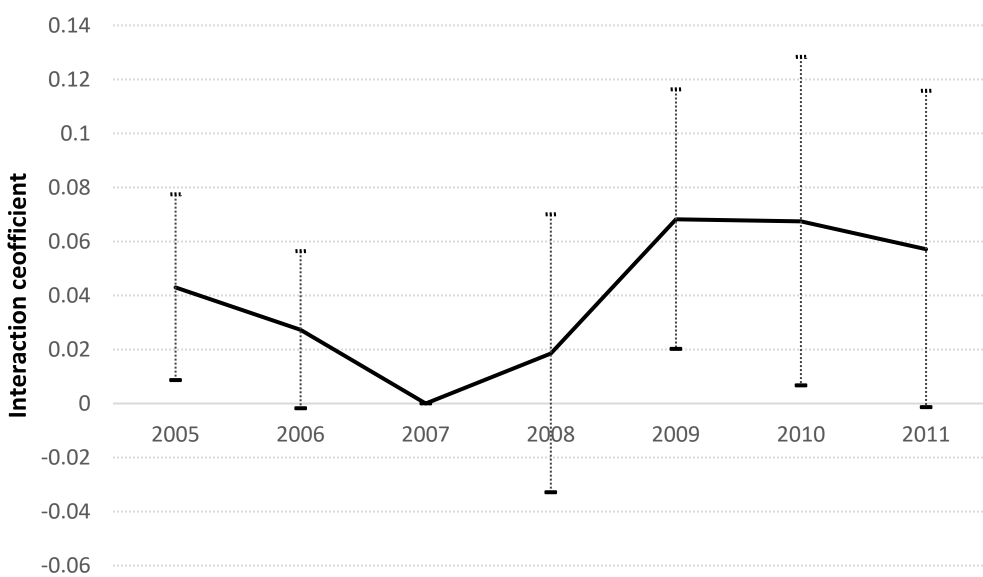


**Table 1: Descriptive statistics for the HCRIS sample.** The sample in Panel A includes 3,272 nonprofit hospitals from 2005 through 2011. The sub-sample in Panel B includes 739 hospitals in the seven states for which we have SID data (AZ, CA, FL, MA, NJ, NY, WA). The financial data come from HCRIS, Schedule G. *Fixed Assets* is gross land, buildings, and equipment minus accumulated depreciation. *Service Revenue* is revenue from medical services. *Net Debt* is financial debt (bonds and bank loans) minus cash and temporary securities scaled by fixed assets. *Financial Investments* is the dollar amount of financial investments scaled by fixed assets. *Operating Income* is the difference between service revenue and service expenses scaled by lagged fixed assets. *Investment Income* is income from investments from the statement of revenues in Schedule G scaled by lagged fixed assets (see details in Section 3.2). *Equipment* includes cars and trucks, major movable equipment, minor equipment, and minor nondepreciable equipment.

| | Mean | Median | Std | P5 | P95 | N |
|---|---|---|---|---|---|---|
| *Panel A: All States* | | | | | | |
| Fixed Assets (in millions) | 82.30 | 35.00 | 140.00 | 1.28 | 313.00 | 19,721 |
| Service Revenue (in millions) | 164.00 | 80.80 | 235.00 | 7.69 | 590.00 | 19,838 |
| Net Debt | 0.25 | 0.23 | 0.83 | -0.87 | 1.40 | 17,906 |
| Financial Investments | 0.56 | 0.29 | 0.73 | 0.00 | 2.08 | 12,417 |
| Investment Income | 0.03 | 0.01 | 0.06 | 0.00 | 0.15 | 13,585 |
| Operating Income | -0.02 | -0.01 | 0.20 | -0.35 | 0.25 | 19,276 |
| Growth in Fixed Assets | 0.06 | 0.00 | 0.21 | -0.11 | 0.44 | 18,654 |
| Growth in Equipment | 0.06 | 0.05 | 0.16 | -0.15 | 0.30 | 15,671 |
| Growth in Buildings | 0.07 | 0.03 | 0.21 | -0.09 | 0.45 | 17,451 |
| Growth in Salaries | 0.05 | 0.05 | 0.06 | -0.05 | 0.14 | 15,311 |
| Growth in Sales | 0.06 | 0.05 | 0.10 | -0.08 | 0.21 | 19,227 |
| *Panel B: Seven SID States* | | | | | | |
| Fixed Assets (in millions) | 111.00 | 59.40 | 162.00 | 3.98 | 407.00 | 4,355 |
| Service Revenue (in millions) | 232.00 | 155.00 | 281.00 | 14.10 | 706.00 | 4,380 |
| Net Debt | 0.33 | 0.30 | 0.82 | -0.80 | 1.51 | 4,169 |
| Financial Investments | 0.41 | 0.16 | 0.62 | 0.00 | 1.65 | 2,555 |
| Investment Income | 0.03 | 0.01 | 0.05 | 0.00 | 0.12 | 3,002 |
| Operating Income | -0.04 | -0.02 | 0.19 | -0.36 | 0.21 | 4,296 |
| Growth in Fixed Assets | 0.07 | 0.01 | 0.21 | -0.10 | 0.42 | 4,181 |
| Growth in Equipment | 0.06 | 0.05 | 0.15 | -0.15 | 0.28 | 3,610 |
| Growth in Buildings | 0.08 | 0.03 | 0.20 | -0.09 | 0.44 | 4,008 |
| Growth in Salaries | 0.06 | 0.06 | 0.06 | -0.03 | 0.15 | 4,108 |
| Growth in Sales | 0.06 | 0.06 | 0.09 | -0.07 | 0.21 | 4,284 |

**Table 2: Descriptive statistics for the heart attack sample.** The sample consists of 513,146 heart attack admissions in 1,029 hospital-years used in Table 3. The admissions are from seven states during 2005 to 2011 (year 2008 is excluded). Heart attacks (Acute Myocardial Infarction, AMI) are identified based on the ICD-9-CM diagnosis code '410'. *Catheter* is an indicator for whether the patient received cardiac catheterization during the hospital stay. We use the Clinical Classifications Software (CCS) for ICD-9-CM, procedure code 47 to identify catheterizations. Panel A shows patient-level variables, and Panel B shows hospital-level variables. *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. For comparison, *Inv_Inc_non08* is measured in years other than 2008. *Intensity_AMI* is the hospital's catheterization rate in 2005. *Size* is the log of hospital service revenue in 2005.

Panel A: Patient-level variables

| | All Hosp. | Arizona | California | Florida | Maryland | New Jersey | New York | Washing-ton |
|---|---|---|---|---|---|---|---|---|
| Catheter | 0.52 | 0.59 | 0.56 | 0.56 | 0.46 | 0.42 | 0.48 | 0.56 |
| White | 0.71 | 0.83 | 0.59 | 0.83 | 0.78 | 0.78 | 0.66 | 0.41 |
| Black | 0.08 | 0.02 | 0.07 | 0.08 | 0.17 | 0.08 | 0.09 | 0.01 |
| Hispanic | 0.09 | 0.10 | 0.18 | 0.06 | 0.01 | 0.07 | 0.10 | 0.01 |
| Private Ins. | 0.24 | 0.21 | 0.27 | 0.20 | 0.26 | 0.27 | 0.21 | 0.30 |
| Medicaid | 0.06 | 0.08 | 0.09 | 0.05 | 0.05 | 0.02 | 0.10 | 0.05 |
| Medicare | 0.63 | 0.63 | 0.58 | 0.65 | 0.63 | 0.64 | 0.65 | 0.60 |
| Self-pay | 0.04 | 0.03 | 0.04 | 0.05 | 0.04 | 0.06 | 0.03 | 0.04 |
| No-charge | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other-pay | 0.02 | 0.06 | 0.03 | 0.03 | 0.01 | 0.00 | 0.01 | 0.02 |
| Female | 0.42 | 0.41 | 0.41 | 0.40 | 0.44 | 0.44 | 0.43 | 0.40 |
| Age | 70.00 | 69.89 | 69.91 | 69.37 | 69.27 | 71.27 | 70.45 | 69.68 |
| N | 513,146 | 41,454 | 118,558 | 115,391 | 48,225 | 69,240 | 92,982 | 27,296 |

Panel B: Hospital-level variables

| | Mean | Median | Std | P5 | P95 | N |
|---|---|---|---|---|---|---|
| Inv_Inc08 | 0.005 | 0.004 | 0.044 | -0.071 | 0.051 | 1029 |
| Inv_Inc_non08 | 0.031 | 0.016 | 0.050 | 0.000 | 0.112 | 928 |
| Intensity_AMI | 0.425 | 0.484 | 0.231 | 0.033 | 0.754 | 1009 |
| Size | 19.154 | 19.097 | 0.712 | 18.037 | 20.387 | 1009 |

**Table 3: Regressions of catheterization choice for heart attack patients: the effect of investment income in 2008.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (year 2008 is excluded). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Inv_Inc08_T2* and *Inv_Inc08_T3* are dummy variables for the second and the third tercile of *Inv_Inc08*. *Intensity_AMI* is the hospital's catheterization rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

Panel A: All patients

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | | | -0.136 | -0.187** | -0.178** |
| | | | (0.125) | (0.090) | (0.087) |
| Post_Crisis*Inv_Inc08_T2 | 0.023 | 0.011 | | | |
| | (0.018) | (0.012) | | | |
| Post_Crisis*Inv_Inc08_T3 | -0.012 | -0.023* | | | |
| | (0.016) | (0.012) | | | |
| Post_Crisis*Intensity_AMI | | -0.250*** | | -0.251*** | -0.240*** |
| | | (0.034) | | (0.035) | (0.035) |
| Post_Crisis*Size0 | | | | | -0.009 |
| | | | | | (0.006) |
| N | 513,146 | 497,972 | 513,146 | 497,972 | 497,972 |
| Hospital FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |

Panel B: By insurance status

| | Other | Medicaid | Medicare | Private |
|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | -0.024 | -0.205 | -0.215** | -0.147 |
| | (0.148) | (0.134) | (0.098) | (0.120) |
| N | 34,793 | 32,395 | 313,251 | 117,505 |
| Hospital FE | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Post_Crisis*Intensity_AMI | Y | Y | Y | Y |

**Table 4: Regressions of catheterization choice for heart attack patients by hospital-level treatment intensity.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay for each quintile of hospital-level treatment intensity in 2005 (defined as the share of patients receiving catheterizations, controlling for all risk factors). *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (year 2008 is excluded). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. The control variables include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | -1.985 | -0.338 | 0.022 | 0.055 | -0.288*** |
| | (1.294) | (0.353) | (0.158) | (0.207) | (0.104) |
| N | 63,785 | 75,112 | 104,817 | 125,024 | 129,234 |
| Hospital FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |

**Table 5: Descriptive statistics for child deliveries patients.** The sample consists of 1,868,777 child delivery admissions in 1,145 hospital-years used in Table 6. The admissions are from seven states during 2005 to 2011 (year 2008 is excluded). Child delivery is identified based on the ICD-9-CM diagnosis code 'V27'. *C-section* is an indicator for whether the delivery was via Cesarean section. We use the ICD-9-CM, procedure codes 740, 741, 742, 744, and 7499 to identify C-sections. Panel A shows patient-level variables, and Panel B shows hospital-level variables. *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. For comparison, *Inv_Inc_non08* is measured in years other than 2008. *Intensity_CS* is the hospital's C-section rate in 2005. *Size* is the log of hospital service revenue in 2005.

Panel A: Patient-level variables

| | All Hospitals | Arizona | California | Florida | Maryland | New Jersey | New York | Washing-ton |
|---|---|---|---|---|---|---|---|---|
| C-section | 0.17 | 0.14 | 0.16 | 0.18 | 0.17 | 0.20 | 0.18 | 0.12 |
| Hypertension | 0.08 | 0.08 | 0.06 | 0.11 | 0.10 | 0.07 | 0.07 | 0.09 |
| Previa | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 |
| Early_Labor | 0.06 | 0.07 | 0.05 | 0.06 | 0.07 | 0.06 | 0.06 | 0.06 |
| Complic_Mother | 0.37 | 0.38 | 0.31 | 0.40 | 0.58 | 0.37 | 0.37 | 0.39 |
| Cord_Prolapse | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rupture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| White | 0.43 | 0.49 | 0.29 | 0.54 | 0.54 | 0.49 | 0.52 | 0.27 |
| Black | 0.11 | 0.04 | 0.05 | 0.19 | 0.31 | 0.11 | 0.12 | 0.01 |
| Hispanic | 0.27 | 0.36 | 0.45 | 0.19 | 0.07 | 0.21 | 0.15 | 0.09 |
| Private Insurance | 0.51 | 0.43 | 0.48 | 0.42 | 0.54 | 0.72 | 0.56 | 0.55 |
| Medicaid | 0.44 | 0.48 | 0.48 | 0.51 | 0.43 | 0.17 | 0.42 | 0.43 |
| Medicare | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Self_Pay | 0.03 | 0.02 | 0.02 | 0.04 | 0.01 | 0.09 | 0.01 | 0.00 |
| No_Charge | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other_Pay | 0.02 | 0.06 | 0.02 | 0.03 | 0.02 | 0.01 | 0.01 | 0.02 |
| Age | 27.77 | 26.24 | 28.01 | 26.54 | 27.38 | 29.03 | 28.84 | 26.54 |
| N | 1,868,777 | 163,144 | 600,840 | 300,109 | 150,295 | 177,365 | 391,967 | 85,057 |

Panel B: Hospital-level variables

| | Mean | Median | Std | P5 | P95 | N |
|---|---|---|---|---|---|---|
| Inv_Inc08 | 0.006 | 0.005 | 0.041 | -0.071 | 0.044 | 1,145 |
| Inv_Inc_non08 | 0.030 | 0.015 | 0.049 | 0.000 | 0.111 | 1,027 |
| Intensity_CS | 0.155 | 0.151 | 0.045 | 0.083 | 0.233 | 1,109 |
| Size | 18.880 | 18.934 | 0.895 | 17.383 | 20.332 | 1,114 |

**Table 6: Regressions of the C-section choice for child deliveries: the effect of investment income in 2008.** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via a Cesarean section. *Post_Crisis* is a dummy variable equal to one for years 2009-2011 and equal to zero for years 2005-2007 (year 2008 is excluded). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Inv_Inc08_T2* and *Inv_Inc08_T3* are dummy variables for the second and the third tercile of *Inv_Inc08*. *Intensity_CS* is the hospital's C-section rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

Panel A: All patients

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | | | -0.023 | -0.025 | -0.028 |
| | | | (0.035) | (0.034) | (0.032) |
| Post_Crisis*Inv_Inc08_T2 | 0.003 | 0.001 | | | |
| | (0.004) | (0.004) | | | |
| Post_Crisis*Inv_Inc08_T3 | -0.002 | -0.003 | | | |
| | (0.004) | (0.004) | | | |
| Post_Crisis*Intensity_CS | | -0.106** | | -0.106** | -0.115*** |
| | | (0.042) | | (0.043) | (0.043) |
| Post_Crisis*Size | | | | | 0.003 |
| | | | | | (0.003) |
| N | 1,868,777 | 1,825,097 | 1,868,777 | 1,825,097 | 1,825,097 |
| Hospital FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |

Panel B: By insurance status

| | Other | Medicaid | Medicare | Private |
|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | 0.014 | -0.032 | -0.103 | -0.002 |
| | (0.043) | (0.034) | (0.271) | (0.031) |
| N | 87,503 | 798,895 | 5,790 | 932,301 |
| Hospital FE | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Post_Crisis*Intensity_CS | Y | Y | Y | Y |

**Table 7: Physician arrangements descriptive statistics:** The table shows hospitals' participation in different types of physician arrangements as reported by the American Hospital Association (AHA) annual survey. The overall sample consists of 316 hospitals for which we have SID data on cardiac treatment and that also have data on HCRIS and AHA in 2008. Panel A shows the fraction of hospitals that report having the arrangement with at least some of its physicians based on the 2008 AHA survey. Panel B shows descriptive statistics for the fraction of privileged physicians under each arrangement based on the 2010 AHA survey (first available year).

Panel A: Fraction of hospitals engaging in each type of physician arrangements

| | |
|---|---|
| Employment | 0.36 |
| Contractual | 0.32 |
| No Integration | 0.38 |

Panel B: Fraction of privileged physicians in the hospital under each arrangement

| | Mean | Median | Std | P25 | P75 | N |
|---|---|---|---|---|---|---|
| Employed | 0.15 | 0.05 | 0.25 | 0.00 | 0.17 | 233 |
| Individual contract | 0.08 | 0.00 | 0.21 | 0.00 | 0.03 | 234 |
| Group contract | 0.22 | 0.14 | 0.26 | 0.01 | 0.29 | 234 |
| Not employed or under contract | 0.49 | 0.59 | 0.34 | 0.00 | 0.80 | 234 |

**Table 8: Regressions of catheterization choice for heart attack patients: the role of physician arrangements.** The sample includes hospital admissions for the Acute Myocardial Infarction (AMI). The table shows OLS regressions of an indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (left panels) or for years 2006-2008 (right panels). *Employment Dummy* is a dummy variable equal to one for hospitals with employment relationship with at least some physicians. *FractEmployed* is the fraction of privileged physicians that are employed by the hospital. *FractEmployed_Q4* are dummy variables for hospitals above the fourth quartile of *FractEmployed*. *Intensity_AMI* is the hospital's catheterization rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

Panel A: All patients

| | Pre-Crisis Period = 2005 to 2007 | | | Pre-Crisis Period = 2006 to 2008 | | |
|---|---|---|---|---|---|---|
| Post_Crisis*Employment_Dummy | 0.025** | | | 0.017** | | |
| | (0.010) | | | (0.009) | | |
| Post_Crisis*FractEmployed | | 0.041 | | | 0.048** | |
| | | (0.026) | | | (0.022) | |
| Post_Crisis*FractEmployed_Q4 | | | 0.022* | | | 0.022** |
| | | | (0.013) | | | (0.011) |
| N | 688,514 | 508,656 | 508,656 | 692,552 | 509,099 | 509,099 |
| Hospital FE | Y | Y | Y | Y | Y | Y |
| Post_Crisis*Intensity_AMI | Y | Y | Y | Y | Y | Y |
| Post_Crisis* Size | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y | Y |

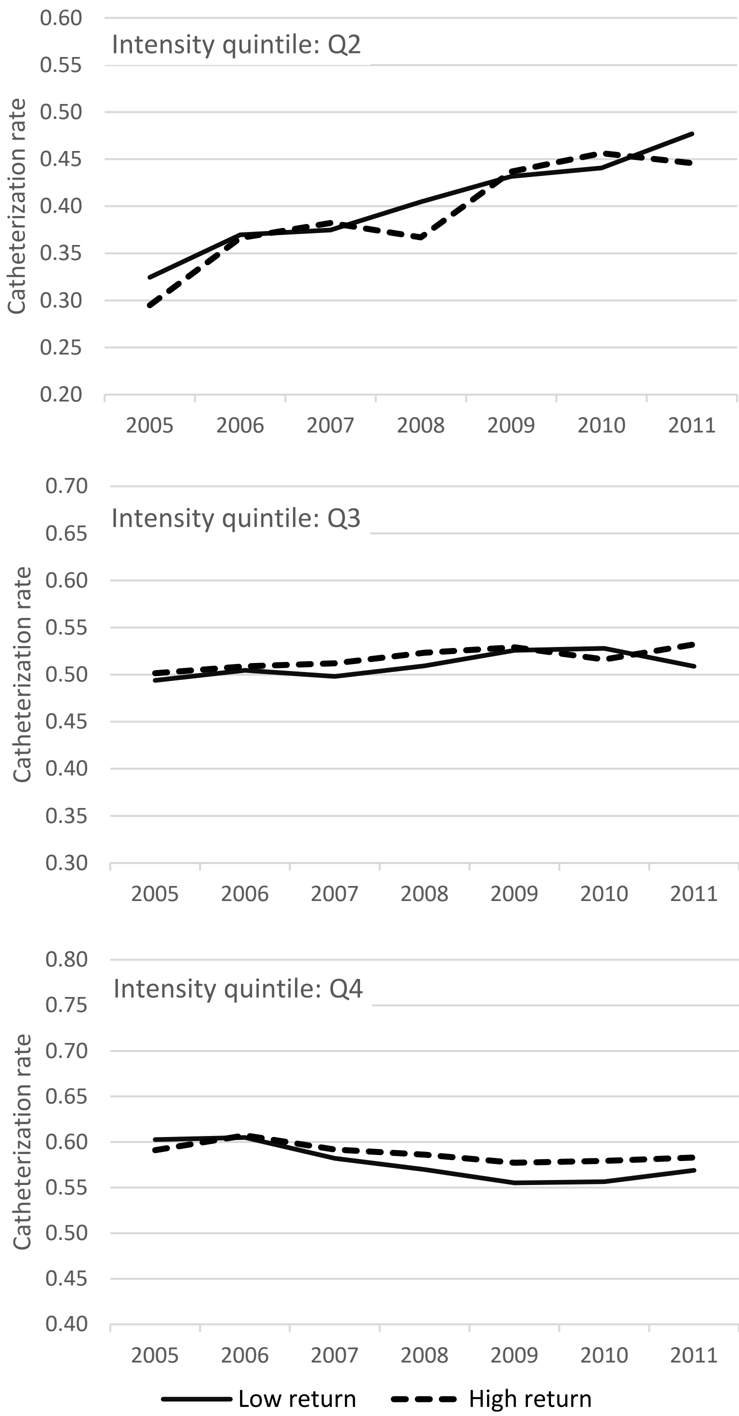
Panel B: Private-insurance patients

| | Pre-Crisis Period = 2005 to 2007 | | | Pre-Crisis Period = 2006 to 2008 | | |
|---|---|---|---|---|---|---|
| Post_Crisis*Employment_Dummy | 0.024* | | | 0.023** | | |
| | (0.012) | | | (0.011) | | |
| Post_Crisis*FractEmployed | | 0.074* | | | 0.082** | |
| | | (0.039) | | | (0.032) | |
| Post_Crisis*FractEmployed_Q4 | | | 0.030* | | | 0.029* |
| | | | (0.017) | | | (0.015) |
| N | 171,328 | 128,379 | 128,379 | 171,426 | 127,781 | 127,781 |
| Hospital FE | Y | Y | Y | Y | Y | Y |
| Post_Crisis*Intensity_AMI | Y | Y | Y | Y | Y | Y |
| Post_Crisis* Size | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y | Y |

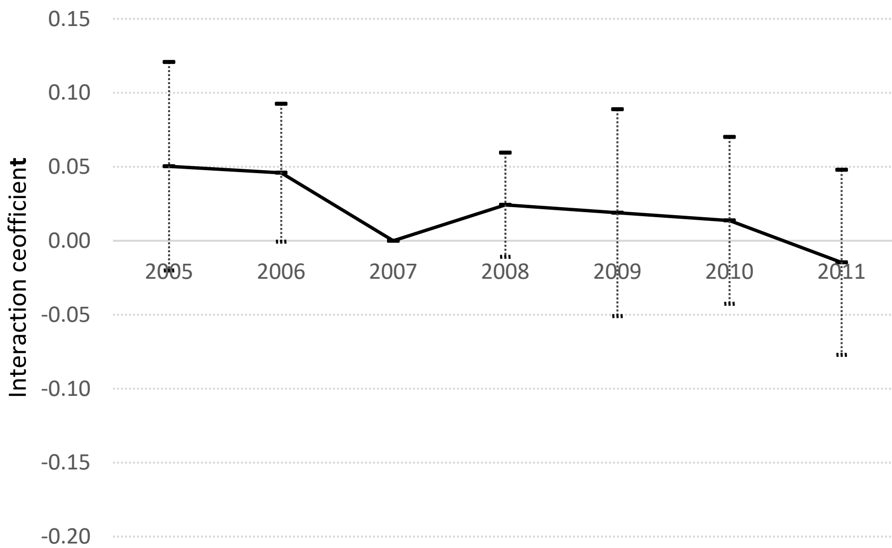
**Table 9: Hospital returns and catheterization: the role of physician arrangements:** The sample includes hospital admissions for the Acute Myocardial Infarction (AMI). The table shows OLS regressions of an indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal to one for years 2009-2011 and equal to zero for years 2005-2007 (year 2008 is excluded). *Integration* measures a hospital's degree of integration with physicians. In the left panel, *Integration* is set to a dummy variable equal to one for hospitals with employment relationship with at least some physicians. In columns (2) and (3), hospitals are classified as *Integrated* when this dummy is equal to one. In the right panel, *Integration* is set to the fraction of privileged physicians that are employed by the hospital. In columns (5) and (6), hospitals are classified as *Integrated* when they are above the third tercile of this measure. *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Intensity_AMI* is the hospital's catheterization rate in 2005. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| Integration measure: | Employment dummy | | | Fraction of physicians that are employed | | |
|---|---|---|---|---|---|---|
| | All hospitals | Integrated | Less Integrated | All hospitals | Integrated | Less Integrated |
| Post_Crisis*Inv_Inc08 | -0.192* | -0.096 | -0.166* | -0.162 | -0.250 | -0.165* |
| | (0.103) | (0.236) | (0.088) | (0.098) | (0.181) | (0.094) |
| Post_Crisis*Integration | 0.011 | | | 0.063 | | |
| | (0.011) | | | (0.046) | | |
| Post_Crisis*Integration*Inv_Inc08 | 0.162 | | | 0.174 | | |
| | (0.285) | | | (1.344) | | |
| Post_Crisis*Intensity_AMI | -0.192* | -0.096 | -0.166* | -0.232*** | -0.356*** | -0.204*** |
| | (0.103) | (0.236) | (0.088) | (0.042) | (0.069) | (0.048) |
| N | 421,854 | 163,273 | 258,581 | 283,404 | 85,012 | 198,392 |
| Hospital FE | Y | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |

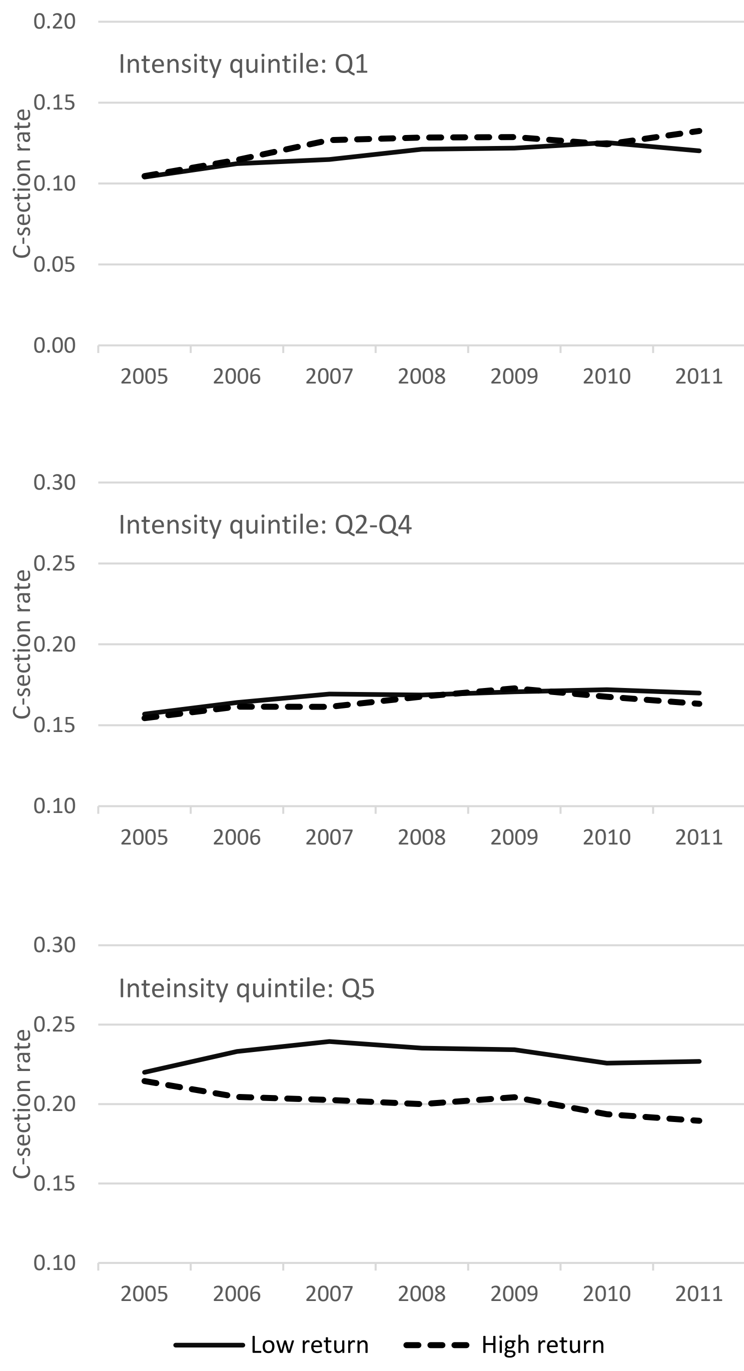
**Internet Appendix – Fig. A1: Catheterization rates for hospitals with different levels of cardiac intensity and 2008 investment returns: quintiles 2-4.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). Hospitals are sorted into quintiles based on their catheterization rate in 2005. The figures below show quintiles Q2, Q3, and Q4. Figure 5 in the paper shows quintiles Q1, Q5, and Q2-Q4 combined for brevity. Each figure shows catheterization rates for hospitals split by their 2008 investment return (*Inv_Inc08*) with *High return* defined as return above the top tercile.



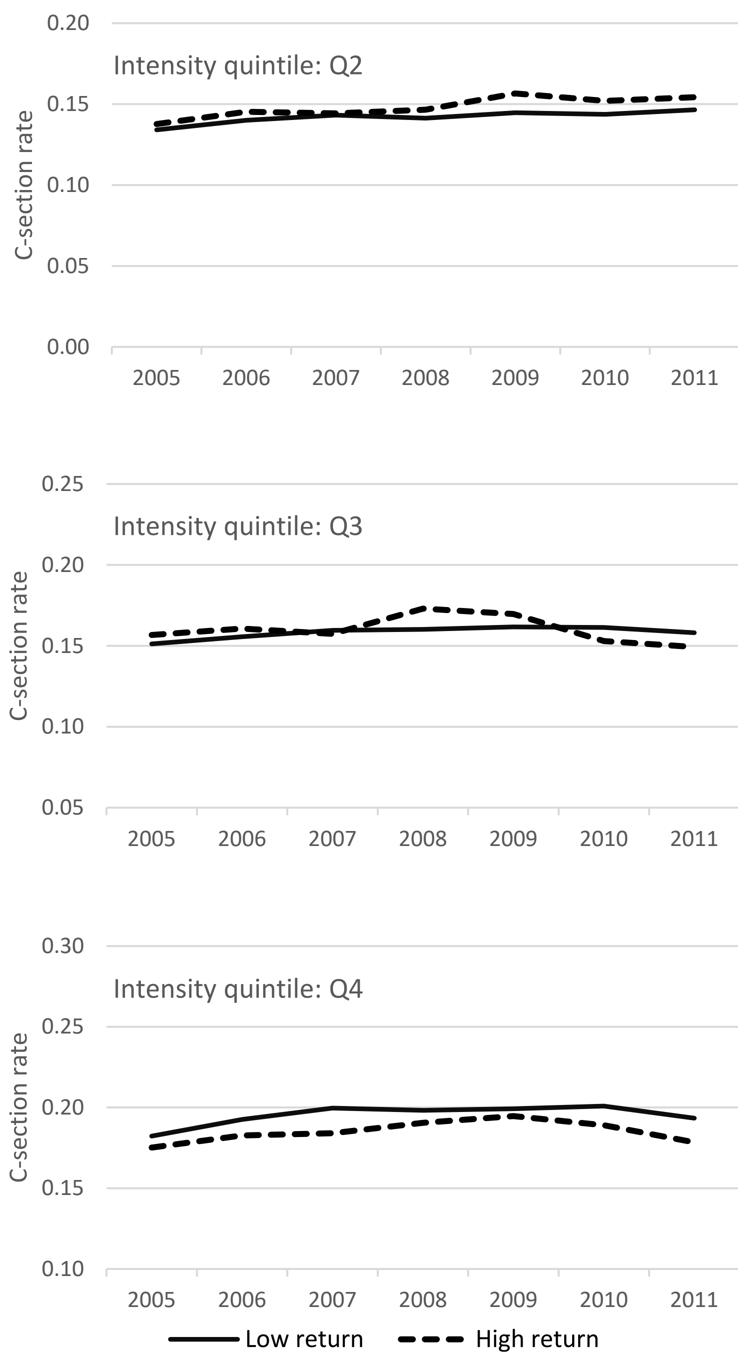
**Internet Appendix - Figure A2: OLS estimates of the effect of the 2008 investment returns on the C-section choice for child deliveries by year.** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via a Cesarean section on the interactions of year fixed effects with investment returns in 2008 (*Inv_Inc08*) and control variables. The figure plots the interaction coefficients for years 2005-2011 and their standard errors. The control variables include hospital fixed effects, year fixed effects, patient controls (indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group), and interactions of year fixed effects with the hospital's C-section rate in 2005 (*Inensity_CS*). Standard errors are clustered by hospital.



**Internet Appendix - Figure A3: C-section rates for hospitals with different levels of C-section intensity and 2008 investment returns.** The sample includes hospital admissions for child delivery. Hospitals are sorted into quintiles based on hospital-level treatment intensity in 2005, adjusted for the patient risk factors for receiving a C-section (see details in Table A9). Q1-Q5 denote quintiles one through five. Each figure shows C-section rates for hospitals split by their 2008 investment return (*Inv_Inc08*) with *high return* defined as return above the top tercile.

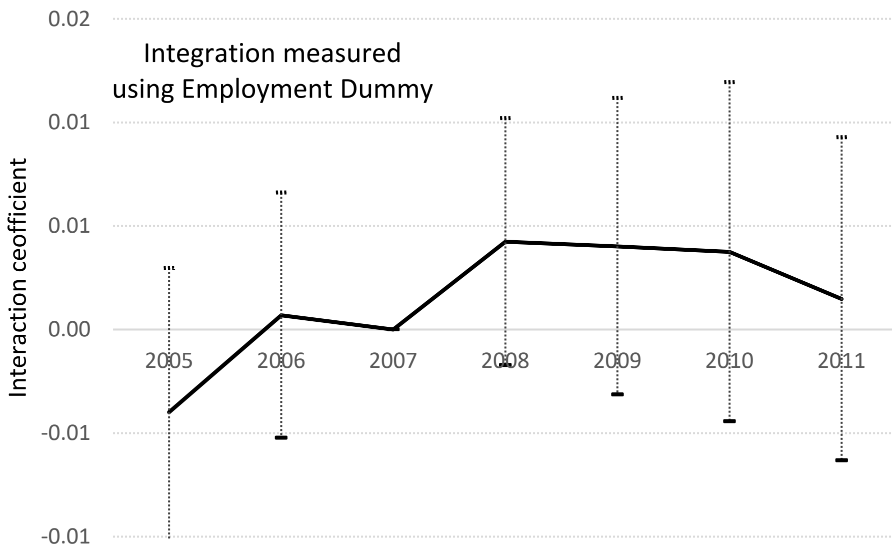


**Internet Appendix - Figure A4: C-section rates for hospitals with different levels of C-section intensity and 2008 investment returns: quintiles 2-4.** The sample includes hospital admissions for child delivery. Hospitals are sorted into quintiles based on hospital-level treatment intensity in 2005, adjusted for the patient risk factors for receiving a C-section (see details in Table A9). The figures below show quintiles Q2, Q3, and Q4. Figure A3 shows quintiles Q1, Q5, and Q2-Q4 combined for brevity. Each figure shows C-section rates for hospitals split by their 2008 investment return (*Inv_Inc08*) with *high return* defined as return above the top tercile.

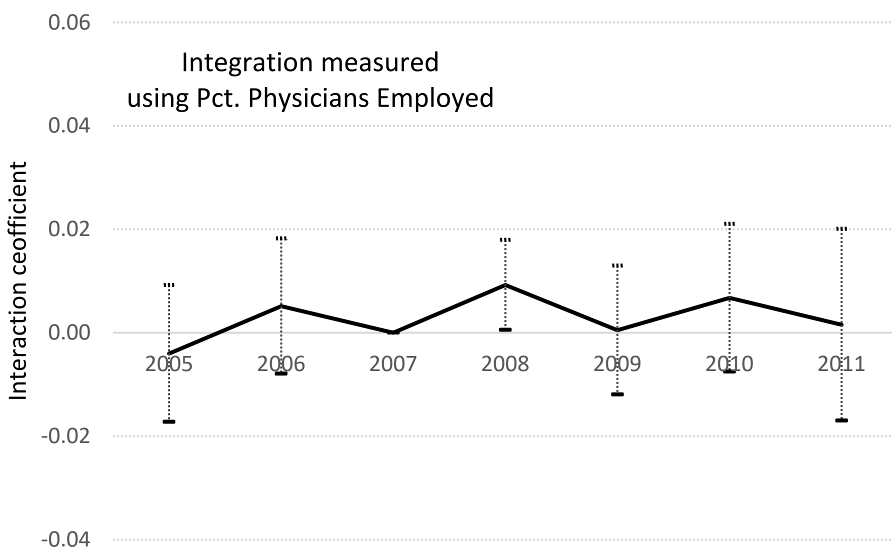


**Internet Appendix - Fig. A5: OLS estimates of the effects of hospital integration on the C-section choice for child deliveries by year.** The sample includes hospital admissions for child delivery. The figures show coefficients from the OLS regression of an indicator variable for whether the delivery was via a Cesarean section on the interactions of year fixed effects with a measure of hospital-physician integration and control variables. The figures plot interaction coefficients for years 2005-2011 and their standard errors. The control variables include hospital fixed effects, year fixed effects, patient controls (indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group), and interactions of year fixed effects with the hospital's C-section rate in 2005 (*Inensity_CS*) and log of patient revenues in 2005 (*Size*). Standard errors are clustered by hospital.

Panel A: Integration measured using an indicator for hospitals with employment relationship with at least some physicians




Panel B: Integration measured using the fraction of privileged physicians employed by the hospital



**Internet Appendix – Table A1: Descriptive statistics for hospitals above and below the median returns on financial investments in 2008, HCRIS sample**. The sample includes 1,777 nonprofit hospitals in 2007. The financial data come from HCRIS, Schedule G. Return on financial investments is measured as income from investments from statement of revenues in Schedule G scaled by lagged fixed assets (see details in Section 3.2). *Fixed Assets* is gross land, buildings, and equipment minus accumulated depreciation. *Service Revenue* is revenue from medical services. *Net Debt* is financial debt (bonds and bank loans) minus cash and temporary securities scaled by fixed assets. *Financial Investments* is the dollar amount of financial investments scaled by fixed assets. *Operating Income* is the difference between service revenue and service expenses scaled by lagged fixed assets. *Equipment* includes cars and trucks, major movable equipment, minor equipment, and minor nondepreciable equipment.

| | Below median returns in 2008 | | | Above median returns in 2008 | | |
|---|---|---|---|---|---|---|
| | Mean | Median | Std. Dev. | Mean | Median | Std. Dev. |
| Fixed Assets (in millions) | 86.10 | 37.00 | 142.00 | 57.70 | 24.10 | 91.80 |
| Service Revenue (in millions) | 170.00 | 82.20 | 247.00 | 133.00 | 58.40 | 209.00 |
| Net Debt | 0.37 | 0.31 | 0.75 | 0.21 | 0.20 | 0.97 |
| Financial Investments | 0.48 | 0.18 | 0.68 | 0.60 | 0.34 | 0.77 |
| Operating Income | -0.04 | -0.02 | 0.18 | -0.02 | -0.01 | 0.18 |
| Growth in Fixed Assets | 0.09 | 0.03 | 0.23 | 0.08 | 0.02 | 0.22 |
| Growth in Equipment | 0.06 | 0.05 | 0.15 | 0.08 | 0.06 | 0.17 |
| Growth in Buildings | 0.09 | 0.03 | 0.24 | 0.08 | 0.03 | 0.19 |
| Growth in Salaries | 0.06 | 0.06 | 0.05 | 0.06 | 0.06 | 0.05 |
| Growth in Sales | 0.07 | 0.06 | 0.09 | 0.06 | 0.06 | 0.09 |

**Internet Appendix - Table A2**: **Hospital investments around the 2008 financial crisis: interaction with investment income in 2008.** The table shows OLS regressions of hospital investments and salary expenditures. The sample consists of nonprofit hospitals during 2005-2011. The dependent variables are change in fixed assets, change in equipment spending, or change in spending on buildings, each scaled by lagged fixed assets, or change in spending on salaries scaled by lagged salaries. The top and bottom 1% of observations in the dependent variables are excluded to minimize the influence of data errors, hospital mergers and closures. The *Post-Crisis* dummy is set to one for years 2009-2011 and is set to zero for years 2005-2007 (year 2008 is excluded). *Inv_Inc08_T2* and *Inv_Inc08_T3* are dummy variables for the second and the third tercile of the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Operating Income* is the difference between service revenue and service expenses scaled by lagged fixed assets. *Service Revenue* is revenue from medical services. *Revenue Growth* is the growth in revenues from medical services. Standard errors are clustered by hospital and are shown in parentheses.

| | Fixed Assets | Equipment | Buildings | Salaries |
|---|---|---|---|---|
| Post_Crisis*Inv_Inc08_T2 | 0.011 | 0.007 | 0.024* | 0.002 |
| | (0.013) | (0.009) | (0.012) | (0.004) |
| Post_Crisis*Inv_Inc08_T3 | 0.049*** | 0.003 | 0.045*** | 0.004 |
| | (0.013) | (0.009) | (0.012) | (0.004) |
| Operating Income | 0.168*** | 0.108*** | 0.122*** | 0.061*** |
| | (0.044) | (0.031) | (0.041) | (0.010) |
| Revenue Growth | -0.004 | 0.012 | -0.078** | 0.100*** |
| | (0.036) | (0.027) | (0.035) | (0.013) |
| Log(Service Revenue) | -0.124*** | -0.068*** | -0.076** | -0.076*** |
| | (0.038) | (0.025) | (0.034) | (0.015) |
| Year FE | Y | Y | Y | Y |
| Hospital FE | Y | Y | Y | Y |
| N | 9,525 | 8,253 | 9,037 | 7,690 |

**Internet Appendix – Table A3: Regressions of catheterization choice for heart attack patients: including 2008.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal to one for years 2009-2011 and equal to zero for years 2006-2008. *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Inv_Inc08_T2* and *Inv_Inc08_T3* are dummy variables for the second and the third tercile of *Inv_Inc08*. *Intensity_AMI* is the hospital's catheterization rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | | | -0.150 | -0.206*** | -0.198** |
| | | | (0.098) | (0.079) | (0.077) |
| Post_Crisis*Inv_Inc08_T2 | 0.020 | 0.011 | | | |
| | (0.014) | (0.011) | | | |
| Post_Crisis*Inv_Inc08_T3 | -0.014 | -0.022** | | | |
| | (0.013) | (0.011) | | | |
| Post_Crisis*Intensity_AMI | | -0.179*** | | -0.180*** | -0.172*** |
| | | (0.030) | | (0.030) | (0.030) |
| Post_Crisis*Size | | | | | -0.007 |
| | | | | | (0.005) |
| N | 519,664 | 501,450 | 519,664 | 501,450 | 501,450 |
| Hospital FE | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |

**Internet Appendix – Table A4: Regressions of catheterization choice for heart attack patients: patient controls robustness.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (left panel) or 2006-2008 (right panel). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Intensity_AMI* is the hospital's catheterization rate in 2005. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | Pre-Crisis Period = 2005 to 2007 | | Pre-Crisis Period = 2006 to 2008 | |
|---|---|---|---|---|
| | Patient controls & interactions included | Patient controls excluded | Patient controls & interactions included | Patient controls excluded |
| Post_Crisis*Inv_Inc08 | -0.190** | -0.193** | -0.206*** | -0.195** |
| | (0.090) | (0.098) | (0.079) | (0.089) |
| Post_Crisis*Intensity_AMI | -0.263*** | -0.287*** | -0.190*** | -0.209*** |
| | (0.036) | (0.038) | (0.031) | (0.033) |
| N | 497,972 | 498,007 | 501,450 | 501,481 |
| Hospital FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Patient controls | Y | N | Y | N |
| Post_Crisis*Patient controls | Y | N | Y | N |

**Internet Appendix – Table A5: Regressions of catheterization choice for heart attack patients: hospital controls robustness.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (left panel) or 2006-2008 (right panel). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Intensity_AMI* is the hospital's catheterization rate in 2005. *Size* is the log of hospital service revenue in 2005. *NetDebt* is financial debt (bonds and bank loans) minus cash and temporary securities scaled by fixed assets in 2005. *FinInvestments* is the dollar amount of financial investments scaled by fixed assets in 2005. *OperatingInc* is the difference between service revenue and service expenses scaled by lagged fixed assets in 2007. *CapitalInvestment* is the growth in Fixed Assets in 2007. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses

| | Pre-Crisis Period = 2005 to 2007 | Pre-Crisis Period = 2006 to 2008 |
|---|---|---|
| Post_Crisis*Inv_Inc08 | -0.154* | -0.193** |
| | (0.086) | (0.076) |
| Post_Crisis*Intensity_AMI | -0.239*** | -0.177*** |
| | (0.041) | (0.036) |
| Post_Crisis*FinInvestments | -0.012 | -0.011 |
| | (0.009) | (0.008) |
| Post_Crisis*Size | -0.009 | -0.007 |
| | (0.006) | (0.006) |
| Post_Crisis*NetDebt | -0.011 | -0.008 |
| | (0.009) | (0.008) |
| Post_Crisis*OperatingInc | -0.016 | -0.041 |
| | (0.038) | (0.034) |
| Post_Crisis*CapitalInvestment | 0.005 | 0.001 |
| | (0.014) | (0.013) |
| N | 380,810 | 382,240 |
| Hospital FE | Y | Y |
| Year FE | Y | Y |
| Patient controls | Y | Y |

**Internet Appendix – Table A6: Regressions of catheterization choice on capital investments for heart attack patients.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay. *Lag(Size)* is the lagged natural logarithm of hospital service revenue. *Lag(NetDebt)* is the lagged financial debt (bonds and bank loans) minus cash and temporary securities scaled by fixed assets. *Lag(FinInvestments)* is the lagged value of financial investments scaled by fixed assets. *Lag(OperatingInc)* is the lagged difference between service revenue and service expenses scaled by lagged fixed assets. *Lag(CapitalExp)* is the lagged growth in fixed assets. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses

| | (1) | (2) |
|---|---|---|
| Lag(CapitalExp) | -0.003 | -0.006 |
| | (0.004) | (0.005) |
| Lag(Size) | | 0.022 |
| | | (0.015) |
| Lag(NetDebt) | | -0.003 |
| | | (0.009) |
| Lag(FinInvestments) | | -0.004 |
| | | (0.008) |
| Lag(OperatingInc) | | -0.023 |
| | | (0.027) |
| N | 987,344 | 747,454 |
| Hospital FE | Y | Y |
| Year FE | Y | Y |
| Patient controls | Y | Y |

**Internet Appendix – Table A7: Regressions of catheterization choice for heart attack patients: scaling investment income with operating costs.** The sample includes hospital admissions for Acute Myocardial Infarction (AMI). The table shows OLS regressions of the indicator variable for whether the patient received catheterization during the hospital stay. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (left panel) or 2006-2008 (right panel). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged operating costs) in 2008. *Intensity_AMI* is the hospital's catheterization rate in 2005. Patient controls include indicators for the patient's race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | Pre-Crisis Period = 2005 to 2007 | | Pre-Crisis Period = 2006 to 2008 | |
|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | -0.370 | -0.359 | -0.423* | -0.422* |
| | (0.249) | (0.251) | (0.215) | (0.219) |
| Post_Crisis*Intensity_AMI | -0.258*** | -0.240*** | -0.186*** | -0.171*** |
| | (0.035) | (0.035) | (0.030) | (0.030) |
| Post_Crisis*Size | | -0.009 | | -0.007 |
| | | (0.006) | | (0.006) |
| N | 503,373 | 497,972 | 507,147 | 501,450 |
| Hospital FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y |

**Internet Appendix - Table A8: Regressions of the C-section choice for child deliveries: including 2008.** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via Cesarean section. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2006-2008. *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Inv_Inc08_T2* and *Inv_Inc08_T3* are dummy variables for the second and the third tercile of *Inv_Inc08*. *Intensity_CS* is the hospital's C-section rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | | | -0.014 | -0.018 | -0.020 |
| | | | (0.030) | (0.028) | (0.027) |
| Post_Crisis*Inv_Inc08_T2 | 0.003 | 0.000 | | | |
| | (0.004) | (0.003) | | | |
| Post_Crisis*Inv_Inc08_T3 | -0.000 | -0.001 | | | |
| | (0.004) | (0.004) | | | |
| Post_Crisis*Intensity_CS | | -0.086** | | -0.086** | -0.093** |
| | | (0.036) | | (0.037) | (0.037) |
| Post_Crisis*Size | | | | | 0.002 |
| | | | | | (0.002) |
| N | 1,878,719 | 1,824,584 | 1,878,719 | 1,824,584 | 1,824,584 |
| Hospital FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |

**Internet Appendix - Table A9: Regressions of the C-section choice for child deliveries by hospital-level treatment intensity.** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via a Cesarean section for each quintile of hospital-level treatment intensity in 2005, adjusted for the patient risk factors for receiving a C-section. The adjustment is done by estimating a logit regression of the C-section indicator on patient characteristics in Table 5 within the full hospital panel. The adjusted intensity is the difference between the hospital's actual and predicted C-section rate in 2005. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (year 2008 is excluded). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. Patient controls include indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | 0.152* | -0.024 | 0.032 | -0.060* | 0.023 |
| | (0.089) | (0.073) | (0.092) | (0.032) | (0.119) |
| N | 262,872 | 440,882 | 300,977 | 467,020 | 333,415 |
| Hospital FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |

**Internet Appendix - Table A10: Regressions of the C-section choice for child deliveries: Washington state excluded.** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via a Cesarean section. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (year 2008 is excluded). *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Inv_Inc08_T2* and *Inv_Inc08_T3* are dummy variables for the second and the third tercile of *Inv_Inc08*. *Intensity_CS* is the hospital's C-section rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post_Crisis*Inv_Inc08 | | | -0.026 | -0.031 | -0.034 |
| | | | (0.035) | (0.034) | (0.032) |
| Post_Crisis*Inv_Inc08_T2 | 0.003 | 0.001 | | | |
| | (0.004) | (0.004) | | | |
| Post_Crisis*Inv_Inc08_T3 | -0.002 | -0.003 | | | |
| | (0.005) | (0.005) | | | |
| Post_Crisis*Intensity_CS | | -0.121*** | | -0.120*** | -0.128*** |
| | | (0.044) | | (0.045) | (0.046) |
| Post_Crisis*Size | | | | | 0.003 |
| | | | | | (0.003) |
| N | 1,783,720 | 1,740,647 | 1,783,720 | 1,740,647 | 1,740,647 |
| Hospital FE | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y |

**Internet Appendix - Table A11: Regressions of the C-section choice for child deliveries: the role of physician arrangements.** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via a Cesarean section. *Post_Crisis* is a dummy variable equal one for years 2009-2011 and equal zero for years 2005-2007 (left panels) or for years 2006-2008 (right panels). *Employment Dummy* is a dummy variable equal to one for hospitals with employment relationship with at least some physicians. *FractEmployed* is the fraction of privileged physicians that are employed by the hospital. *FractEmployed_Q4* are dummy variables for hospitals above the fourth quartile of *FractEmployed*. *Intensity_CS* is the hospital's C-section rate in 2005. *Size* is the log of hospital service revenue in 2005. Patient controls include indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

Panel A: All patients

| | Pre-Crisis Period = 2005 to 2007 | | | Pre-Crisis Period = 2006 to 2008 | | |
|---|---|---|---|---|---|---|
| Post_Crisis*Employment_Dummy | 0.004 | | | 0.001 | | |
| | (0.003) | | | (0.003) | | |
| Post_Crisis*FractEmployed | | 0.003 | | | -0.002 | |
| | | (0.009) | | | (0.007) | |
| Post_Crisis*FractEmployed_Q4 | | | -0.002 | | | -0.003 |
| | | | (0.004) | | | (0.003) |
| N | 2,468,528 | 1,830,256 | 1,830,256 | 2,479,643 | 1828317 | 1828317 |
| Hospital FE | Y | Y | Y | Y | Y | Y |
| Post_Crisis*Intensity_CS | Y | Y | Y | Y | Y | Y |
| Post_Crisis* Size | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y | Y |

Panel B: Private-insurance patients

| | Pre-Crisis Period = 2005 to 2007 | | | Pre-Crisis Period = 2006 to 2008 | | |
|---|---|---|---|---|---|---|
| Post_Crisis*Employment_Dummy | 0.005 | | | 0.001 | | |
| | (0.004) | | | (0.004) | | |
| Post_Crisis*FractEmployed | | 0.008 | | | -0.000 | |
| | | (0.010) | | | (0.008) | |
| Post_Crisis*FractEmployed_Q4 | | | 0.002 | | | 0.000 |
| | | | (0.004) | | | (0.004) |
| N | 1,317,977 | 1,015,978 | 1,015,978 | 1,318,462 | 1,007,745 | 1,007,745 |
| Hospital FE | Y | Y | Y | Y | Y | Y |
| Post_Crisis*Intensity_CS | Y | Y | Y | Y | Y | Y |
| Post_Crisis* Size | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y | Y |

**Internet Appendix - Table A12: Hospital returns and the C-section choice: the role of physician arrangements:** The sample includes hospital admissions for child delivery. The table shows OLS regressions of the indicator variable for whether the delivery was via a Cesarean section. *Post_Crisis* is a dummy variable equal to one for years 2009-2011 and equal to zero for years 2005-2007 (year 2008 is excluded). *Integration* measures a hospital's degree of integration with physicians. In the left panel, *Integration* is set to a dummy variable equal to one for hospitals with employment relationship with at least some physicians. In columns (2) and (3), hospitals are classified as *Integrated* when this dummy is equal to one. In the right panel, *Integration* is set to the fraction of privileged physicians that are employed by the hospital. In columns (5) and (6), hospitals are classified as *Integrated* when they are above the third tercile of this measure. *Inv_Inc08* is the hospital's return on financial investments (scaled by lagged fixed assets) in 2008. *Intensity_CS* is the hospital's C-section rate in 2005. Patient controls include indicators for birth complications, mother's diagnoses, race, sex, insurance status, and age group. Year fixed effects and hospital fixed effects are included in all regressions. Standard errors are clustered by hospital and are shown in parentheses.

| Integration measure: | Employment dummy | | | Fraction of physicians that are employed | | |
|---|---|---|---|---|---|---|
| | All hospitals | Integrated | Less Integrated | All hospitals | Integrated | Less Integrated |
| Post_Crisis*Inv_Inc08 | -0.045* | 0.142 | -0.046* | -0.049** | 0.090 | -0.051** |
| | (0.025) | (0.096) | (0.025) | (0.022) | (0.078) | (0.021) |
| Post_Crisis*Integration | 0.006 | | | 0.006 | | |
| | (0.005) | | | (0.009) | | |
| Post_Crisis*Integration*Inv_Inc08 | 0.215** | | | 0.552** | | |
| | (0.102) | | | (0.269) | | |
| Post_Crisis*Intensity_CS | -0.139*** | -0.193** | -0.121** | -0.114* | -0.114 | -0.121* |
| | (0.046) | (0.094) | (0.048) | (0.058) | (0.102) | (0.072) |
| N | 1,452,392 | 555,234 | 897,158 | 954,437 | 311,472 | 642,965 |
| Hospital FE | Y | Y | Y | Y | Y | Y |
| Patient controls | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |