THE FAILURE OF GEORGIA'S CERTIFICATE-OF-NEED LAWS

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Health Care and CON; Better Patient Outcomes; Better Patient Access, More Affordability for Patients

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Thank you for the opportunity to share my recent work on certificate-of-need laws as they are applied to healthcare in Georgia.

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INTRODUCTION

Certificate-of-need (CON) laws, which require healthcare providers to obtain permission by proving "need" of their services in the community before they open or expand their practices or purchase certain devices or new technologies, currently exist in some form in 35 states. In four different academic, data-driven studies, my coauthors and I examined the effect of CON laws by comparing economic and health measures in these 35 states to those in states that do not have CON laws.[1] These studies, and additional data analysis and research, show that CON laws have largely failed to achieve their stated objectives of increased access to healthcare services, particularly to the poor. On the contrary, our research shows that CON laws do the following:

1. Harm patients by reducing healthcare quality.
2. Harm patients by reducing access to healthcare. They reduce the availability of medical care by making it difficult for medical providers to offer their services.
3. Harm patients by reducing the availability of medical equipment such as MRI machines and CT scanners that help to diagnose illnesses and thereby prevent premature death.

Our findings are consistent with the positions of the Federal Trade Commission and the US Department of Justice under both Democratic and Republican administrations,[2] which have argued

[1] Thomas Stratmann and Jake Russ, "Do Certificate-of-Need Laws Increase Indigent Care?" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, 2014); Thomas Stratmann and Matthew C. Baker, "Are Certificate-of-Need Laws Barriers to Entry? How They Affect Access to MRI, CT, and PET Scans" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, 2016); Thomas Stratmann and David Wille, "Certificate-of-Need Laws and Hospital Quality" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, 2016); Thomas Stratmann and Christopher Koopman, "Entry Regulation and Rural Health Care: Certificate-of-Need Laws, Ambulatory Surgical Centers, and Community Hospitals" (Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, 2016).
[2] *Certificate of Need: Evidence for Repeal* (Chicago, IL: American Medical Association 2015); US Department of Justice and Federal Trade Commission, *Improving Health Care: A Dose of Competition*, July 2004, 22. See also Maureen K. Ohlhausen, "Certificate of Need Laws: A Prescription for Higher Costs," *Antitrust* 30, no. 1 (2015): 50–54; Federal Trade Commission and US

that CON laws fail to meet their stated goals and that CON laws are harmful to patients. Also, the largest association of physicians, the American Medical Association, favors repeal of all CON laws.

All four of these peer-reviewed studies (see footnote 1) are attached as part of my submitted written testimony. These studies use state-of-the-art statistical methods that are well accepted in social sciences, health sciences, and many other areas that analyze data, such that the conclusions are based on apples-to-apples comparisons—that is, we perform the analysis in such a way that states with and without CON laws are comparable. All data we use are publicly available so that our results can be replicated by anyone who chooses to do so.

BACKGROUND

Certificate-of-need laws require state agency approval before an already-licensed healthcare provider can establish a new healthcare facility and before an already-licensed healthcare provider can expand. In some states, CON laws require permission from state regulators to provide medical services or to purchase medical equipment to which the government otherwise has no objections.

CON LAWS IN GEORGIA

CON laws in Georgia require medical providers to obtain government permission to compete for 20 medical services (out of 35 medical services regulated across the US states by CON). Among the states with the highest number of CON laws, Georgia ranks 12th. Some examples of CON laws are the following:

- In Georgia, a hospital needs permission to add a new hospital bed.
- In Georgia, permission is required for a new provider to open a new hospital.
- In Georgia, permission is required to purchase an MRI machine, CT scanner, or PET scanner.
- In Georgia, permission is required to open an ambulatory surgery center.

RATIONALE FOR AND CONCEPTUAL INEFFECTIVENESS OF CON LAWS

While there are many justifications made for CON laws, the typical goals include

- ensuring an adequate supply of healthcare resources,
- protecting access in rural and underserved communities,
- promoting high-quality care,
- supporting charity care, and
- controlling cost.

Certificate-of-need laws were well intentioned when they were first introduced in states in the mid-1960s. Their effectiveness, however, should be measured by their outcomes. Even the best-intended laws might not lead to the desired results and, indeed, might yield unintended consequences that should have been foreseeable.

Department of Justice, *Joint Statement of the Federal Trade Commission and the Antitrust Division of the U.S. Department of Justice on Certificate-of-Need Laws and South Carolina House Bill 3250*, January 11, 2016; Federal Trade Commission and US Department of Justice, *Joint Statement of the Federal Trade Commission and the Antitrust Division of the U.S. Department of Justice to the Virginia Certificate of Public Need Work Group*, October 26, 2015; Letter from Federal Trade Commission Staff to Marilyn W. Avila, North Carolina State Representative, July 10, 2015; US Department of Justice and Federal Trade Commission, *Competition in Health Care and Certificates of Need: Joint Statement of the Antitrust Division of the US Department of Justice and the Federal Trade Commission before the Illinois Task Force on Health Planning Reform*, September 15, 2008; Daniel Sherman, *The Effect of State Certificate-of-Need Laws on Hospital Costs: An Economic Policy Analysis* (Washington, DC: Federal Trade Commission, January 1988); Monica Noether, "Competition among Hospitals" (Washington, DC: Federal Trade Commission, 1987), 82.

The failure of CON laws might have been expected because CON laws grant a government-protected monopoly to incumbent providers. Both basic economics and common sense tell us that government-protected monopolies tend to have negative consequences, particularly for poor consumers.

Moreover, CON laws do not have a public health justification. That is, CON requirements have nothing to do with public health or safety. Separate state and federal laws govern who is allowed to practice medicine, what type of qualifications are required to do so, and what kind of medical procedures are or are not permitted.

CON laws are designed to restrict competition. And in a manner unheard of in any other industry I know, in healthcare, existing hospitals and other medical providers have the opportunity to oppose the CON application of a would-be competitor, simply by claiming that there is no need for that additional medical service. This is akin to McDonald's needing permission from Burger King to open a restaurant in Georgia.

By requiring permission from regulators prior to any change, these state laws limit the ability of healthcare providers to offer cost-effective and innovative healthcare. The wholly undesirable result is that CON laws prevent innovation that would otherwise result in less costly, less invasive medical procedures, and safer medical procedures.

One example of a less costly, less invasive, and safer medical procedure is the virtual colonoscopy—as opposed to the traditional optical colonoscopy. When a state requires a certificate of need for MRI machines, as does Georgia, it discourages providers from offering new procedures like virtual colonoscopies. This is because providers first have to get permission from state regulators, which is not easy to obtain. The subsequent lack of adequate screening to detect cancer early probably contributes to unnecessary deaths.

EMPIRICAL EVIDENCE OF THE FAILURE OF CON LAWS

My colleagues and I started a project several years ago to analyze data to rigorously test whether each of the stated goals of CON was being achieved.

Specifically, we examined the following claims made by CON proponents, which were often stated expressly as objectives in CON legislations:

- CON laws increase access to medical care facilities.
- CON laws improve access to diagnostic services, such as medical imaging services.
- CON laws ensure that more indigent care is provided.
- The adoption of CON laws increases quality of medical care.

We found that CON laws do not deliver on these promises. There has not been increased patient access to medical care, and the quality of medical care has not been improved. In fact, CON laws have backfired. It turns out that states with CON laws have less patient access to medical care and lower quality of medical care.

CON REDUCES ACCESS TO MEDICAL CARE IN FACILITIES ACROSS THE STATE

One measure of access to medical care is the number of hospitals in a state. To control for the state population served, we measure hospitals per 100,000 population. More hospitals means shorter travel times to hospitals and greater access.

However, the data show that there are *fewer* hospitals per 100,000 in CON states than in states without CON. In 2017, Georgia had about 175 hospitals. A comparable state without CON has 227 hospitals. So *a state without CON has more than 30 percent more hospitals*. And this estimate controls for confounding factors—such as age distribution, healthiness of the population, and percentage of the population on Medicaid and Medicare—in order to do an apples-to-apples comparison. This finding suggests that CON *reduces* access to medical care.

Our research also uses another metric to determine the effect of CON on access to medical care—the number of hospital beds available in CON states versus states without CON. Here we compare states with a CON law that regulates hospital beds with states that do not regulate beds.

Our findings unambiguously show that *states without CON have more beds* per patient. Why is this important? Well, it means that patients have more choices. They are less likely to be turned away from a hospital. And it might mean that there are hospitals closer to patients.

Georgia also has a CON law for ambulatory surgery centers. Comparing Georgia to statistically similar states without CON laws shows that *without a CON, Georgia likely would have over 500 centers instead of the 356* it had in 2017.

CON proponents also say that CON laws increase provision of medical care and access to medical care in rural areas. But instead of providing more help for the rural population and better access for the entire state population, as CON proponents claim, CON in fact does the opposite. Georgia has fewer ambulatory surgery centers and fewer hospitals, thus fewer choices. Georgians in both urban and rural areas have fewer choices because of CON. For example, states comparable to Georgia without CON have *7 additional* rural hospitals instead of the current roughly 58 rural hospitals as of 2011.[3]

PATIENTS IN STATES WITH CON HAVE LESS ACCESS TO MEDICAL IMAGING AND OTHER SERVICES

The negative effect of CON on medical supply is not restricted to facilities. Medical inputs such as MRI, CT, and PET scans are also negatively affected. This is because there are CON laws that require permission to purchase such imaging equipment. This reduces access to medical care. For example, per year, Georgia residents have about 90,000 MRI scans. Our estimates show that residents in states comparable to Georgia but without CON have more access to MRI scans. They receive almost one-third more MRI scans—that is 120,000 MRI scans. States without CON also have more access to CT scans. That is, states without CON have about 30 percent more CT scans than states with CON.[4] This gives us a glimpse at how access to medical care in Georgia would improve, if Georgia were to drop its CON laws.

QUALITY OF HOSPITAL CARE IS LOWER IN STATES WITH CON

In states without CON laws, hospitals have an incentive to compete to attract patients. Hospitals cannot compete as well on prices as most industries do because many of their patients are Medicare and Medicaid patients who can only be charged fixed amounts. But hospitals can compete on different margins, such as quality of service. So there is a strong incentive for hospitals in states without CON to compete for patients by providing better quality of medical services. This incentive does not exist to the same degree in states with CON laws, because in these states, hospitals are shielded by law from competition.

In contrast to this reasoning, some proponents of CON claim that it is good to have fewer hospital providers. They argue that when procedures are concentrated in a few hospitals, physicians have more

[3] Stratmann and Koopman, “Entry Regulation and Rural Health Care.”
[4] Stratmann and Baker, “Are Certificate-of-Need Laws Barriers to Entry?”

experience performing operations because they have more volume, and this translates into higher quality of medical services.

To analyze which of these competing views is correct, we used data on the quality of medical services delivered by hospitals. These data come from a publicly available database maintained by the Centers for Medicare and Medicaid Service. The evidence from the analysis of this data shows that CON does not improve quality of medical care.[5]

Unfortunately, however, the numbers are much more alarming than this. The numbers show that CON laws actually reduce hospital quality. Comparing states with CON laws to those with no CON laws shows that *states with CON laws have lower quality of service, as measured by their hospital mortality rates and hospital readmission rates*. Specifically, states with CON laws have

- 0.5 percent more deaths for surgery patients with serious complications,
- A 0.6 percentage point higher pneumonia mortality rate,
- A 0.3 percentage point higher heart failure mortality rate, and
- A 0.4 percentage point higher heart attack mortality rate.

This evidence shows that CON is harmful to patient health and survival.

QUALITY OF INDIGENT CARE IS NOT BETTER IN STATES WITH CON

CON proponents sometimes claim that CON increases indigent care because successful applicants might commit themselves to increase their medical services to the indigent. However, the data fail to support such optimism. It turns out that hospitals in CON states have only as much indigent care—measured as uncompensated care—as hospitals in states without a CON law. Thus, *CON does not lead to additional services for the poor*.[6]

CONCLUSION

If all states had CON laws, studying the effect of CON laws would be very difficult because we would not know what the world would look like without CON laws. Fortunately, 15 states do not have CON laws. This allows us to get a glimpse into the world without CON. And when comparing these two worlds, the data show that CON states have reduced access to medical care in both rural areas and urban areas. CON states have fewer providers, such as hospitals and ambulatory surgery centers. CON results in fewer medical inputs, such as MRI and CT scans and the number of hospital beds. CON does not live up to the claim that it increases indigent care. Moreover, CON reduces quality of medical services.

The takeaway from these findings is that CON laws are bad for Georgia residents because they reduce the quality of medical care in Georgia, they reduce access for Georgians, and they reduce opportunities to obtain medical services such as MRI and CT scans. Georgians would be better off if the Peach State would join the 15 states that do not have CON laws.

Sincerely,

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[5] Stratmann and Wille, "Certificate-of-Need Laws and Hospital Quality."

[6] Stratmann and Russ, "Do Certificate-of-Need Laws Increase Indigent Care?"

APPENDIX 1: MEDICAL SERVICES AND FACILITIES REGULATED BY CON LAWS IN GEORGIA AS OF 2016

1. Acute Hospital Beds
2. Ambulatory Surgery Centers
3. Burn Care
4. Cardiac Catheterization
5. Computed Tomography (CT) Scanners
6. Gamma Knives
7. Lithotripsy
8. Long-Term Acute Care (LTAC)
9. Nursing Home Beds/Long-Term Care Beds
10. Mobile Hi Technology (CT, MRI, PET, etc.)
11. Magnetic Resonance Imaging (MRI) Scanners
12. Neonatal Intensive Care
13. Obstetrics Services
14. Open-Heart Surgery
15. Organ Transplants
16. Positron Emission Tomography (PET) Scanners
17. Psychiatric Services
18. Radiation Therapy
19. Renal Failure/Dialysis
20. Subacute Services

Source: Christopher Koopman and Anne Philpot, "The State of Certificate-of-Need Laws in 2016," Mercatus Center at George Mason University, September 27, 2016.

ATTACHMENTS (4)

"Do Certificate-of-Need Laws Increase Indigent Care?" (Mercatus Working Paper).
"Are Certificate-of-Need Laws Barriers to Entry? How They Affect Access to MRI, CT, and PET Scans" (Mercatus Working Paper).
"Certificate-of-Need Laws and Hospital Quality" (Mercatus Working Paper).
"Entry Regulation and Rural Health Care: Certificate-of-Need Laws, Ambulatory Surgical Centers, and Community Hospitals" (Mercatus Working Paper).

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DO CERTIFICATE-OF-NEED LAWS INCREASE INDIGENT CARE?

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Abstract

Many states have certificate-of-need regulations, which prohibit hospitals, nursing homes, and ambulatory surgical centers from entering new markets or making changes to the existing capacity of medical facilities without first gaining approval from certificate-of-need regulators. These regulations purport to limit the supply of medical services and to induce regulated institutions to use the resulting economic profits to cross-subsidize indigent care. We document that these regulations do limit supply. However, we do not find strong evidence of higher levels of indigent-care provision in states that have certificate-of-need regulations as opposed to those that do not.

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Keywords: certificate-of-need, certificate of need, medical subsidy program, healthcare, health care, Medicaid, regulation, entry barrier

Do Certificate-of-Need Laws Increase Indigent Care?

Thomas Stratmann and Jacob W. Russ

1. Introduction

Certificate-of-need (CON) programs prohibit hospitals, nursing homes, and ambulatory surgical centers from entering new markets or making changes to the existing capacity of medical facilities without first gaining approval from certificate-of-need regulators. During the period examined, 36 states and the District of Columbia had CON programs that reviewed applications for medical equipment and services (see the map on page 23).[1] These programs intend to create a quid pro quo in which the agencies increase the profitability of covered medical services by restricting competition and, in return, medical providers cross-subsidize specified amounts of indigent care, or medical services to the poor that are unprofitable to the provider (Banks, Foreman, and Keeler 1999; David et al. 2011).[2]

The theory of cross-subsidization is well established. Posner (1971) and Faulhaber (1975) outline how regulators can create "internal subsidies" within firms to encourage them to provide unprofitable, but socially desirable, services. If regulators restrict entry and limit firm output, profits for existing firms likely increase because of reduced competition. After regulation, firms have the monopoly profits with which to cover losses on unremunerated services.[3]

However, there is reason to question the willingness and ability of medical providers to comply with the subsidy scheme (David et al. 2011). First, because hospitals can claim to offer

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[1] CON programs vary significantly in the stringency of the review process and the services and equipment covered. At the extremes, in 2011, Ohio's CON program only regulated long-term acute care, while as many as 30 categories of medical services and equipment are reviewable in Vermont (AHPA 2012).
[2] For example, Virginia's CON statute explicitly grants the state health commissioner the discretion to include indigent care as a condition of approving a CON permit (Virginia Dept. of Health 2004).
[3] We take the claim of cross-subsidization at face value, but note that firms may view such regulation as part of their profit maximizing strategy (i.e., regulatory capture). Two papers that directly hypothesize that hospitals desire CON regulations are Payton and Powsner (1980) and Wendling and Werner (1980).

subsidized service through one of many channels, regulators cannot monitor the hospitals effectively. Without effective monitoring, hospitals have little incentive to subsidize indigent care. Second, because technological change, the rise of managed care organizations, reduced federal payment rates to Medicare, and deregulation have made the health care industry more competitive since the 1980s, medical providers have lower profits and less ability to provide cross-subsidies (Santerre and Pepper 2000; Frakt 2011, 2014).

Several state-specific studies, however, do find evidence of cross-subsidization among hospitals and nursing homes (Dranove 1988; Campbell and Fournier 1993; Ford and Kaserman 1993; Fournier and Campbell 1997; Troyer 2002; David et al. 2011). Most of this evidence comes from the 1980s.

In this paper, we provide new evidence on the cross-subsidization hypothesis and contribute to the literature on the economics of regulation (Stigler 1971; Peltzman 1976; Becker 1983). We use two state-level measures of indigent care, covering the entire United States: uncompensated care from 2007 to 2010 and Medicaid patient days from 2000 to 2010.[4] Further, we create a comprehensive database on state CON regulations. This dataset allows us to capture differences in regulatory authority among state CON programs.

We do not find evidence associating CON programs with an increase of indigent care. The effect of CON programs on indigent care shows no clear pattern using either direct or indirect measures of indigent care. However, consistent with the existing literature, our results suggest that CON programs restrict entry and limit the provision of regulated medical services. For example, CON states have about 13 percent fewer hospital beds per 100,000 persons than non-CON states.

[4] The only other large-scale study of CON programs is Zhang (2008), which uses data from 17 states. Zhang finds that both for-profit and nonprofit hospitals increase their provision of uncompensated care in response to CON laws.

In section 2 we provide background on CON regulations and discuss the above justification and a different one. In section 3 we describe our data and outline our empirical strategy. Section 4 presents our results. We then discuss these results and conclude our analysis in section 5.

2. Background

New York introduced CON regulation to the United States in 1964 to contain health care costs.[5] Proponents thought unregulated market competition created incentives for medical providers to overinvest in facilities and equipment. Regulators could lower the growth rate of health care costs by restricting market expansion to expenditures for which the medical provider could demonstrate a clear public need. The early studies of these laws generally found evidence neither of reduced investment by hospitals (Hellinger 1976; Salkever and Bice 1976) nor of cost control (Sloan and Steinwald 1980; Sloan 1981; Joskow 1980; Joskow 1981).

The results of more recent research are mixed: Conover and Sloan (1998) find that while CON laws appear to have a modest cost-control effect, their removal in several states was not associated with a surge in hospital spending. The "Big Three" automakers, Chrysler, Ford, and General Motors, released internal studies showing that health care costs in a handful of non-CON states were higher than in Michigan, New York, Missouri, and Kentucky, each of which has CON laws (DaimlerChrysler Corporation 2002; Ford Motor Company 2000; General Motors Corporation 2002). A study by Rivers, Fottler, and Frimpong (2010) finds no evidence that CON laws are associated with reduced hospital costs, but does find evidence that stringent CON programs increase costs by 5 percent. Most recently, Rosko and Mutter (2014), using stochastic frontier analysis, find that states with CON laws show increased cost efficiency.

[5] Simpson (1985) provides a brief and comprehensive history of CON legislation.

Campbell and Fournier (1993) and Fournier and Campbell (1997) propose that regulators have a different primary justification for CON programs: cross-subsidizing indigent care. Using CON application data in Florida, they find evidence of a quid pro quo. Hospitals that provided the most indigent care had a higher probability of winning CON approval.[6] Several other state-specific studies also find evidence of cross-subsidization among hospitals and nursing homes. Dranove (1988) argues hospitals in Illinois raised prices on privately paying patients in response to a drop in Medicaid payments in the 1980s—an example of cross-subsidization.[7] Troyer (2002) finds evidence of cross-subsidies among nursing home patients in Florida. Self-paying nursing home patients appear to pay more than do comparable Medicaid patients. Troyer concludes that this cross-subsidy is intertemporal: nursing homes charge more at the beginning of a patient's care cycle in anticipation of switching to the lower-paying Medicaid system later. Finally, David et al. (2011) find that hospitals in Arizona and Colorado changed their product mix in response to the entry of specialty hospitals. As competition increased, hospitals provided fewer unprofitable services and more profitable services. Their results show that competition limits hospitals' ability to cross-subsidize.

Recent papers, however, do not find evidence of cross-subsidization. Frakt (2011, 2014) surveys the literature and concludes that although in the 1980s it was possible for hospitals to shift much of their costs between patient groups (Cutler 1998), the market is now too competitive to allow them to do so to a significant extent (Wu 2010; Dranove, Garthwaite, and Ody 2013; White 2013; White and Wu 2014).

[6] Miller and Hutton (2004) cite court documents as additional evidence that uncompensated care provision leads to favorable treatment during the application process.
[7] Dranove uses the term "cost-shift" when describing the process of raising private prices in response to changes in public prices. While we recognize that cross-subsidization and cost-shifting are not interchangeable in the literature, both are examples of price discrimination. Because the underlying mechanism is the same, forces that affect a firm's ability to price discriminate will influence both of these processes. Therefore, we reference studies in the cost-shifting literature here. However, to ease exposition, we will only refer to cross-subsidization throughout this paper.

3. Data and Empirical Strategy

3.1. *Data*

The dependent variables used in this paper come from three sources. The most direct measure of indigent care, uncompensated care, comes from the Healthcare Cost Report Information System (HCRIS).[8] HCRIS defines uncompensated care as the sum of charity care and bad debt (CMS 2014). We use HCRIS figures from fiscal years 2007 to 2010.[9] We aggregate hospital-level data to create state-level observations. These data include the number of beds from the reporting hospitals, which allows us to standardize our uncompensated care measure on a per-bed basis.

Second, we use data from two American Hospital Association (AHA) sources: *Hospital Statistics 2013* and the AHA subsidiary Health Forum's Medicaid statistics. We glean two indirect measures of indigent care: ratios of Medicaid patient days to total patient days and of Medicaid admissions to total patient discharges. *Hospital Statistics*, compiled from the AHA's Annual Survey of Hospitals, contains state-level summary data from 1994 to 2011. This source provides information on facilities and services, utilization rates, personnel, and financial aggregates.

We use other data from the AHA to examine whether CON laws restrict hospital capacity. Data include state-level summaries of total patient admissions, discharges, and inpatient days. These data distinguish between hospitals and nursing homes as well as between Medicare and Medicaid status. They cover separate measures of health care capacity based on the number of hospitals that report providing each of the following medical services: computed tomography (CT) scanning, magnetic resonance imaging (MRI), optical colonoscopy, and virtual colonoscopy. These hospitals also report the number of operating indigent-care clinics and rural

[8] HCRIS data are collected by the Centers for Medicare & Medicaid Services (CMS 2014).
[9] For example, fiscal year 2007 began on October 1, 2006, and ended on September 30, 2007.

health clinics, the total number of hospital beds in a state, and the number of beds for hospitals that reported data to the AHA.

Certificate-of-need program data come from our third source, the American Health Planning Association (AHPA). The AHPA publishes its annual survey of state CON programs in annual national directories. From these directories we assembled the most comprehensive dataset on state CON regulations to date, covering 1992 through 2011.[10] Classifying data by AHPA's state-by-state surveys allows us to create variables that evaluate the stringency of CON programs by state.

The first of these variables equals one if there is CON regulation in a state. Second, from the directories' 28 standardized categories[11] for equipment and services regulated by CON programs, we create a variable counting the number of categories by state and year. We also create binary measures for each of the categories. These variables capture the fact that although a state may have a CON regulation agency, this agency may or may not regulate a particular service or type of equipment. For example, in 2011 Delaware had a CON program, but its agency did not review psychiatric services or MRIs.

The control variables we use in our study come from a variety of sources. We collect state-level demographic information from the Census Bureau on the total population, the poverty level, and the percentages of white, black, and Hispanic citizens. From the census data we also calculate, for three population groups, measures likely to be correlated with an increased use of hospital facilities and with indigent care: the proportion of the population below age 18, above

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[10] AHPA has published its national directories from 1990 to 2012, but we do not use the two earlier surveys because AHPA did not report its survey data by state.

[11] The AHPA surveys actually cover 31 categories. Because they do not report three of these categories consistently for the entire period, we omit them to keep our count of regulated services uniform. Business computers started as a reported category, but as of the 2008 directory no state claimed to regulate this category and in the 2009 directory it was removed completely. Hospice was added as a category as part of the 2006 directory, and nursing home bed regulation was separated from long-term acute care and given its own category as part of the 2007 directory.

age 65, and female and of child-bearing age (15–44). We collect nominal per capita state income from the Bureau of Economic Analysis and convert it to real income using the consumer price index from the Bureau of Labor Statistics. We use 2011 as our base year. Our state-level unemployment-rate data also come from the Bureau of Labor Statistics. Finally, we get the age-adjusted percentage of adults (persons 18 and over) with diagnosed diabetes from the Centers for Disease Control and Prevention. We include diabetes as an additional control variable to capture poor health outcomes that may not be captured by the other control variables. Diabetes is known to increase the risk of heart disease and strokes (NDIC 2014).

We show summary statistics for each of our measures in table 1 (page 24). The second column reports the number of observations per variable. These numbers range from a low of four surveyed years and 204 observations for optical colonoscopy to a high of eleven years and 561 observations for emergency room visits. The mean of our CON indicator is 73 percent, and on average each state regulates 10.1 medical services. If we restrict the sample to states that have CON programs, the average count of regulated services increases to about 14. In the analysis that follows we only include in our models the category-specific CON indicators that are relevant to the dependent variable in question. Thus, in table 1 we only report the indicators that appear in our model specifications. As two examples, with these indicators we report that only 27 percent of our state-year observations have CT scanner regulation, and 54 percent of our sample regulates acute hospital beds.

3.2. *Empirical Strategy*

If state CON programs grant medical providers a degree of market power, we should expect to see evidence of capacity restrictions in the states with CON programs. Only monopoly power allows providers to raise prices, giving them excess profits to potentially use to cross-subsidize indigent services. Without market power, providers are unlikely to have the capital with which to cross-subsidize indigent care, as mandated in some of the CON regulations.

We estimate a set of models such as

$$Health\ care\ capacity_{st} = \alpha(CON_{st}) + \delta X_{st} + \vartheta_t + \varepsilon_{st}, \tag{1}$$

in each of which we use several measures of health care capacity. These measures include the number of hospital beds per 100,000 persons and the number of hospitals that report the use of CT scanners, MRI machines, optical colonoscopy, and virtual colonoscopy. To compare across states, we scale each of these measures to the number of hospitals offering any particular medical service per 500,000 persons. For these regressions, the coefficient of interest is α. A negative indicates that CON regulations correlate with restricted health care capacity.

As with previous studies, we measure CON_{st} as a binary variable for the presence or absence of a CON program. But because this variable implicitly assumes that all states' CON programs are identical, we introduce additional variation into our CON regulation measure. We include specifications where CON_{st} counts the number of regulated-service categories in a state. This variable potentially allows us to differentiate between stringent CON programs and programs that intervene less. For example, Louisiana's CON program only regulated three categories in 2011, while its neighbor Mississippi regulated 18 of the 28 categories. In other specifications, we include the category-specific indicator for regulation in the area relevant for our dependent variable. For example, in some of our MRI services regressions, we include an indicator for both the presence of a CON program and MRI regulation because not all CON programs regulate MRI machines.

The matrix X_{st} includes our control variables for state s in year t. We also include year indicators ϑ_t. We do not include state fixed effects because the CON binary variable is constant for 36 states and the District of Columbia.

Having determined whether CON laws restrict capacity, we estimate several specifications to test whether CON programs influence the provision of indigent care:

$$Indigent\ care_{st} = \beta(CON_{st}) + \delta X_{st} + \vartheta_t + \varepsilon_{st}. \quad (2)$$

We use two measures of indigent care: uncompensated care and the ratio of Medicaid patient days to total patient days. For these regressions, a positive coefficient β indicates that CON programs correlate with greater provision of indigent care.

4. Results

This section presents two sets of results. We first show the effect of CON programs on several measures of hospital capacity. We then estimate the effect of CON programs on the provision of uncompensated care.

4.1. *Certificate-of-Need Regulation and Hospital Capacity*

Table 2 (page 25) shows estimates for the effect of CON programs on the number of hospital beds in a given state. Columns 1–4 use hospital beds per 100,000 persons and columns 5 and 6 use the log of this measure. All specifications reported in table 2 and subsequent tables present robust standard errors clustered by state.

Our coefficients of interest, the state CON program measures, are all negative and statistically significant in most specifications. This suggests that CON programs correlate with fewer hospital beds. Throughout the United States there are, on average, 362 hospital beds per

100,000 persons. Controlling for demographics and year-specific effects, the presence of a state CON program is associated with 99 fewer hospital beds per 100,000 persons. As we discussed earlier, not every state CON program regulates acute hospital beds. If we control for the effect of regulation of acute hospital beds, the reduction increases to about 131 fewer hospital beds per 100,000, as shown in column 3.

Our results in column 4 of table 2 show that the stringency and effectiveness of CON programs vary by state. When we measure stringency by the number of services regulated in a state, we find 4.7 fewer hospital beds per 100,000 persons for each additional regulated service. Recall that among states with CON programs, the average number of regulated services is about fourteen, the minimum, one, and the maximum, twenty-eight. Because the average CON program reduces the number of beds per 100,000 by about 66, as shown in column 4, we would expect to see roughly 132 fewer hospital beds in states that regulate the maximum number of services. Our log specifications produce similar magnitudes, and the −13 percent estimate in column 5 closely resembles the −12.3 percent estimate that Eichmann and Santerre (2011) present.

Table 3 (page 26) shows the effect of CON programs on the number of hospitals that offer MRI services. The estimated coefficients on the CON measures are negative across all specifications and statistically significant in all but one specification. An average of six hospitals per 500,000 persons offer MRI services. CON programs reduce MRI provision by between one and two hospitals per 500,000 persons. As expected, if a CON program regulates MRI machines, the effect increases in absolute value, to 2.5 fewer hospitals. The effects in columns 4, 5, and 6 are similar.

Table 4 (page 27) reports the effect of CON programs on the number of hospitals with CT scanners per 500,000 persons. All specifications show a negative effect of CON programs on availability of CT scanners. About half of the estimated coefficients are statistically significant. In the average state, nine hospitals per 500,000 individuals offer CT scans. The presence of a CON program in a state is associated with about 2.5 to 3.5 fewer hospitals offering CT scans. If a CON program specifically regulates CT scanners, the reduction increases roughly 25 percent in absolute value, from −3.41 to −4.27. Our estimated coefficient for CON regulation per covered service, −0.16, implies that for the average CON program, which regulates 14 services, 2.24 fewer hospitals per 500,000 persons offer CT scanning.

We can compare the effects on MRI machines and CT scanners, which are potential substitutes for hospitals. Since we estimate that CON programs reduce MRI provision by one to two hospitals per 500,000 persons and reduce CT scanners by 2.5 to 3.5 hospitals, it appears that CON programs have a larger effect on CT-scan services than on MRI services. When these estimates are compared to their standard deviations, the effect on MRIs is slightly larger. CON regulation decreases the availability of each of these services by about one standard deviation.

According to the Technology Price Index from Modern Healthcare and the ECRI Institute (2014), MRI machines are more expensive than CT scanners. As of January 2014, the average MRI machine costs $1.6 million and the average CT scanner is priced at $913,000. In terms of CON regulations, MRI machines are regulated in 42 percent of our state-year observations, as compared to 29 percent for CT scanners.

That MRI machines are the more expensive capital investment and are regulated more frequently than CT scanners suggests that CON regulations exert tighter control over MRI machines. Thus, hospitals have an incentive to invest in more CT scanners than MRI machines, and the effect of CON regulation on MRI machines should be larger than the effect on CT scanners. The figures we report in table 1 show that more hospitals offer CT scanning than

MRIs. The mean number of hospitals offering CT scans is nine hospitals per 500,000 persons, as compared to only six hospitals for MRIs, though the standard deviation for CT scanners is also higher—that is, 5.2 and 2.7 for CT scanners and MRI machines, respectively. This evidence is not conclusive, but is consistent with our expectation that hospitals invest in CT scanners at the margin.

The estimated effect of CON programs on the provision of optical colonoscopy, shown in table 5 (page 28), is negative in all specifications and statistically significant in four of the six models. The mean number of hospitals offering optical colonoscopy is about 5.5 per 500,000 persons. Between the count measure of CON regulation and the indicator variable for CON presence, the results show that CON regulations reduce the number of hospitals offering optical colonoscopy by between 1.4 and 2.8 per 500,000 persons.

We hypothesize that hospitals are more likely to provide optical colonoscopies where ambulatory surgical centers are restricted because optical colonoscopies are typically classified as an outpatient surgery, and ambulatory surgical centers can perform them away from hospital facilities. In table 5, column 3, we include an indicator for regulation of ambulatory surgery centers. We do not find evidence for this conjecture: the estimated effect is negative, small, and not statistically different from zero.

The majority of the coefficients on variables of interest in our estimates for the effect of CON regulation on virtual colonoscopy are negative, as shown in table 6 (page 29). Two coefficients are statistically significant. Like optical colonoscopy, virtual colonoscopy is an outpatient surgery. The key difference between the two procedures is that for virtual colonoscopy a CT scanner is used to make the surgery less invasive. Thus, in addition to our binary variable for the presence of a CON program and the count of regulated services, we also include dummies for ambulatory surgical centers and CT scanner regulation. These coefficients are both small and statistically insignificant.

In line with the previous tables, CON regulations correlate with fewer hospitals offering virtual colonoscopy. On average, about 1.5 hospitals per 500,000 persons provide virtual colonoscopy. CON programs reduce this number by roughly a third, the specifics depending on the indicator of CON regulation.

4.2. *Certificate-of-Need Regulation and Indigent Care*

We calculate our measure of uncompensated care as the sum of hospital-level uncompensated care in a state divided by the number of beds in the reporting hospitals. Table 7 (page 30) shows the effect of CON programs on uncompensated care. For the years 2007 to 2011, the average annual level of uncompensated care was about $100,000 per reporting hospital bed.

The results in table 7 suggest that CON programs do not have an effect on indigent care, as measured by uncompensated care. The estimated effect is negative in half of the specifications and positive in the other half. Additionally, the coefficients are small relative to the standard deviation, and none are statistically significant.

Of the 37 CON programs, 13 have made charity care a requirement in the CON application process. To measure the impact of these requirements on reported uncompensated care, we include an indicator that tracks the presence of these requirements.[12] The estimated effect of charity care requirements is positive, but is never statistically significant. For those

[12] The CON programs that have these requirements, and the years when these requirements were added to state statutes, are Connecticut in 2007, Delaware in 2005, the District of Columbia in 1996, Florida in 1987, Georgia in 2008, Illinois in 2009, Iowa in 1991, Nebraska in 1997, North Carolina in 1983, Ohio in 2009, Virginia in 1991, Washington in 1979, and West Virginia in 1977.

regressions where we estimate a negative effect of CON programs, the net effect, taking into account charity care requirements, is smaller but would still be negative.

We have tested two other variations of uncompensated care but do not report the results. Because the results of these tests were nearly identical to those reported in table 7, we avoid unnecessary duplication. In the first case, we divide uncompensated care by the population in the state. One problem with this straight per capita metric is that the number of reporting hospitals changes from year to year, which means the variation in measured uncompensated care per capita may be driven by changes in the number of reporting hospitals, not by changes in actual uncompensated care rates.

To address this issue, we use a second per capita measure, in which we multiply the straight per capita measure by the fraction of reporting beds in a state. For example, suppose a state has 10,000 hospital beds and the number of beds in reporting hospitals in that state was 6,000 in a given year. We would divide the aggregate total of uncompensated care by 60 percent of the population in that state. Here we assume that population is distributed in the same manner that hospitals file cost reports. While this assumption is strong, we use it as an attempt to account for the year-to-year changes in reporting hospitals.

Our per-bed metric inaccurately measures provision of uncompensated care if larger hospitals were more likely both to file a cost report and to provide different amounts of uncompensated care. Still, averaging uncompensated care by the number of reporting beds seemed to be the most accurate way to scale this measure.

We also investigate several other measures of indigent care. Taken together, our regression results show little evidence of a cross-subsidy for Medicaid patients. Since Medicaid is the largest source of funding for health care for low-income groups in the United States

(O'Neill 2014), we test two measures related to Medicaid patients. Medicaid is an insurance program that reimburses hospitals for health care services, but some studies show that Medicaid patients often have higher patient costs and lower reimbursement rates (Miller 2014). The results of those studies lead us to test whether there is evidence that the hypothetical indigent-care cross-subsidy goes toward providing increased access to Medicaid patients.

In table 8 (page 31) we report the results for the percentage of inpatient days for Medicaid patients. The coefficients on the CON variables are positive, but the estimated effects are small, and only one of the four is statistically significant. Approximately 17 percent of all inpatient days are accounted for by Medicaid patients. CON programs correlate with an increase in Medicaid patient days of between 0.3 and 1.3 percentage points, a range whose maximum is about one-third of the standard deviation. In column 4 the coefficient for count of regulated services is 0.001 and is statistically significant. For the average CON program, with 14 regulated services, this amounts to an increase of 0.014 patient days, a nearly identical magnitude to the effect reported in column 3.

We also tested, but do not report in our tables, regressions with the percentage of admissions by Medicaid patients. The descriptive statistics are similar to inpatient days, with the same mean, 17 percent, and a correlation coefficient between these measures of 0.61. The results of these specifications were similar to those in table 8, with one exception. The sign on the binary CON-program variable switched to negative, −0.002, in the specification that includes the dummy for acute hospital beds.

4.3. *Limitations and Alternative Interpretations*

A major limitation of this study is that while we are able to present correlations, we do not have an identification strategy that allows us to give a causal interpretation to our results.

Future studies should address this concern by identifying a causal mechanism for how CON regulations are able to enforce the cross-subsidy. Because CON programs often report their decisions for individual applications, with hospital-level data it may be possible to identify the effect directly.

Other limitations of this study relate to our measurement of indigent care. We use uncompensated-care data because this measure is the closest available metric for measuring indigent care, and its widespread use in health economics suggests the profession agrees. However, one could argue that an increase in uncompensated care may not represent a true increase in indigent care. If regulators focus on uncompensated care to monitor the provision of indigent care, this may simply incentivize hospitals to provide more unnecessary, but billable, services to the same number of patients as before. Costs will have increased, but indigent care will not have increased in a meaningful sense.

In light of the weaknesses of our study, we do not place undue weight on any single measure. Our empirical strategy is to look for an increase in indigent care across multiple measures and draw our conclusions on the basis of the overall patterns.

5. Discussion and Conclusion

This paper analyzes the connection between CON laws and cross-subsidization in the health care industry. We consider CON laws as a mechanism for financing a subsidy to the medically indigent.

The theory of cross-subsidization requires that CON programs do two things: First, they must act as an entry barrier to reduce the competitiveness of regulated medical sectors and increase the profitability of existing providers. Accomplishing that, these regulations must also force firms to provide the cross-subsidy. CON laws must provide incentives for the regulated to use their profits to provide more indigent services than they otherwise would.

We investigated indigent care with state-level hospital data and put together the most comprehensive CON-regulation database to date. We do not find any evidence of an increase in indigent care. Our coefficients are small in magnitude, not statistically different from zero, and the direction of the effect changes across specifications. Our evidence is consistent with previous studies in showing that CON programs are effective at restricting the supply of regulated medical services. It appears, however, that CON programs do not induce cross-subsidization. Since we lack measures of hospital profitability, our data do not allow us to make conclusions about whether this is because supply restrictions have not increased hospital profits, or because indigent care provision is not sufficiently enforced by the states that have these provisions.

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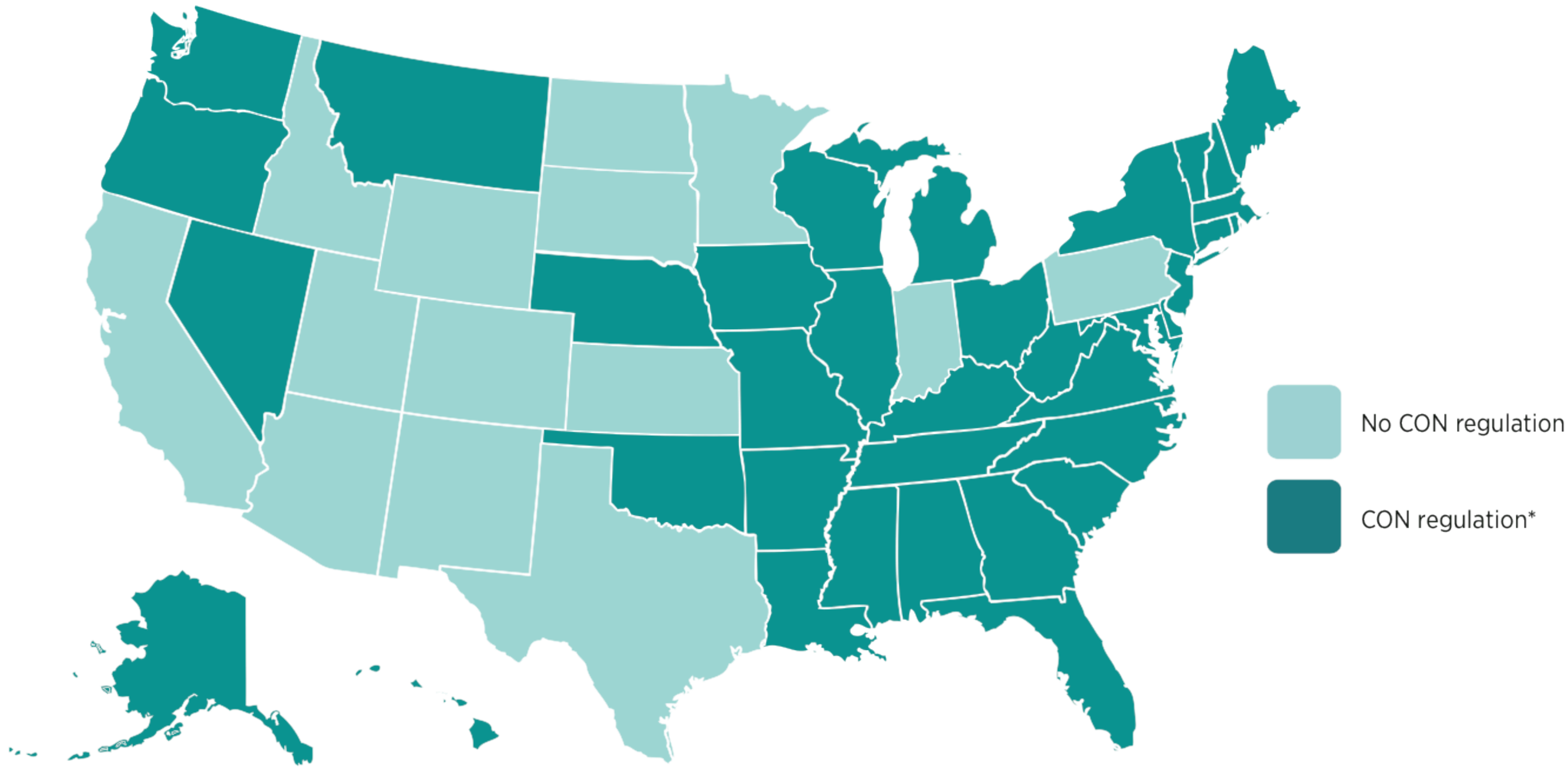
Certificate-of-Need (CON) Regulation in the United States



* As of 2011, after the period covered in this study, Wisconsin has repealed its CON regulations.

Source: AHPA (2012).

Table 1. Summary Statistics for Hospital Capacity, Certificate of Need, and Indigent Care

Statistic	*N*	Mean	Stan. dev.	Min	Median	Max
Hospital beds (per 100,000 population)	561	362.05	121.80	208.80	327.60	906.60
Hospitals with MRI services (per 500,000 population)	561	5.87	2.69	1.91	5.12	17.21
Hospitals with CT scanner (per 500,000 population)	561	9.00	5.20	2.55	7.37	26.27
Hospitals with optical colonoscopy (per 500,000 population)	153	5.41	3.55	1.17	4.24	17.86
Hospitals with virtual colonoscopy (per 500,000 population)	306	1.44	1.11	0.00	1.12	6.82
Uncompensated care (dollars per capita)	204	247.40	410.10	53.30	206.40	5,773.00
Uncompensated care (dollars per capita, adjusted)	204	517.40	879.40	144.50	409.20	12,549.00
Uncompensated care (per reporting bed)	204	109,346	103,841	27,234	91,440	1,306,574
Hospital inpatient days: percentage Medicaid	561	0.16	0.04	0.08	0.16	0.31
Facility admissions: percentage Medicaid	561	0.17	0.03	0.09	0.17	0.29
State certificate-of-need regulation (yes = 1)	561	0.73	0.45	0	1	1
Count of certificate-of-need regulated services	561	10.13	9.02	0	9	28
Acute hospital bed regulation (yes = 1)	561	0.54	0.50	0	1	1
Ambulatory surgical center regulation (yes = 1)	561	0.53	0.50	0	1	1
CT scanner regulation (yes = 1)	561	0.27	0.44	0	0	1
MRI regulation (yes = 1)	561	0.39	0.49	0	0	1
Certificate-of-need application: charity care required (yes = 1)	561	0.19	0.39	0	0	1
Unemployment rate (seasonally adjusted)	561	5.52	1.98	2.30	5.10	13.80
State real per capita income (2011 dollars)	561	30,875	7,917	16,501	30,166	67,634
Population (× 1,000)	561	5,802	6,472	494	4,101	37,267
Adult diagnosed diabetes percentage (18+, age adjusted)	561	7.25	1.41	4.60	7.10	11.30
Youth percentage (under 18)	561	0.25	0.02	0.17	0.25	0.32
Elderly percentage (65 and over)	561	0.12	0.02	0.05	0.12	0.17
Women of child-bearing age percentage (15–44)	561	0.21	0.01	0.18	0.21	0.27
White percentage	561	0.81	0.14	0.26	0.84	0.97
Black percentage	561	0.11	0.11	0.00	0.08	0.61
Hispanic percentage	561	0.09	0.09	0.01	0.06	0.46

Table 2. Hospital Beds

	Hospital beds (per 100,000 population)				Logged hospital beds	
	(1)	(2)	(3)	(4)	(5)	(6)
State certificate-of-need regulation	−2.78	−99.00***	−61.47*		−0.13	
(yes = 1)	(41.02)	(31.19)	(36.02)		(0.09)	
Acute hospital bed regulation (yes = 1)			−70.07***		−0.17**	
			(25.87)		(0.07)	
Count of certificate-of-need regulated				−4.66***		−0.01***
services				(1.45)		(0.00)
Unemployment rate (seasonally		−4.06	−1.21	−4.85	−0.01	−0.02
adjusted)		(2.96)	(6.55)	(6.98)	(0.02)	(0.02)
Real income (2011 dollars)		0.000	0.004	0.002	0.000	0.000
		(0.002)	(0.003)	(0.003)	(0.000)	0.000
Population (logged)		−48.67***	−55.37***	−55.21***	−0.11***	−0.11***
		(13.76)	(12.69)	(15.31)	(0.03)	(0.04)
Adult diagnosed diabetes percentage		13.25	29.71***	27.24**	0.08***	0.08**
(18+, age adjusted)		(9.15)	(10.70)	(12.50)	(0.03)	(0.03)
Youth percentage (under 18)		30.95	−158.70	−148.70	0.07	0.21
		(1,218.00)	(1,078.00)	(1,175.00)	(2.74)	(3.05)
Elderly percentage (65 and over)		3,402.00***	2,686.00**	2,851.00**	6.35**	6.89**
		(1,291.00)	(1,209.00)	(1,322.00)	(3.05)	(3.38)
Women of child-bearing age		3,286.00*	1,693.00	3,393.00*	1.03	5.03
percentage (15–44)		(1,807.00)	(1,801.00)	(2,049.00)	(4.97)	(5.62)
White percentage		−11.62	−11.59	−25.92	−0.003	−0.03
		(98.97)	(80.73)	(81.51)	(0.18)	(0.19)
Black percentage		401.90**	387.90**	255.10	0.95**	0.66
		(188.40)	(164.40)	(178.00)	(0.39)	(0.42)
Hispanic percentage		−310.00***	−301.90***	−279.40***	−0.89***	−0.84***
		(110.20)	(105.40)	(94.64)	(0.26)	(0.25)
Constant	364.50***	−351.90	0.33	−336.40	5.29***	4.45**
	(36.54)	(746.70)	(630.80)	(706.80)	(1.74)	(1.98)
Year indicators?	No	No	Yes	Yes	Yes	Yes
N	561	561	561	561	561	561
R^2	0.0001	0.60	0.64	0.59	0.62	0.56
Adjusted R^2	−0.002	0.59	0.63	0.57	0.60	0.54

Notes: 561 observations are the 50 states and the District of Columbia observed from the year 2000 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 3. Hospitals with Magnetic Resonance Imaging (MRI) Services

	Hospitals with MRI services (per 500,000 population)				Logged hospital MRI services	
	(1)	(2)	(3)	(4)	(5)	(6)
State certificate-of-need regulation (yes = 1)	−1.28 (0.98)	2.10*** (0.76)	−1.85** (0.87)		−0.26** (0.11)	
MRI regulation (yes = 1)			−0.64 (0.55)		−0.07 (0.09)	
Count of certificate-of-need regulated services				−0.10*** (0.03)		−0.01*** (0.00)
Unemployment rate (seasonally adjusted)		−0.10 (0.07)	−0.12 (0.11)	−0.18 (0.11)	−0.02 (0.02)	−0.03 (0.02)
Real income (2011 dollars)		0.00 (0.00)	−0.00 (0.00)	−0.00 (0.00)	−0.00** (0.00)	−0.00** (0.00)
Population (logged)		−1.26*** (0.31)	−1.25*** (0.36)	−1.30*** (0.38)	−0.18*** (0.05)	−0.19*** (0.05)
Adult diagnosed diabetes percentage (18+, age adjusted)		0.33** (0.17)	0.35 (0.28)	0.40 (0.28)	0.04 (0.04)	0.05 (0.04)
Youth percentage (under 18)		−4.93 (21.58)	−13.50 (19.62)	−14.14 (19.58)	−2.73 (3.04)	−3.20 (3.02)
Elderly percentage (65 and over)		−3.93 (25.90)	−8.89 (29.38)	−12.65 (31.76)	−1.16 (4.04)	−2.01 (4.23)
Women of child-bearing age percentage (15–44)		−70.97 (36.04)	−57.59 (55.79)	−44.24 (55.85)	−2.82 (7.50)	−0.98 (7.52)
White percentage		4.24*** (1.21)	4.00*** (1.31)	3.58*** (1.32)	0.61*** (0.16)	0.54*** (0.16)
Black percentage		4.82 (3.21)	3.81 (2.75)	2.11 (2.76)	0.48 (0.42)	0.21 (0.43)
Hispanic percentage		−7.29*** (2.54)	−7.89*** (2.51)	−6.59*** (2.26)	−1.42*** (0.38)	−1.28*** (0.36)
Constant	6.80*** (0.92)	29.73** (14.62)	30.21* (16.96)	28.11* (17.03)	4.59** (2.29)	4.45** (2.26)
Year indicators?	No	No	Yes	Yes	Yes	Yes
N	561	561	561	561	561	561
R^2	0.04	0.56	0.57	0.56	0.60	0.60
Adjusted R^2	0.04	0.56	0.56	0.54	0.58	0.58

Notes: 561 observations are the 50 states and the District of Columbia observed from the year 2000 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 4. Hospitals with Computed Tomography (CT) Scanners

	Hospitals with CT scanners (per 500,000 population)				Logged hospital CT scanners	
	(1)	(2)	(3)	(4)	(5)	(6)
State certificate-of-need regulation (yes = 1)	−2.45	−3.41**	−3.01*		−0.26*	
	(1.92)	(1.56)	(1.70)		(0.15)	
CT scanner regulation (yes = 1)			−1.26		−0.10	
			(0.87)		(0.09)	
Count of certificate-of-need regulated services				−0.16**		−0.01***
				(0.06)		(0.01)
Unemployment rate (seasonally adjusted)		−0.26**	−0.39	−0.47*	−0.04	−0.04*
		(0.12)	(0.24)	(0.24)	(0.03)	(0.03)
Real income (2011 dollars)		−0.00	−0.00	−0.00	−0.00**	−0.00**
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Population (logged)		−2.25***	−2.23***	−2.32***	−0.20***	−0.21***
		(0.61)	(0.64)	(0.68)	(0.07)	(0.07)
Adult diagnosed diabetes percentage (18+, age adjusted)		0.26	0.27	0.48	0.02	0.05
		(0.37)	(0.51)	(0.52)	(0.05)	(0.05)
Youth percentage (under 18)		16.44	1.93	1.13	−2.47	−2.95
		(48.74)	(47.05)	(49.20)	(4.73)	(4.81)
Elderly percentage (65 and over)		17.57	5.27	−1.12	−2.21	−3.13
		(52.65)	(56.03)	(60.46)	(5.61)	(5.85)
Women of child-bearing age percentage (15–44)		−144.60*	−132.40	−110.10	−6.42	−4.66
		(77.47)	(102.40)	(102.70)	(10.61)	(10.57)
White percentage		8.27***	7.43***	7.48***	0.85***	0.83***
		(2.68)	(2.69)	(2.53)	(0.21)	(0.19)
Black percentage		9.93	8.21	5.50	0.54	0.28
		(6.72)	(5.99)	(6.35)	(0.60)	(0.62)
Hispanic percentage		−13.82**	−14.14**	−12.50**	−1.79***	−1.69***
		(5.55)	(5.58)	(4.89)	(0.59)	(0.55)
Constant	10.77***	49.08	52.94	48.13	6.18*	5.97*
	(1.79)	(30.74)	(32.97)	(33.34)	(3.40)	(3.36)
Year indicators?	No	No	Yes	Yes	Yes	Yes
N	561	561	561	561	561	561
R^2	0.04	0.58	0.59	0.58	0.60	0.60
Adjusted R^2	0.04	0.57	0.57	0.56	0.59	0.58

Notes: 561 observations are the 50 states and the District of Columbia observed from the year 2000 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 5. Hospitals with Optical Colonoscopy

	Hospitals with optical colonoscopy (per 500,000 population)				Logged optical colonoscopy	
	(1)	(2)	(3)	(4)	(5)	(6)
State certificate-of-need regulation (yes = 1)	−2.27*	−2.80***	−2.03**		−0.19	
	(1.32)	(1.07)	(0.99)		(0.12)	
Ambulatory surgical center regulation (yes = 1)			−0.43		−0.19*	
			(0.67)		(0.12)	
Count of certificate-of-need regulated services				−0.10**		−0.01**
				(0.04)		(0.01)
Unemployment rate (seasonally adjusted)		−0.16*	−0.65***	−0.68***	−0.12***	−0.13***
		(0.09)	(0.20)	(0.19)	(0.04)	(0.04)
Real income (2011 dollars)		0.00	−0.00	−0.00	−0.00	−0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Population (logged)		−1.54***	−1.20***	−1.25***	−0.17***	−0.17**
		(0.39)	(0.40)	(0.43)	(0.06)	(0.07)
Adult diagnosed diabetes percentage (18+, age adjusted)		0.37	0.28	0.31	0.06	0.06
		(0.35)	(0.34)	(0.31)	(0.05)	(0.04)
Youth percentage (under 18)		4.21	−15.13	−16.87	−6.97	−6.36
		(33.13)	(35.59)	(34.71)	(5.03)	(4.64)
Elderly percentage (65 and over)		22.11	7.89	7.26	−5.57	−4.26
		(38.36)	(41.50)	(39.17)	(6.25)	(5.61)
Women of child-bearing age percentage (15–44)		−65.68	−29.58	−6.44	−1.01	2.63
		(49.13)	(49.35)	(49.11)	(8.17)	(8.52)
White percentage		6.99***	7.42***	7.17***	1.80***	1.78***
		(2.04)	(2.05)	(1.82)	(0.21)	(0.21)
Black percentage		2.69	2.51	0.12	0.53	0.21
		(4.59)	(4.31)	(4.56)	(0.65)	(0.71)
Hispanic percentage		−7.78**	−6.66*	−5.80**	−1.35***	−1.23***
		(3.48)	(3.45)	(2.84)	(0.48)	(0.46)
Constant	7.06***	19.95	20.84	16.85	4.85	3.75
	(1.25)	(18.56)	(19.81)	(19.02)	(2.99)	(2.83)
Year indicators?	No	No	Yes	Yes	Yes	Yes
N	153	153	153	153	153	153
R^2	0.08	0.60	0.66	0.64	0.69	0.67
Adjusted R^2	0.08	0.57	0.62	0.61	0.66	0.64

Notes: 153 observations are the 50 states and the District of Columbia observed from the year 2008 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 6. Hospitals with Virtual Colonoscopy

	Hospitals with virtual colonoscopy (per 500,000 population)				Logged virtual colonoscopy	
	(1)	(2)	(3)	(4)	(5)	(6)
State certificate-of-need regulation	−0.38	−0.71*	−0.65*		−0.18*	
(yes = 1)	(0.42)	(0.37)	(0.34)		(0.11)	
Ambulatory surgical center regulation			−0.16		−0.08	
(yes = 1)			(0.30)		(0.10)	
CT scanner regulation (yes = 1)			−0.01		0.02	
			(0.27)		(0.10)	
Count of certificate-of-need regulated				−0.04**		−0.01**
services				(0.02)		(0.01)
Unemployment rate (seasonally		−0.06*	−0.04	−0.05	−0.02	−0.03
adjusted)		(0.04)	(0.07)	(0.07)	(0.03)	(0.03)
Real income (2011 dollars)		0.00**	0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Population (logged)		−0.32**	−0.36**	−0.37**	−0.08	−0.08
		(0.14)	(0.17)	(0.18)	(0.05)	(0.06)
Adult diagnosed diabetes percentage		0.04	0.13	0.15	0.04	0.04
(18+, age adjusted)		(0.12)	(0.20)	(0.19)	(0.06)	(0.05)
Youth percentage (under 18)		−16.17	−15.40	−16.22	−5.12	−5.40
		(10.71)	(11.40)	(11.05)	(3.77)	(3.63)
Elderly percentage (65 and over)		−20.11	−22.17	−23.07	−6.85	−6.94
		(15.66)	(16.26)	(16.17)	(5.38)	(5.28)
Women of child-bearing age		−42.67*	−50.87*	−44.28	−14.05*	−11.90
percentage (15–44)		(24.79)	(27.50)	(27.87)	(7.96)	(8.32)
White percentage		2.08***	2.15***	2.05**	0.75***	0.70***
		(0.75)	(0.76)	(0.80)	(0.25)	(0.24)
Black percentage		2.14	1.91	1.12	0.51	0.24
		(1.80)	(1.56)	(1.70)	(0.51)	(0.56)
Hispanic percentage		−1.92*	−2.02*	−1.80*	−1.02***	−0.97***
		(1.07)	(1.05)	(0.92)	(0.33)	(0.30)
Constant	1.71***	16.53*	17.33*	16.30*	5.22*	4.88*
	(0.40)	(8.99)	(9.10)	(8.98)	(2.76)	(2.69)
Year indicators?	No	No	Yes	Yes	Yes	Yes
N	306	306	306	306	306	306
R^2	0.02	0.42	0.43	0.42	0.41	0.40
Adjusted R^2	0.02	0.40	0.40	0.39	0.38	0.37

Notes: 306 observations are the 50 states and the District of Columbia observed from the year 2005 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7. Hospital Uncompensated Care (per reported bed)

	Uncompensated care (per reported bed)				Logged uncomp. care	
	(1)	(2)	(3)	(4)	(5)	(6)
State certificate-of-need regulation (yes = 1)	6,976.00	−9,380.00	−13,661.00		0.07	
	(20,713.00)	(13,507.00)	(14,868.00)		(0.12)	
Acute hospital bed regulation (yes = 1)			−2,548.00		0.07	
			(15,490.00)		(0.14)	
Count of certificate-of-need regulated services				−557.20		0.01
				(1,944.00)		(0.01)
Charity care required (yes = 1)		4,183.00	7,286.00	4,715.00	0.005	0.01
		(11,722.00)	(14,030.00)	(15,252.00)	(0.10)	(0.09)
Unemployment rate (seasonally adjusted)		1,617.00	6,236.00	5,707.00	0.06*	0.06*
		(3,419.00)	(4,536.00)	(4,967.00)	(0.03)	(0.03)
Real income (2011 dollars)		−2.00	−0.73	−0.79	−0.00	−0.00
		(1.75)	(1.55)	(1.52)	(0.00)	(0.00)
Population (logged)		2,432.00	−1,349.00	−1,546.00	0.07	0.07
		(6,878.00)	(7,710.00)	(7,932.00)	(0.05)	(0.05)
Adult diagnosed diabetes percentage (18+, age adjusted)		−5,163.00	−2,106.00	−2,124.00	−0.02	−0.03
		(6,016.00)	(5,805.00)	(6,282.00)	(0.05)	(0.05)
Youth percentage (under 18)		−1,813,548.00***	−1,631,841.00***	−1,631,525.00**	−9.28**	−7.71*
		(624,266.00)	(597,637.00)	(705,266.00)	(4.45)	(4.13)
Elderly percentage (65 and over)		−144,962.00	−95,372.00	−81,954.00	−4.03	−2.96
		(649,204.00)	(659,800.00)	(784,602.00)	(4.80)	(4.94)
Women of child-bearing age percentage (15–44)		3,478,053.00***	2,912,567.00**	3,102,963.00***	14.03*	12.97*
		(763,924.00)	(1,161,876.00)	(1,162,779.00)	(7.29)	(6.63)
White percentage		−239,766.00***	−242,538.00***	−241,099.00***	−0.92***	−0.81**
		(34,516.00)	(40,308.00)	(59,311.00)	(0.30)	(0.33)
Black percentage		−316,800.00**	−319,635.00**	−333,778.00***	−2.59***	−2.40***
		(135,418.00)	(129,620.00)	(122,349.00)	(0.76)	(0.75)
Hispanic percentage		140,975.00*	132,950.00**	139,983.00**	1.20***	1.32***
		(72,481.00)	(66,176.00)	(63,587.00)	(0.40)	(0.39)
Constant	104,285.00***	166,064.00	186,748.00	146,400.00	11.70***	11.26***
	(17,706.00)	(417,738.00)	(436,178.00)	(529,704.00)	(2.64)	(2.78)
Year indicators?	No	No	Yes	Yes	Yes	Yes
N	204	204	204	204	204	204
R^2	0.001	0.25	0.26	0.26	0.42	0.43
Adjusted R^2	−0.004	0.21	0.20	0.20	0.37	0.39

Notes: 204 observations are the 50 states and the District of Columbia observed from the year 2007 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 8. Percentage of Hospital Inpatient Days for Medicaid Patients

	Percentage of hospital inpatient days for Medicaid patients			
	(1)	(2)	(3)	(4)
State certificate-of-need regulation (yes = 1)	0.003	0.01	0.01	
	(0.01)	(0.01)	(0.01)	
Acute hospital bed regulation (yes = 1)			0.003	
			(0.01)	
Count of certificate-of-need regulated services				0.001**
				(0.0004)
Unemployment rate (seasonally adj.)		0.003***	0.003	0.003
		(0.001)	(0.003)	(0.003)
Real income (2011 dollars)		0.00	−0.00	−0.00
		(0.00)	(0.00)	(0.00)
Population (logged)		−0.003	−0.002	−0.002
		(0.003)	(0.004)	(0.003)
Adult diagnosed diabetes percentage (18+, age adj.)		0.005*	0.001	−0.001
		(0.003)	(0.004)	(0.004)
Youth percentage		0.12	0.07	0.25
		(0.25)	(0.29)	(0.29)
Elderly percentage		0.09	0.17	0.33
		(0.41)	(0.44)	(0.42)
Women of child-bearing age percentage (15–44)		0.65	1.02	1.00
		(0.55)	(0.68)	(0.63)
White percentage		−0.06*	−0.07*	−0.06
		(0.03)	(0.04)	(0.04)
Black percentage		−0.10*	−0.10*	−0.07
		(0.06)	(0.06)	(0.06)
Hispanic percentage		0.08**	0.08**	0.10***
		(0.03)	(0.03)	(0.03)
Constant	0.16***	−0.003	−0.04	−0.11
	(0.01)	(0.21)	(0.23)	(0.22)
Year indicators?	No	No	Yes	Yes
N	561	561	561	561
R^2	0.001	0.20	0.22	0.25
Adjusted R^2	−0.001	0.18	0.19	0.22

Notes: 561 observations are the 50 states and the District of Columbia observed from the year 2000 to the year 2010. Values in parentheses are standard errors, clustered by state; * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Are Certificate-of-Need Laws Barriers to Entry?

How They Affect Access to MRI, CT, and PET Scans

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Abstract

Certificate of need (CON) laws in 21 states restrict acquisition of imaging equipment, including magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography (PET) scans. We compare the effect of CON regulations for imaging services provided by hospitals and other providers to determine whether CON laws affect use of imaging services across provider types. We find that services by nonhospital providers, but not by hospital providers, are negatively associated with CON laws. We also find that CON laws reduce the overall number of medical providers, suggesting less availability of imaging services in CON states. We provide evidence consistent with this result showing that residents of CON states are more likely to travel out of state to obtain imaging services than are residents of non-CON states. These results imply that the effect of CON is heterogeneous on hospitals and nonhospitals, affecting the market structure for imaging services.

JEL codes: I180

Keywords: barriers to entry, medical imaging services, health care, healthcare, utilization, certificate of need laws, Medicaid, regulation

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Are Certificate-of-Need Laws Barriers to Entry?

How They Affect Access to MRI, CT, and PET Scans

Thomas Stratmann and Matthew C. Baker

Certificate-of-need (CON) programs restrict healthcare institutions from expanding, offering a new service, or purchasing certain pieces of equipment without first gaining the approval of certificate-of-need regulators. On average, hospitals pay $32,000 per application to obtain regulator permission to provide a regulated service. The total costs per application include application fees and consulting fees as well as review and appeal fees (Conley and Valone 2011). The initial and main justification for this regulation is the assumption that unregulated market competition drives medical providers to overinvest in facilities and equipment, resulting in increased cost of medical care.

Largely because no evidence indicated that CON curtailed healthcare costs, the federal government repealed national CON requirements for many services in 1987, leaving regulation of certificate-of need-programs to individual states. Since then, several states have dropped their CON requirements.

A wide range of studies has examined the effect of CON requirements on hospital cost, price, and efficiency. Some researchers have presented evidence that CON laws are associated with higher hospital costs (Lanning, Morrisey, and Ohsfeldt 1991). However, other research implies that CON laws do not affect efficiency at a typical metropolitan hospital (Bates, Mukherjee, and Santerre 2006). A different strand of literature examines whether medical providers deliver indigent services as required by many CON laws. Many CON regulations explicitly recognize that these laws limit entry, thereby generating excess profits for medical providers, and thus the laws require service for the indigent to be financed from the excess profits. North Carolina, which currently regulates magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography (PET) scans, justifies the program as a means of controlling "unnecessarily duplication" (NC Division of Health Service Regulation 2015). However, to date, little evidence indicates that providers in CON states provide more indigent care than do provides in other states (Stratmann and Russ 2014).

Although much work has studied the effect of CON laws on cost and on whether they have delivered what they promised, little work has been done to determine whether the laws have a differential effect on providers with more market power. Providers with the greatest market power include financed institutions such as hospitals (Ginsburg 2010) that tend to have sufficient recourses to absorb application fees and legal fees associated with CON laws.

Although we do not collect data on the amount of imaging equipment in hospitals relative to other medical providers, which include new entrants, we can observe whether use of imaging services is higher in hospitals than in the facilities of other medical providers. To measure the level of proliferation of imaging services in hospitals relative to other medical providers, we can observe use of imaging services in CON states and in non-CON states. We predict that hospitals, relative to other providers, provide more services in CON states than in non-CON states. Thus, the hypothesis that CON laws benefit providers with larger market shares predicts that in CON states, the differential in utilization per capita of imaging services between hospital and nonhospital providers is larger than the corresponding differential in states without a CON law.

This paper examines CON requirements for imaging services on the use of medical services. For the period examined in this study, 21 states had CON requirements for at least one of three regulated imaging services—MRI, CT, or PET scans. We use Medicare claims to measure utilization. We compare CON and non-CON states for use of and access to imaging services.

We find that CON requirements are associated with lower medical use of imaging services by nonhospital providers. These differences occur amid higher hospital market share in CON states. However, CON requirements have no effect on medical use in hospitals.

We also find that CON laws reduce the overall number of providers, suggesting less availability of imaging services in CON states. To test whether the data are consistent with the latter explanation, we study whether patients seek imaging services out of state when their state of residence restricts the provision of imaging machines via CON regulations. If patients in CON states seek imaging services out of state, this is consistent with the explanation that there is a higher cost attached to finding the imaging services in their own state. Our findings show that up to 8.1 percent of patients in CON states are induced to travel out of state to receive care for MRI, CT, and PET scans.

Background

New York introduced CON regulation to the United States in 1964 to contain healthcare costs.[1] Proponents thought unregulated market competition created incentives for medical providers to overinvest in facilities and equipment. Regulators could lower the growth rate of healthcare costs by restricting market expansion to expenditures for which the medical provider could demonstrate a clear public need. The early studies of these laws generally found evidence neither of reduced investment by hospitals (Hellinger 1976; Salkever and Bice 1976) nor of cost control (Sloan and Steinwald 1980; Sloan 1981; Joskow 1980; Joskow 1981).

The results of more recent research are mixed. A study by Rivers, Fottler, and Frimpong (2010) finds no evidence that CON laws are associated with reduced hospital costs, but it does

[1] Simpson (1985) provides a brief and comprehensive history of CON legislation.

find evidence that stringent CON programs increase costs by 5 percent. Another study found that hospital efficiency at the state level was not improved by CON requirements (Ferrier, Leleu, and Valdmanis 2010). Most recently, Rosko and Mutter (2014), using stochastic frontier analysis, find that states with CON laws show increased cost efficiency. Although little research has been devoted specifically to CON regulations for advanced imaging services, some research shows that CON laws are not associated with lower hospital investment in new CT technology (Ladapo et al. 2009).

Other studies focus on the negative unintended consequences of CON requirements, such as an effect on market structure and competition (Eichmann and Santerre 2010). Previous research has demonstrated that the number of providers and the use of certain services are affected by CON requirements (Ho 2006; Short, Aloia, and Ho 2008).

Our study hypothesizes that CON laws have a negative effect on the quantity of imaging services supplied by healthcare providers. We hypothesize that use is reduced because provider applications for imaging services are denied or because providers who expect that their application will be denied may refrain from applying and thus not offer those services.

Previous studies have found some evidence that physicians face larger political barriers to obtaining certificates of need than do hospitals. According to a survey by the National Institute for Health Care Reform, physicians report greater difficulties than do hospitals in entering new markets, and they cite CON requirements as the primary barrier (NIHCR 2011). Thus, we will test whether the cost and effects of CON requirements vary across provider types. To measure the differences in the supply of imaging services across states with and without CON policies, we separately test the association of CON requirements on both hospitals and nonhospital providers, which include independently practicing physicians, group practices, and other ambulatory settings.

Because our utilization measure sums across all providers in a state, differences in use may be traced to one of two factors: the number of providers or the number of services performed by each provider. Because CON regulations may bar potential market entrants from providing services, we predict that any differences we find in utilization can be traced to having fewer providers in CON states than in non-CON states, consistent with previous findings (Stratmann and Russ 2014). To examine this possibility, we will test for differences in the number of hospital providers and nonhospital providers per person for each type of imaging service and compare CON states with non-CON states. Consistent with our first hypothesis, we will compare whether the effect of CON requirements on the number of providers varies across provider types.

We further hypothesize that CON requirements affect the consumer's ability to obtain services. In states with CON requirements, local providers may be prevented from offering imaging services demanded by the community. This situation may force patients to travel further to find a provider who offers the service. Furthermore, if CON requirements raise barriers to entry, providers in CON states may be more difficult to schedule or may have higher waiting times. This difficulty might also induce patients to travel to other providers to obtain care in a timely manner. We test whether patients living in CON states are more likely to travel out of their state of residence to access imaging services than are patients in non-CON states.

This study is unique within the CON literature in that it simultaneously examines the quantity of services provided, the number of suppliers of services, and the access to services by consumers. As well, we test for differences among provider types to determine whether CON requirements affect provider types unequally. Determining how CON requirements affect market factors beyond utilization helps to paint a broad picture of the effect of CON laws.

Data

AHPA Data

We collected state-level data on 2013 CON programs for imaging technologies from the American Health Planning Association (AHPA 2012). For each regulated equipment or facility, the association classifies each of the 50 states and the District of Columbia as either having a CON requirement or having no CON requirement. We focus on CON requirements for three types of imaging technologies: MRI scanners, CT scanners, and PET scanners.

Figures 1, 2, and 3 (pages 23–24) display the map of all states, indicating the states where each policy applies. For the three imaging services, a large overlap is clear among CON laws by state; states with a CON requirement for one imaging service tend to have CON requirements for other imaging services. The maps also highlight the regional clustering of the CON requirements. Along with Alaska and Hawaii, the CON requirements for imaging services occur throughout the eastern half of the United States.

CON laws for MRI and PET scans are similar across states, with requirements occurring jointly in 19 states. Georgia and Delaware have CON requirements for PET scanners only, whereas New York does not have CON requirements for PET scanners but does for MRI scanners. Only 13 states require a CON for CT scanners, fewer than for MRI or PET scans.

Medicare Claims Data

We use data from Medicare's 2013 5 percent Standard Analytic Files (SAF) to aggregate fee-for-service (FFS) claims to the state level. The FFS claims exclude Medicare Advantage managed care plans. Our analysis uses the Carrier limited dataset (LDS) file for physician Medicare Part B claims, as well as the Inpatient LDS and the Outpatient LDS files for facility claims data. These data contain information on the state of residence of the patient as well as the state of service of the provider on the claim. We also use revenue center data and Healthcare Common Procedure Coding System (HCPCS) codes from the LDS files to identify claims for use of MRI scanners, CT scanners, and PET scanners.

From the same Medicare database, we obtained a count of the number of Medicare beneficiaries by state. These data were used as denominators to derive a measure of utilization per person for imaging services use. For each state, we normalized the number of claims by first multiplying the results of the 5 percent Medicare sample by 20 to compute utilization estimates for the state's entire Medicare population. Then we divided each of our utilization statistics by the corresponding number of beneficiaries in the state. Thus, utilization is measured as the number of claims using the specified services in a state, divided by the number of Medicare beneficiaries who reside in a state. Hospital market share is defined as the number of procedures in the hospital divided by the number of procedures in all settings for a specific imaging service.

We use data for the entire Medicare population within the state to control for demand for healthcare services, including average age, percentage male, percentage non-Hispanic white, percentage black, percentage Hispanic, and average health risk score. The average health risk score measures the severity of a Medicare patient's medical history, as measured by the Hierarchical Condition Category (HCC) model from the Centers for Medicare and Medicaid Services. These data are from Medicare's Geographic Variation database (CMS 2013) and are based on the population of Medicare beneficiaries that are eligible to use FFS services. We used these demographic characteristics as control variables for our utilization measure.

Other Data

We collected additional variables related to the demand for healthcare services: the state's unemployment rate in 2013 from the US Bureau of Labor Statistics, the average household income in 2013 for each state using the American Community Survey 2013 estimates, and the urban percentage of the population by state from the Decennial Census 2010 from the US Census Bureau. These variables will serve as controls in our healthcare utilization regression.

Empirical Methods

Measuring the Effect of CON Requirements on Utilization

To test the hypothesis that CON requirements are negatively related to the medical services provided in a state, we estimate

$$(Claims\ utilization)_i = \beta_0 + \beta_1 (CON\ requirement)_i + \mathbf{X}_i \delta + \varepsilon_i.$$

The $CON\ requirement$ variable is the binary variable for the CON requirement policy in state i for the respective imaging service for each measure of claims utilization. For example, when we consider MRI use, we explain this utilization measure as whether there is a CON requirement for MRI machines. We proceed in an analogous way for use of CT and PET scan services.

The vector $\mathbf{X}_i$ includes a vector of control variables, including average age and HCC score of the Medicare FFS beneficiaries, the percentage of Medicare FFS beneficiaries that are non-Hispanic white, black, Hispanic, and male, and the state's overall unemployment rate and median household income. In some specifications we also include indicators for state regions, to control for geographic patterns of CON laws. For this purpose, we divided states into four regions—West, South, Midwest, and Northeast—using the US Census classification. Because of the strong collinearity across CON laws for each of the three imaging services (as demonstrated in figures 1, 2, and 3), the regression's independent variables include only the CON requirement status for the respective imaging service rather than measuring cross-elasticity across services that may result from having more than one type of certificate of need law in the state.

We employ three dependent variables: claims for MRI scans, CT scans, and PET scans. For each, we estimate two specifications, one with hospital claims counts and one with nonhospital claims counts. As is common with claims counts, we measure the dependent variable using the natural log as $\ln(1 + x)$, where x is the number of claims that are filed by all providers within the state that contain a MRI, CT, or PET procedure, divided by the number of beneficiaries (in thousands) eligible for Medicare FFS in the corresponding state.[2] Using the log dependent variable smoothed the distribution of claims per beneficiary, especially for nonhospital claims, which exhibited a wide range of claims counts.

We define MRI, CT, and PET procedures using codes from the HCPCS and from hospital revenue centers, as laid out in chapter 13 of Medicare's *Claims Processing* (CMS 2015). Our data include hospital claims and nonhospital claims. Hospital claims include all inpatient, outpatient, and emergency department claims, summed from the Inpatient SAF and the Outpatient SAF using the hospital revenue center that corresponds to each imaging service. Nonhospital claims are from a subset of the Carrier SAF, using only those services that were delivered outside the hospital inpatient, outpatient, or emergency departments, using the HCPCS codes that correspond to each imaging service. To ensure accuracy and consistency of our data across states, we excluded claims that were not paid under FFS, rejected claims, claims for which Medicare was not the primary payer, and claims containing services provided outside the United States.

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[2] The measurement of the dependent variable in the form of $\log(x + \mathrm{c})$ allows for inclusion of states with zero claims used in the category. In our data, for PET services, 3 states of 51 have no nonhospital claims. The numbers for all MRI and CT claims within a state are greater than zero.

Measuring Differences between Hospital and Nonhospital Utilization in CON States

To test whether CON laws affect hospitals and nonhospitals differently, we estimate a difference-in-difference regression:

$$(Claims\ utilization)_{ij} = \beta_0 + \beta_1(CON\ requirement)_i \times (Hospital) + \beta_2(Hospital) + u_i + \varepsilon_{ij}.$$

As in our ordinary least squares (OLS) regression, the $CON\ requirement$ variable is the binary variable for the CON requirement policy in state i in setting j (hospital or nonhospital) for the respective imaging service for each measure of claims utilization. $Hospital$ is a dummy variable for whether the setting of the claims is hospital or nonhospital. Thus, the term

$$\beta_1(CON\ requirement)_i \times (Hospital)$$

takes the value of 1 if the observation is set in the hospital and in a CON state, and is 0 otherwise. Our state fixed effects are u_i.

In these regressions, one difference is the utilization difference between CON and non-CON states and the other difference is the utilization between hospitals and nonhospitals. The coefficient β_1 captures whether hospitals in CON states experience more use than nonhospitals in the same states, relative to these two groups of providers in non-CON states. For this regression, which is a comparison of means between use of imaging services in a given state and between two types of providers, holding state characteristics constant via fixed effects, we estimate robust standard errors.

Measuring the Effect of CON Requirements on Number of Providers

We calculated the number of providers of imaging services per 100,000 beneficiaries in states that require CONs and states that do not require CONs. For each imaging service—MRI, CT, and PET—we count the number of providers that filed a claim for each type of service. For hospital claims, the provider of services is a hospital and for nonhospital claims, the provider of services is a performing physician. Each provider is attributed to a state using the location in which the physician practices or the hospital is located. To compare the provider counts across states, we divide the number of providers by the number of beneficiaries in the state (denominated in 100,000 beneficiaries).

Measuring the Effect of CON Requirements on Patient Access

To test whether CON requirements affect the percentage of patients who travel out of state to obtain medical services, we compute the number of claims for each state in each type of imaging service, aggregating hospital claims and nonhospital claims. Similar to the previous regressions, we model the following:

$$(Percentage\ traveling\ out\ of\ state)_i = \beta_0 + \beta_1(CON\ requirement)_i + \boldsymbol{X}_i\boldsymbol{\delta} + \varepsilon_i.$$

Whether the patient traveled out of state is determined from the patient's state of residence and the provider's place of service as documented in the Inpatient, Outpatient, and Carrier SAF files. We calculate a percentage of patients who traveled out of state: the number of claims by residents of the state who obtained the specific imaging service in a state other than their state of residence divided by the number of claims by residents of the state who obtained the imaging service in any state. For example, for MRIs, the resulting ratio is *Patients residing in the state who had obtained an MRI performed in some other state* divided by *Patients residing in the state who had obtained an MRI performed in any state*. The resulting ratio is such that a value of 0 percent means that all residents of the state who obtained a scan were provided the service in their home state and a value of 100 percent means that all residents of the state who obtained a scan were provided a service outside their home state.

Our $\boldsymbol{X}$ vector of control variables include state characteristics that may affect the residents' propensity to travel out of state to obtain care.

This regression allows for a test of the hypothesis that CON laws are associated with patients' limited access to care within their own state. Larger ratios among CON states as opposed to non-CON states are consistent with the hypothesis that access is more restricted for patients in CON states, because larger ratios indicate that more patients needed to travel out of state to obtain care. We will analyze the percentage of claims that are out of state for the three claims types—MRI, CT, and PET.

Results

The Effect of CON Requirements on Utilization

Table 1 (page 25) presents the summary statistics for our variables for each type of imaging service—MRI, CT, and PET—disaggregated by whether states have or do not have CON requirements for each of these services.

Our summary results show that there are modest characteristic differences across states with CON requirements and states without CON requirements. With the exception of the racial variables, the demographic characteristics are balanced between CON and non-CON states and the differences in means for these latter variables are not statistically significant. As displayed in figures 1, 2, and 3, states with CON requirements for each imaging service tend to cluster in the East, with fewer non-Hispanic whites, more blacks, and fewer Hispanics. Our regressions will control for these regional demographic differences by including variables for Western, Midwestern, Northeastern, and Southern states. Our measures for claims per beneficiary show that among the sample of states that have CON programs for each imaging technology, there is greater use of services in hospitals and lower use of services outside the hospital. The results also demonstrate that hospitals in CON states have a higher market share than in non-CON states.

Table 2 (page 28) presents results for our OLS model for MRI scans, with four specifications each for hospital and nonhospital claims.

The point estimates on the variable CON requirement measure the association of the CON policy with MRI services in each setting type. For our regressions for hospital claims, we find no statistically significant effect of CON policies on utilization. However, for nonhospital claims, we see a negative coefficient on (5) through (8). The magnitude of the coefficient is robust across specifications, and is −0.42 for (6) using the full vector of control variables. Thus, our log-linear results imply that CON requirements are associated with a (exp(−0.42) − 1) decrease (a 34 percent decrease) in MRI scans in the nonhospital market relative to those states without MRI CON requirements.

Table 3 (page 29) presents the same results for CT scan utilization.

The results from table 3 also find no effect different from zero of CON requirements on hospital claims, but a large association with nonhospital claims. For each specification, CON requirements are negatively correlated with the log of the number of nonhospital claims per 1,000 beneficiaries, with the final specification indicating that CON requirements are associated with a exp(−0.58) − 1 decrease (a 44 percent decrease) in nonhospital utilization. This result is statistically significantly different at the 1 percent level, with the point estimate (−0.58) nearly two times larger than the robust standard error (0.30). These differences in our OLS model are larger than differences in nonhospital claims count per 1,000 beneficiaries in the summary statistics in table 1B, which shows that CON states have 24 percent fewer nonhospital claims.

Table 4 (page 30) reports the results for PET scan use.

The results in table 4 for PET scans are consistent with MRI and CT scans. CON requirements have no effect on hospital claims, but they have a negative relationship with nonhospital claims. For PET scans, the association is larger than for the other two imaging services, with our final specification (8) implying a (exp(−1.05) − 1) difference (a decrease of 65 percent) associated with the state CON requirement. In all four specifications, the point estimates on CON requirements is statistically significant at the 1 percent level, with the coefficient on the final specification (−1.05) over four times larger than the magnitude of the robust standard error (0.24). This result from our OLS model is similar to our summary statistics in table 1C, which shows that 64 percent fewer nonhospital claims are filed in CON states than are filed in non-CON states.

Differences between Hospital and Nonhospital Utilization in CON States

Table 5 (page 31) shows the difference-in-difference regression results for MRI, CT, and PET scans. The regressions for each of the three imaging services include state fixed effect, two dependent variables for each state—namely, hospital and nonhospital utilization —and an indicator for whether the dependent variable pertains to hospital utilization. The main variable of interest in this specification is the interaction variable between whether the state has a CON requirement, the imaging service for which the regression is estimated, and the hospital indicator. This interaction variable measures whether hospitals in CON states experience significantly more use for these imaging services than do nonhospitals.

For all three imaging services, the coefficients on the CON restriction and on the binary hospital variable are similar across specifications and statistically significant at the 5 percent level for MRI use, at the 11 percent level for CT use, and at the 1 percent level for PET scan use. For the MRI utilization regressions, the point estimate on MRI-CONs implies that in states with these CON regulations, 51 percent more MRI claims are filed by hospitals than by other providers, as compared with states without these regulations. That finding is consistent with the hypothesis that the MRI-CONs benefit hospitals relative to other providers. The CT and PET regressions show similar findings. The point estimates in the CT utilization regression imply that relative to hospitals in states without CON laws limiting the purchase of CT imaging equipment, hospitals in states with CT-CONs experience 73 percent higher use of these scans than do nonhospitals. Furthermore, the PET-scan regressions show that hospitals have 91 percent more claims relating to PET scans than do other providers, relative to states without PET-CONs. These findings are consistent with the hypothesis that CON laws benefit hospitals because hospitals capture a larger share of the market for those services that are regulated by CONs.

Assuming that our state fixed effects capture all variables that simultaneously affect both utilization and the adoption of the CON law, the CON law is uncorrelated with the error term in the regression equation. In this case, CON is exogenous conditional on the controls, and we can give the point estimates a causal interpretation.

The Effect of CON Requirements on Number of Providers

Table 6 (page 31) displays the number of providers, both hospital and nonhospital, in CON states and non-CON states for each type of imaging service.

Table 6 demonstrates a consistently lower number of providers in CON states for MRI and CT scans for both hospital and nonhospital claims. For PET scan services, hospitals show a much different effect than do nonhospitals. Hospital providers are nearly equally frequent in CON states relative to non-CON states, whereas nonhospital providers are much more frequent in non-CON states. The differences for all nonhospital services are statistically significant at the 10 percent level, with PET scans demonstrating the largest difference.

In sum, table 6 demonstrates some evidence that nonhospital providers may be barred from market entry by CON requirements. For hospitals, the result is mixed—for MRI and CT CON requirements, the effect on hospitals in the market is negative, but for PET-CON requirements, a negative effect does not appear.

The Effect of CON Restrictions on Patient Access

The results in table 7 (page 32) demonstrate differences in patient travel across CON states and non-CON states.

The results in table 7 show that after controlling for state characteristics, there is a positive coefficient on MRI, CT, and PET services. Those coefficients imply that CON laws are associated with 3.93 percent more MRI scans, 3.52 percent more CT scans, and 8.13 percent more PET scans occurring out of state, all statistically significant at the 10 percent level. These results are produced by aggregating both hospital and nonhospital claims, demonstrating that among all service settings, CON laws are related to fewer patients receiving care in their own states.

The coefficients on the control variables show that dense and landlocked states have more out-of-state travel, whereas older patients are associated with lower traveling rates. The percentage of hospitals in the state that are teaching hospitals, which may provide unique services, is related to having fewer patients travel out of state.

Limitations

One limitation of our study is that we do not have a time series aspect to our data. We used no time series primarily because virtually no changes have been made in CON laws over the past 20 years and none with respect to the CON requirements that are the focus of this study.

Second, our results account for MRI, PET, and CT services for Medicare patients only, but we did not evaluate the effect on all patients. Thus, although it is not obvious why our results would not extend to other populations, we do not have direct evidence for the effect of CON for the population not covered by Medicare.

Discussion and Conclusion

Our results provide evidence that market entry for nonhospital providers is limited by CON requirements, whereas hospital providers remain largely unaffected. The magnitude of the coefficients implies that the association of the CON policy with those nonhospital providers is substantial, ranging from −34 percent to −65 percent for MRI, CT, and PET scans.

The results for hospitals are consistently different from the results for nonhospitals. Our regressions, using the same control variables, identified no effect of CON on hospital utilization of services. With very small magnitudes and low *t*-statistics, we find no support for the hypothesis that the volume of services provided in hospitals is negatively affected by CON policy. This explains some of the differences in market share across CON states and non-CON states; hospital providers have a stronger market presence in CON states.

The results in table 5 provide evidence that the difference between hospitals and nonhospitals is statistically significant with respect to their relationship to CON laws. This supports our theoretical framework, which hypothesized that nonhospital providers experience greater barriers to providing imaging services under CON laws than hospital providers do.
The number of providers of imaging services demonstrates a significant association of CON laws with lower numbers of nonhospital providers per beneficiary. This finding complements the utilization regression for nonhospitals. The lower number of nonhospital providers offers an

explanation for why the number of scans may be lower in the utilization regression. If providers are less likely to enter the market for imaging services in CON states, then fewer suppliers of services could explain lower utilization.

Our results for patient travel inform several claims from our theoretical framework. First, it supports the idea that CON laws may harm consumers because patients living in CON states have to travel out of state more often than do patients living in non-CON states. The propensity for residents of CON states to travel out of state to obtain medical services can be attributed to any of several factors: higher costs, a smaller selection of services, or lower access to care.

The results imply that CON laws widen the differences between hospitals and nonhospitals in imaging services. In our utilization regression and out-of-state travel regression, hospital services did not display the strong association with CON laws that nonhospital services did. A possible explanation is that some market players are prevented from entering the market for MRI, CT, and PET scans in those states, squeezing out people who live in those states from getting care from those nonhospital providers and spilling some of the demand over to other states or hospitals. Another explanation is that hospitals in CON states may attract consumers who would otherwise prefer to travel to a nonhospital provider but who were limited by lower accessibility in CON states.

Together, these results imply support for our hypotheses. First, less imaging care for MRIs, CTs, and PETs is provided in states with CON requirements, but the effect across all provider types is not consistent. The negative effect occurs only for scans provided outside the hospital. More research is needed on why additional costs and barriers in the healthcare industry restrict certain market providers and may affect where services occur.

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Figure 1. Certificate-of-Need (CON) Requirements for MRI Services by State

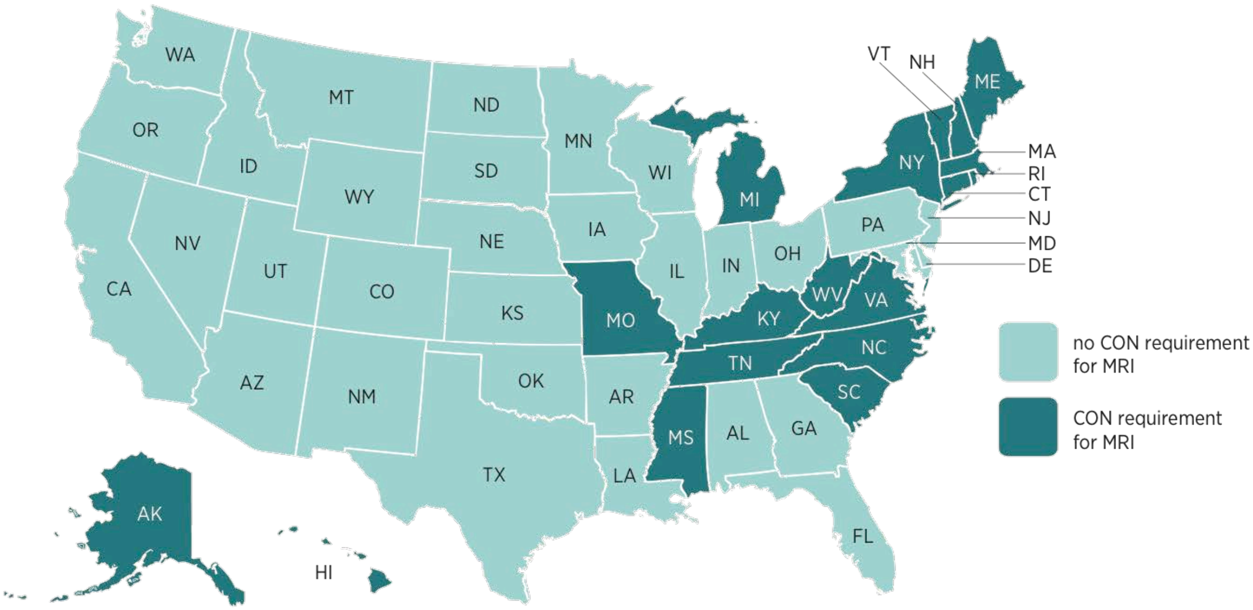

Figure 2. Certificate-of-Need (CON) Requirements for CT Services by State

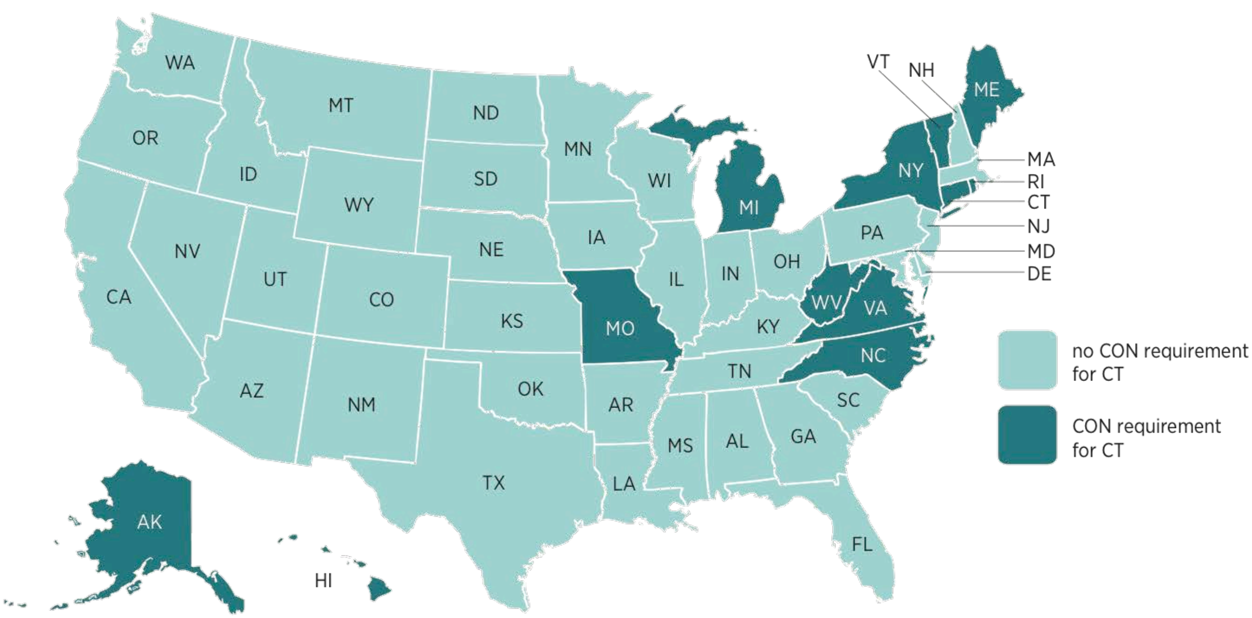

Figure 3. Certificate-of-Need (CON) Requirements for PET Services by State

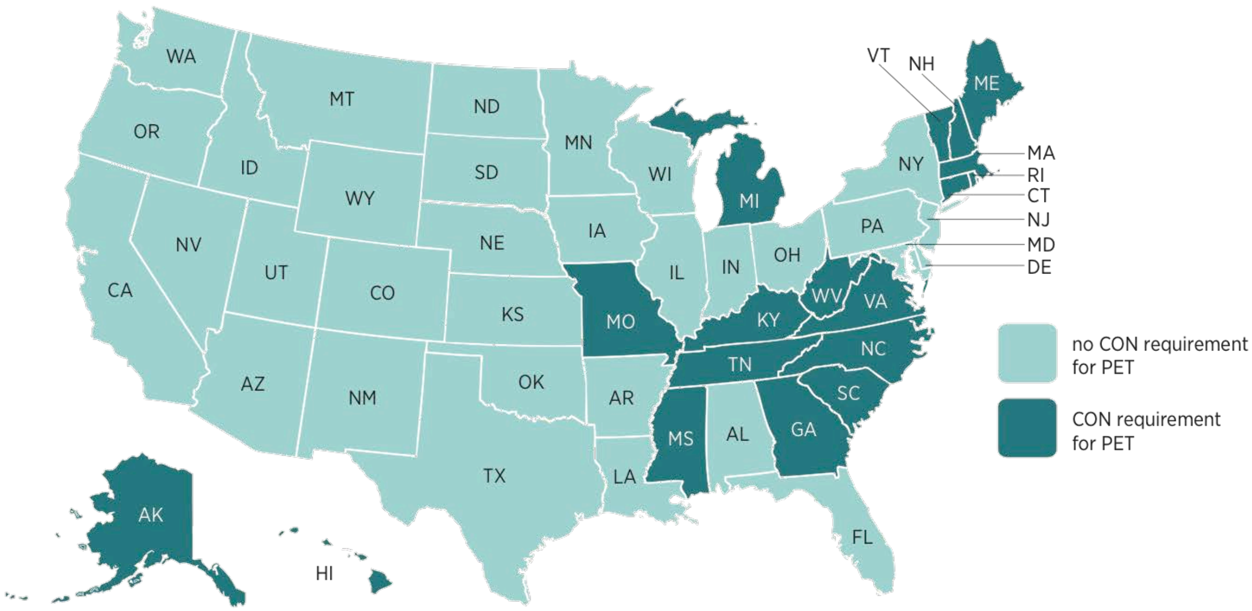

Table 1. Summary Statistics

Panel A. MRI Scans

	No CON requirements	CON requirements	Test for differences (p-value)
Number of states	32	19	
Hospital MRI claims per 1,000 beneficiaries	110.50 (28.05)	123.89 (43.74)	0.19
Hospital MRI claims per 1,000 beneficiaries (log)	4.68 (0.27)	4.78 (0.30)	0.23
Nonhospital MRI claims per 1,000 beneficiaries	95.58 (41.97)	76.78 (38.74)	0.12
Nonhospital MRI claims per 1,000 beneficiaries (log)	4.48 (0.43)	4.17 (0.75)	0.07
Hospital market share	0.55 (0.02)	0.63 (0.04)	0.05
Average age	75.41 (0.67)	75.42 (0.69)	0.94
Percentage male	44.29 (1.80)	43.34 (1.90)	0.08
Percentage non-Hispanic white	86.46 (8.67)	81.84 (19.14)	0.24
Percentage black	5.43 (5.85)	9.46 (13.56)	0.23
Percentage Hispanic	4.24 (5.57)	2.01 (1.89)	0.10
Average HCC score	0.92 (0.07)	0.95 (0.08)	0.15
Unemployment	6.55 (1.61)	7.14 (1.39)	0.19
Household income (thousands)	52.31 (7.05)	53.65 (10.22)	0.58

Panel B. CT Scans

	No CON requirements	CON requirements	Test for differences (p-value)
Number of states	38	13	
Hospital CT claims per 1,000 beneficiaries	409.09 (91.81)	432.47 (140.90)	0.50
Hospital CT claims per 1,000 beneficiaries (log)	5.99 (0.23)	6.02 (0.35)	0.74
Nonhospital CT claims per 1,000 beneficiaries	73.54 (40.83)	55.70 (37.63)	0.14
Nonhospital CT claims per 1,000 beneficiaries (log)	4.17 (0.53)	3.66 (1.22)	0.04
Hospital market share	0.85 (0.01)	0.88 (0.03)	0.20
Average age	75.37 (0.63)	75.54 (0.78)	0.43
Percentage male	44.11 (1.72)	43.41 (2.26)	0.25
Percentage non-Hispanic white	86.70 (8.44)	79.01 (22.30)	0.08
Percentage black	6.01 (6.32)	9.61 (15.72)	0.25
Percentage Hispanic	3.73 (5.25)	2.46 (2.04)	0.40
Average HCC score	0.93 (0.07)	0.95 (0.09)	0.25
Unemployment	6.67 (1.57)	7.06 (1.49)	0.43
Household income (thousands)	52.04 (8.09)	55.06 (8.83)	0.26

Panel C. PET Scans

	No CON requirements	CON requirements	Test for differences (*p*-value)
Number of states	31	20	
Hospital PET claims per 1,000 beneficiaries	12.54 (6.90)	14.17 (8.13)	0.44
Hospital PET claims per 1,000 beneficiaries (log)	2.50 (0.45)	2.57 (0.64)	0.68
Nonhospital PET claims per 1,000 beneficiaries	3.79 (4.12)	1.37 (1.95)	0.02
Nonhospital PET claims per 1,000 beneficiaries (log)	1.23 (0.83)	0.64 (0.63)	0.01
Hospital market share	0.78 (0.04)	0.90 (0.03)	0.02
Average age	75.45 (0.68)	75.35 (0.67)	0.60
Percentage male	44.25 (1.88)	43.45 (1.81)	0.14
Percentage non-Hispanic white	86.53 (8.82)	81.96 (18.62)	0.24
Percentage black	4.95 (5.46)	9.99 (13.31)	0.07
Percentage Hispanic	4.48 (5.62)	1.75 (1.53)	0.04
Average HCC score	0.93 (0.07)	0.95 (0.07)	0.30
Unemployment	6.53 (1.62)	7.15 (1.37)	0.16
Household income (thousands)	52.52 (7.12)	53.26 (10.04)	0.77

Note: Includes 50 states and the District of Columbia. Values in parentheses are standard deviations. CON = certificate of need; HCC = hierarchical condition category.

Table 2. Regression Results: The Effect of CON Laws on MRI Utilization

	Log MRI scans—hospital				Log MRI scans—nonhospital			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CON requirement	0.10 (0.08)	0.02 (0.06)	0.03 (0.07)	0.06 (0.08)	−0.31 (0.19)	−0.37* (0.20)	−0.40* (0.22)	−0.42* (0.20)
Average age		−0.04 (0.08)	0.03 (0.07)	−0.03 (0.08)		−0.01 (0.15)	0.05 (0.18)	0.24 (0.21)
Percentage male		−0.06* (0.04)	0.03 (0.04)	0.03 (0.05)		0.11 (0.07)	0.09 (0.10)	0.10 (0.09)
Percentage non-Hispanic white		0.00 (0.00)	0.00* (0.00)	0.00 (0.00)		−0.01 (0.01)	0.00 (0.01)	0.00 (0.01)
Percentage black			0.02*** (0.01)	0.02** (0.01)			0.01 (0.02)	0.01 (0.01)
Percentage Hispanic			−0.01* (0.01)	−0.01 (0.01)			0.01 (0.01)	0.01 (0.01)
Average HCC score		0.87 (0.75)	2.20* (1.02)	2.38* (1.04)		4.13** (1.87)	1.56 (2.29)	1.01 (2.60)
Unemployment			−0.06* (0.03)	−0.05 (0.03)			0.15* (0.08)	0.16* (0.08)
Per capita income (thousands)			0.00 (0.00)	0.00 (0.00)			0.02* (0.01)	0.02* (0.01)
West				0.04 (0.22)				0.18 (0.54)
South				0.10 (0.11)				0.42 (0.40)
Midwest				0.21* (0.10)				−0.09 (0.32)
Constant	4.68*** (0.05)	9.22 (7.26)	−0.62 (6.94)	2.73 (7.79)	4.48*** (0.08)	−2.54 (14.02)	−6.69 (17.65)	−21.41 (19.09)
R^2	0.03	0.32	0.51	0.56	0.07	0.25	0.37	0.43

* Statistically significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Note: Includes 50 states and the District of Columbia. West, South, and Midwest measure the difference in utilization relative to the Northwest. Values in parentheses are robust standard errors. CON = certificate of need; HCC = hierarchical condition category.

Table 3. Regression Results: The Effect of CON Laws on CT Utilization

	Log CT scans—hospital				Log CT scans—nonhospital			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CON requirement	0.03 (0.10)	−0.05 (0.06)	−0.06 (0.06)	−0.05 (0.06)	−0.52 (0.34)	−0.65* (0.37)	−0.73* (0.40)	−0.58* (0.30)
Average age		−0.01 (0.07)	0.03 (0.07)	0.03 (0.08)		0.00 (0.18)	0.04 (0.24)	0.19 (0.24)
Percentage male		−0.04 (0.03)	0.01 (0.03)	0.02 (0.04)		0.18* (0.09)	0.16 (0.12)	0.14 (0.10)
Percentage non-Hispanic white		0.00 (0.00)	0.00 (0.00)	0.00 (0.00)		−0.01* (0.01)	−0.02 (0.01)	−0.01 (0.01)
Percentage black			0.01* (0.00)	0.01 (0.00)			0.00 (0.02)	0.00 (0.01)
Percentage Hispanic			−0.01* (0.01)	−0.01 (0.01)			−0.02 (0.03)	−0.01 (0.02)
Average HCC score		2.12*** (0.50)	2.57*** (0.70)	2.47*** (0.75)		5.64** (2.24)	3.94 (2.96)	3.94 (3.31)
Unemployment			−0.02 (0.02)	−0.01 (0.02)			0.13 (0.10)	0.16 (0.11)
Per capita income (thousands)			0.00 (0.00)	0.00 (0.00)			0.01 (0.01)	0.03** (0.01)
West				0.00 (0.15)				0.73 (0.67)
South				0.10 (0.09)				1.11** (0.45)
Midwest				0.07 (0.07)				0.60 (0.41)
Constant	5.99*** (0.04)	6.80 (6.03)	1.12 (6.55)	0.38 (7.75)	4.17*** (0.09)	−7.55 (17.34)	−9.59 (21.71)	−22.78 (19.40)
R^2	0.00	0.63	0.70	0.71	0.08	0.29	0.33	0.46

* Statistically significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Note: Includes 50 states and the District of Columbia. West, South, and Midwest measure the difference in utilization relative to the Northwest. Values in parentheses are robust standard errors. CON = certificate of need; HCC = hierarchical condition category.

Table 4. Regression Results: The Effect of CON Laws on PET Utilization

	Log PET scans—hospital				Log PET scans—nonhospital			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CON requirement	0.06 (0.16)	−0.03 (0.15)	0.04 (0.13)	0.19 (0.13)	−0.59*** (0.20)	−0.78*** (0.16)	−0.83*** (0.19)	−1.05*** (0.24)
Average age		0.10 (0.14)	0.23 (0.14)	0.19 (0.18)		−0.56*** (0.15)	−0.66*** (0.20)	−0.59*** (0.18)
Percentage male		−0.12* (0.07)	0.01 (0.07)	−0.04 (0.11)		0.05 (0.10)	0.04 (0.13)	0.16 (0.12)
Percentage non-Hispanic white		0.00 (0.00)	0.01 (0.01)	0.01* (0.01)		0.00 (0.01)	−0.01* (0.01)	−0.02** (0.01)
Percentage black			0.03** (0.01)	0.03*** (0.01)			−0.01 (0.02)	−0.02 (0.02)
Percentage Hispanic			0.00 (0.01)	0.00 (0.01)			−0.02 (0.02)	−0.01 (0.02)
Average HCC score		0.64 (1.15)	2.43 (1.55)	3.69** (1.50)		6.80*** (2.09)	8.17* (3.11)	5.80* (2.94)
Unemployment			−0.12* (0.05)	−0.15** (0.06)			−0.04 (0.09)	0.05 (0.10)
Per capita income (thousands)			−0.01* (0.01)	−0.01 (0.01)			0.00 (0.01)	0.02 (0.01)
West				0.63 (0.44)				−0.91* (0.52)
South				0.31 (0.23)				0.28 (0.35)
Midwest				0.46** (0.18)				−0.14 (0.33)
Constant	0.06 (0.16)	−0.03 (0.15)	0.04 (0.13)	0.19 (0.13)	−0.59*** (0.20)	−0.78*** (0.16)	−0.83*** (0.19)	−1.05*** (0.24)
R^2	0.00	0.32	0.47	0.54	0.13	0.48	0.49	0.56

* Statistically significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Note: Includes 50 states and the District of Columbia. West, South, and Midwest measure the difference in utilization relative to the Northwest. Values in parentheses are robust standard errors. CON = certificate of need; HCC = hierarchical condition category.

Table 5. Difference-in-Difference Regression Results: Differences between Hospital and Nonhospital Providers

	MRI scans	CT scans	PET scans
CON requirement × hospital	0.41** (0.21)	0.55+ (0.33)	0.65*** (0.25)
Hospital	0.20 ** (0.10)	1.82*** (0.09)	1.27*** (0.18)
R^2	0.57	0.89	0.80

+ Statistically significant at the 11% level, * significant at the 10% level, ** significant at the 5% level,
*** significant at the 1% level.

Note: Includes 50 states and the District of Columbia. All regressions include state fixed effects. Values in parentheses are robust standard errors. CON = certificate of need.

Table 6. Providers of MRI, CT, and PET Services per 100,000 Beneficiaries by CON Status

	CON state providers—mean	Non-CON state providers—mean	Test for differences (*p*-value)
MRI scans			
Hospital providers	10.8	11.8	0.29
Nonhospital providers	58.1	77.2	0.05
CT scans			
Hospital providers	10.8	12.4	0.13
Nonhospital providers	51.2	66.4	0.10
PET scans			
Hospital providers	4.8	4.9	0.85
Nonhospital providers	2.1	5.3	<0.01

Note: Includes 50 states and the District of Columbia. CON = certificate of need. Results presented here are mean state provider counts for CON and non-CON states. These results differ from the aggregate provider counts for all states (rather than weighting each state equally in computing the average). Several claim types had lower aggregate provider counts than state averages but were affected by outlier states that had a smaller or larger than average number of claims.

Table 7. Percentage of Services Obtained by Traveling Out of the Patient's State of Residence

	MRI scans	CT scans	PET scans
CON requirement	3.93* (2.20)	3.52* (2.00)	8.13** (3.17)
Ln(density)	−1.35 (0.96)	−1.30* (0.65)	−4.63*** (1.17)
Income (thousands)	0.08 (0.11)	0.09 (0.09)	0.47*** (0.15)
Constant	10.74 (6.99)	9.67* (5.18)	7.08 (7.28)
R^2	0.11	0.18	0.20

* Statistically significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Note: Includes residents of all 50 states and the District of Columbia. Values in parentheses are robust standard errors. CON = certificate of need. Results presented here are mean state percentages for CON and non-CON states. These results differ from the aggregate percentages for all states (rather than weighting each state equally in computing the average). All claim types had lower aggregate percentages than state average percentages but were affected by outlier states that had a smaller or larger than average number of claims.

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Abstract

We investigate the effect of certificate-of-need (CON) laws on the quality of hospitals. As of 2015, 36 states and the District of Columbia required healthcare providers to seek approval from a state's healthcare regulator before making any major capital expenditures. These requirements restrict entry into the healthcare market. Therefore, incumbent medical providers in states with CON laws may face fewer competitive pressures. Hospital service quality is one important margin on which hospitals compete. In this paper, we test the hypothesis that hospitals in states with CON laws provide lower-quality services than hospitals in states without CON laws. Our results do not allow us to reject the hypothesis that CON hospitals deliver lower-quality care than non-CON hospitals. Nor do our results show that hospital quality is higher in CON states. Our overall results suggest that CON regulations lead to lower-quality care for some measures of quality and have little or no effect on other measures of quality. The results are largely robust to a variety of alternative samples and quality measures.

JEL codes: I110, I180, H75, L130, D430

Keywords: healthcare, welfare, hospitals, certificate of need, CON, entry, competition, quality, quality competition, nonprice competition, Medicare, Hospital Compare

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Certificate-of-Need Laws and Hospital Quality

Thomas Stratmann and David Wille

Since the mid-1970s, the majority of states have required healthcare providers to seek approval from the state's healthcare planning agency before making any major capital expenditure. As of 2015, 36 states and the District of Columbia had laws in place that allow them to approve or reject spending on new facilities, devices, and services based on community "need." These certificate-of-need regulations, or CON laws, were enacted with the goal of restraining healthcare spending.[1]

One objective of these CON laws is to limit entry into the medical profession. By forcing healthcare providers to seek government approval before expanding facilities, offering new services, or purchasing new equipment, these regulations potentially restrict new providers from entering the marketplace. When regulations restrict entry into a market, incumbent providers face fewer competitive pressures. Hospital service quality is one margin on which hospitals compete. The decisions and efforts of hospital administrators and staff members are among the determinants of hospital quality. Decision makers in hospitals facing fewer competitive pressures may therefore set lower standards of quality or effort.

One relevant issue with respect to the margins on which hospitals compete is how hospital prices are determined. When prices are determined administratively rather than by the market, hospitals cannot compete through pricing and therefore have an incentive to compete more intensely on nonprice margins such as the quality of care. Thus, economic theory predicts

[1] The National Health Planning and Resources Development Act of 1974, the original impetus for CON laws, contains the following language in its statement of purpose: "The massive infusion of Federal funds into the existing health care system has contributed to inflationary increases in the cost of health care and failed to produce an adequate supply or distribution of health resources, and consequently has not made possible equal access for everyone to such resources." Pub. L. No. 93-641 (1975).

that free entry and competition among hospitals facing regulated prices will tend to increase the equilibrium quality of patient care. In contrast, hospitals facing market-determined prices may compete on both price and quality margins. The effect of free entry and competition on equilibrium hospital quality in a system of market-determined prices is therefore ambiguous. In their review of the literature on competition in healthcare markets, Gaynor and Town (2011, 81–82) find that empirical work generally confirms these theoretical predictions: "Most of the studies of Medicare patients show a positive impact of competition on quality," whereas "the results from studies of markets where prices are set by firms (e.g., privately insured patients) are much more variable."

Supporters of CON regulations have suggested that these regulations have a positive impact on healthcare quality. For instance, in response to a Federal Trade Commission critique of CON laws, the American Health Planning Association (AHPA) argued that "recent empirical evidence shows substantial economic and service quality benefits from CON regulation and related planning" (AHPA 2005, 14). Further, Thomas Piper, director of Missouri's CON program, told a joint Federal Trade Commission–Department of Justice hearing that "quality is improved" thanks to Missouri's CON program (Piper 2003, 27).

Specifically, CON supporters argue that a state regulator's ability to set standards and monitor utilization rates positively affects the quality of healthcare services (Thomas 2015; Steen 2016). This argument is based on research that links procedural volume with better outcomes: As practitioners serve more patients with the same condition and perform the same procedure more often, they become more specialized and proficient, leading to better patient outcomes (Halm, Lee, and Chassin 2002). By restricting the number of providers through CON laws, regulators aim to allocate more patients to existing providers, thereby increasing providers' expertise and improving patient outcomes (Cimasi 2005).

However, several scholarly works do not find evidence of a systematic difference in the quality of care between providers in states governed by CON laws and those in non-CON states. For example, Polsky et al. (2014) examine the effects of CON laws for home healthcare services and find no significant differences in rehospitalization rates or expenditures between CON and non-CON states. Further, Paul, Ni, and Bagchi (2014) find that CON laws are associated with shorter emergency department visits. Lorch, Maheshwari, and Even-Shoshan (2011) find that mortality rates for infants with low birth weight are not significantly different between CON and non-CON states, although CON states with large metropolitan areas have significantly lower all-infant mortality rates than non-CON states.

A number of studies examine the relationship between CON laws and mortality after coronary artery bypass graft (CABG) surgeries—with contradictory results. Cutler, Huckman, and Kolstad (2009) find that CABG mortality rates declined after Pennsylvania repealed its CON laws. However, Ho, Ku-Goto, and Jollis (2009) find no difference between CON and non-CON states with respect to CABG mortality rates. Two studies of 1990s data report that CABG mortality rates are higher in non-CON states (Vaughan-Sarrazin et al. 2002; Rosenthal and Sarrazin 2001).

Studies examining the effect of CON laws on the quality of health care typically suffer from two limitations. First, inadequate data on provider quality limit scholars to investigating how CON regulations affect the quality of specific procedures, such as CABG, rather than considering quality across multiple margins. Second, studies on this topic, with the exception of Polsky et al. (2014), have difficulty untangling the causal effect of CON laws from other important factors that independently affect healthcare quality and that might be correlated with whether a state has a CON program.

Biased estimates might be owing to unobserved hospital patient characteristics, such as systematic geographic variation in the severity of illnesses. For example, if hospitals in CON states have patients who are less healthy but healthiness is unobserved or unmeasured, then lower hospital quality in those states might be attributable to patient characteristics rather than to CON laws. Geographic variation in healthcare utilization or provider quality might also be a confounding factor, if systematic variation across the country is correlated with the presence of CON laws but not caused by those laws.

In this paper, we propose an empirical design that addresses those omitted-variable issues and that allows us to estimate a causal effect. First, we exploit a dataset whose stated purpose is to measure hospital quality objectively, across many aspects of the patient experience. Second, we build on the identification strategy of Polsky et al. (2014), which allows us to estimate the causal effect of CON regulations on the quality of hospital services. This empirical strategy compares outcomes of hospitals in a particular healthcare market that are located in a CON state with outcomes of hospitals in the same healthcare market that are located in a non-CON state. By focusing only on hospitals in these specific markets and assuming that unobserved patient- and geographic-level heterogeneities are similar on both sides of the CON border within one market, we can estimate the causal effect of CON regulations on hospital quality.

The data used in our analysis come from Hospital Compare, a database maintained by the Centers for Medicare and Medicaid Services (CMS). Hospital Compare contains more than 100 quality indicators from more than 4,000 Medicare-certified hospitals (CMS 2016b). These measures include readmission and mortality rates for common conditions, quality- and process-of-care indicators, and patient-experience surveys. CMS used these measures because they represent some of the most common, costliest, and most variable factors affecting individual hospitals' performance. When considered together, these measures are meant to capture the overall quality of care by a given provider. According to CMS, the purpose of these data is to provide a consistent and objective tool for patients to compare quality when selecting a healthcare provider. We use provider-level quality metrics for nine different conditions from more than 900 hospitals for the years 2011–2015 to assess the effect of CON laws on hospital quality.

Our findings show that the quality of hospital care in states with CON laws is not systematically higher than the corresponding quality in non-CON states. Moreover, we find support for the hypothesis that in states where CON laws regulate provider entry into healthcare markets, incumbents tend to provide lower-quality services. In particular, we find that mortality rates for pneumonia, heart failure, and heart attacks are significantly higher in hospitals in CON states relative to those in non-CON states. We also find that deaths from complications after surgery are significantly higher in CON states. Further, our findings provide some evidence that CON regulations are associated with lower overall hospital quality, although the corresponding point estimates are not always precise. We present balancing tests and conduct several robustness tests whose results support the causal interpretation of our findings.

Regulatory Background

CON programs were adopted nationwide when the National Health Planning and Resources Development Act of 1974 became law (Cimasi 2005). The act was part of the federal government's plan to develop a national health planning policy, and the legislation required federal agencies to establish specific health policy goals, priorities, and guidelines (Cimasi

2005). The act also incentivized all 50 states to adopt a process by which healthcare providers would seek approval from their state's health planning agency before making any major capital expenditure, such as a building expansion or purchasing new medical devices (NCSL 2016). The stated goal of this policy was to ensure that the additional medical services to be provided did not exceed community need. Once a regulator determined that there was community need, the applicant was granted permission to commence the project—hence the term *certificate of need* (NCSL 2016).

The National Health Planning and Resources Development Act of 1974 provided strong incentives to the 50 states to implement CON programs by tying certain federal healthcare funding to the states' enactment of CON programs (Cimasi 2005). In addition, the federal government directly subsidized the development of state CON programs. These federal policies encouraged the states that did not already have a CON program to adopt CON regulations. In 1974, 23 states had some form of CON regulations, and by 1980 the number had increased to 49. The National Health Planning and Resources Development Act of 1974 was repealed in 1986, lifting the requirement that states maintain CON programs and eliminating the associated federal subsidy. Subsequently, some states kept their CON laws and others repealed theirs. Table 1 lists the states with CON laws for the years 2011–2015 and the facilities, equipment, and procedures that those states regulated. States did not significantly change their CON programs between 2011 and 2015.

Table 1. Certificate-of-Need Regulations in the United States

	Acute Hospital Beds	Air Ambulance	Ambulatory Surgical Centers	Burn Care	Cardiac Catheterization	Computed Tomography Scanners	Gamma Knives	Home Health	Hospice	Intermediate Care Facilities/Mental Retardation	Long Term Acute Care	Lithotripsy	Nursing Home Beds/Long Term Care Beds	Medical Office Buildings	Mobile Hi Technology	Magnetic Resonance Imaging (Scanners	Neo-Natal Intensive Care	Obstetrics Services	Open Heart Surgery	Organ Transplants	Positron Emission Tomography Scanners	Psychiatric Services	Radiation Therapy	Rehabilitation	Renal Failure/Dialysis	Assisted Living & Residential Care Facilities	Subacute Services	Substance/Drug Abuse	Swing Beds	Ultra-Sound	Counts by State
AK	X		X		X	X	X				X	X	X		X	X	X	X	X	X	X	X	X		X		X				19
AL	X	X	X	X	X		X	X	X		X		X				X	X	X	X		X	X	X	X			X	X		20
AR								X	X	X			X									X				X					6
CT	X		X		X	X			X		X		X		X	X	X	X	X	X	X	X	X					X			17
DC	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	28
DE	X		X		X						X	X	X								X		X								8
FL	X								X	X	X		X				X			X		X		X			X	X			11
GA	X		X		X		X	X		X	X	X	X				X	X	X		X	X	X	X				X			17
HI	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	27
IA	X		X		X					X	X		X						X	X		X	X								10
IL	X		X		X					X	X		X				X	X	X	X				X	X		X		X		14
KY	X		X		X			X	X	X	X		X		X	X	X		X	X	X	X	X	X				X			18
LA										X			X													X					3
MA		X	X				X					X	X			X	X		X	X	X	X	X	X				X			14
MD	X		X	X	X			X	X	X	X		X				X	X	X	X		X		X				X			16
ME		X	X	X	X	X	X				X	X	X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	23
MI	X	X	X		X	X	X				X	X	X		X	X	X		X	X	X	X	X						X		18
MO	X				X	X	X			X	X	X	X		X	X					X		X	X		X					14
MS	X		X		X		X	X	X	X	X		X			X			X		X	X	X	X	X			X	X		18
MT			X					X		X			X											X				X	X		7
NC	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X			25
NE													X											X							2
NH			X		X						X		X		X	X			X		X	X	X	X				X			12
NJ	X			X	X			X		X	X		X				X		X	X		X		X							12
NV	X		X							X			X																		4
NY	X		X	X	X	X		X	X			X	X		X	X	X	X	X	X			X	X	X						18
OH													X																		1
OK										X			X									X					X				4
OR									X		X		X																X		4
RI	X		X		X	X	X		X		X		X		X	X	X	X	X	X	X	X	X	X			X	X			20
SC	X		X		X		X	X	X	X	X	X	X		X	X	X		X		X	X	X	X			X	X			20
TN	X		X	X	X			X	X	X	X	X	X			X	X		X		X	X	X	X			X	X	X		20
VA	X		X		X	X	X			X	X	X	X		X	X	X	X	X	X	X	X	X	X							19
VT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	30
WA	X		X	X	X			X	X		X		X				X	X	X	X		X		X	X		X		X		17
WI										X			X														X				3
WV	X		X		X	X		X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X			X			21

Source: NCSL (2016).

In states with CON programs, healthcare providers who seek to enter a market, to expand their facilities, or to offer new services must submit an application to their state's healthcare planning agency for approval. Virginia, a state with a CON program that covers comparatively many aspects of medical care, is representative in this regard.[2] Applicants must first submit a letter of intent to the Virginia Department of Health and to the appropriate regional health planning agency. Next, the applicant submits a formal application and pays a fee of up to $20,000. Submissions are reviewed by state regulators in 60-day batches, depending on the type of facility or procedure under review. The Code of Virginia requires the regional healthcare planning agencies to hold at least one public hearing for each application, at which point competitors of an applicant are given the opportunity to challenge the need for the proposed medical service. Regional planners then submit their recommendations and reasoning to the department, which reviews the applications and recommendations and may hold additional hearings. At the end of this process, the department makes a recommendation and submits the application to the state health commissioner for final approval or denial (Virginia Department of Health 2015).

The criteria for assessing CON applications are usually specified in regulations promulgated by each state's planning agency (Cimasi 2005). For instance, Virginia mandates that the state health commissioner consider eight factors when determining whether there is a public need for a new project: (1) whether the project will provide or increase access to health services; (2) whether the project will meet the needs of residents; (3) whether the project is consistent with current rules for medical facilities, such as minimum utilization rates; (4) to what extent the project will foster beneficial competition; (5) how the project will affect the healthcare

[2] For a summary of Virginia's application process, see Virginia Department of Health (2015, 18).

system, such as the utilization and efficiency of existing facilities; (6) the project's feasibility, including financial costs and benefits; (7) to what extent the project will provide improvements in the financing and delivery of services; and (8) the project's contribution to research, training, and improvements to health services, in the case of a project proposed by or affecting a teaching hospital (Va. Code § 32.1-102.3 (2009)). However, the Code of Virginia does not rank these criteria with respect to their importance, leaving discretion to regulators as to how to weigh each criterion in their decisions.

In addition to their role in monitoring and managing applications for proposed healthcare projects, state CON programs set highly specific standards that govern the use of facilities and procedures (Cimasi 2005). Virginia's CON program sets rules that apply to 18 different healthcare services and facilities; collectively, these rules are called the State Medical Facilities Plan. For example, in the section that sets standards for CT scans, the plan states that "CT services should be within 30 minutes driving time one way under normal conditions of 95% of the population of the health planning district" (12 Va. Admin. Code § 5-230-90 (2009)). Other aspects of the plan set standards for determining minimum utilization rates, timing for services to be introduced or expanded, levels of staffing, and the minimum number of bassinets at facilities offering newborn services.

This level of specificity is typical for state CON programs. The South Carolina Health Plan, for example, requires applicants seeking a CON for diagnostic catheterization services to "project that the proposed service will perform a minimum of 500 diagnostic equivalent procedures annually within three years of initiation of services, without reducing the utilization of the existing diagnostic catheterization services in the service area below 500" per laboratory (South Carolina Health Planning Committee 2015, VIII-5). Similarly, Missouri's CON regulations state that "approval of additional intermediate care facility/skilled nursing facility (ICF/SNF) beds will be based on a service area need determined to be fifty-three (53) beds per one thousand (1,000) population age sixty-five (65) and older minus the current supply of ICF/SNF beds" (Mo. Code Regs. tit. 19, § 60-50.450 (2014)).

Data

We use a selection of CMS metrics to estimate the difference in quality between hospitals in CON and non-CON states, including rates at which patients develop or die from surgical complications, patient survey results, readmission rates, and mortality rates. Here, we explain where and how we obtained those data and why we chose those specific metrics. In this section, we also describe what aspect of quality each metric is intended to capture, how each metric is calculated, and our reasoning for including these metrics for measuring hospital quality.

We use data from CMS's Hospital Compare to examine variation in the quality of hospitals' medical services. Hospital Compare was launched in 2005 as part of an effort to "make it easier for consumers to make informed healthcare decisions and to support efforts to improve quality in U.S. hospitals" (CMS 2016b). CMS partners with the Hospital Quality Alliance, whose members include the American Hospital Association, American Medical Association, and US Chamber of Commerce. Before Hospital Compare, hospitals reported quality measures voluntarily. The Medicare Modernization Act of 2003 included incentives for hospitals to begin reporting data to CMS (Werner and Bradlow 2006). Today, CMS requires hospitals seeking reimbursement for any services funded by Medicare or Medicaid to provide data about the quality of their services and to meet minimum quality thresholds (Medicare.gov 2016).

For the years 2011–2015, we analyze the effect of state CON laws on nine different quality-of-care indicators. One measure meant to capture the quality of surgical patient care is *Deaths among Surgical Inpatients with Serious Treatable Complications* (PSI #4). This measure is a composite of mortality rates. It measures how many deaths occur per 1,000 patients who develop a serious complication after surgery. Hospital Compare considers this measure to be an indicator of quality because higher-quality hospitals identify complications sooner, treat them correctly, and thus incur fewer patient deaths.[3]

The denominator in PSI #4 comprises all hospital-level surgical discharges age 18 and older who developed complications of care, including pneumonia, pulmonary embolism or deep vein thrombosis, sepsis, shock or cardiac arrest, and gastrointestinal hemorrhage or acute ulcer. The numerator in PSI #4 comprises all discharged patients (included in the denominator) who died after developing a complication. Excluded from the computation of this measure are patients age 90 and older, patients transferred to an acute-care facility, and patients with missing discharge disposition, gender, age, quarter, year, or principal diagnosis information. The annual rate for the *Death among Surgical Inpatients with Serious Treatable Complications* measure is calculated using data over 20 months. For example, the data used to compute this measure in 2011 are for the period October 2008–June 2010.

[3] A hospital's performance on the *Deaths among Surgical Inpatients with Serious Treatable Complications* measure is an accurate indicator of quality of care, assuming that providers in CON and non-CON states turn away patients at the same rate. If this assumption does not hold, it may be that hospitals in CON states only appear to perform worse on this measure. For example, if CON regulations give incumbents the market power to be able to turn away all but the most seriously ill patients, the CON hospitals' quality metrics would tend to be lower because they are treating a pool of less healthy patients, not because they provide lower-quality care. Alternatively, use of the *Deaths among Surgical Inpatients with Serious Treatable Complications* measure will result in underestimation of the effect of CON laws on hospital quality if patients with the most serious risk of dying choose high-quality hospitals and if those patients develop complications not because of poorer hospital care but because they are very ill. Therefore, the direction of the potential bias is theoretically ambiguous.

Postoperative Pulmonary Embolism or Deep Vein Thrombosis (PSI #12) measures the number of cases of pulmonary embolism or deep vein thrombosis per 1,000 adult surgical discharges. According to the Centers for Disease Control and Prevention (CDC), patients recovering from surgery are at an increased risk of developing potentially deadly blood clots in their deep veins (deep vein thrombosis) and lungs (pulmonary embolism) (CDC 2016). Page (2010) notes that a 2010 study by the Healthcare Management Council found that postoperative pulmonary embolism and deep vein thrombosis together were the second most common hospital-acquired conditions after bedsores. These conditions are also the most expensive conditions to treat, averaging $15,000 per case or $564,000 per hospital per year. The denominator of this measure comprises all patients age 18 and older who underwent an operating-room procedure. The numerator comprises all patients included in the denominator who developed deep vein thrombosis or pulmonary embolism as a secondary diagnosis. Excluded were patients who were diagnosed with deep vein thrombosis or pulmonary embolism before or on the same day as the first operating-room procedure, patients undergoing childbirth, and patients with missing discharge disposition, gender, age, quarter, year, or principal diagnosis information. The annual rate for the *Postoperative Pulmonary Embolism or Deep Vein Thrombosis* measure is calculated using data collected over 20 months. For example, the data used to compute this measure in 2011 were collected from October 2008 to June 2010.

Another hospital quality measure, which comes from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, is the percentage of patients surveyed who gave their hospital a 9 or 10 overall rating during their last inpatient stay, on a scale of 1 (lowest) to 10 (highest). The survey was developed in 2005 by CMS in partnership with the Agency for Healthcare Research and Quality (CMS 2016a). This survey is based on a standardized instrument and data collection methodology that allows for cross-hospital comparisons of patients' experiences for different aspects of care. The instrument contains 27 questions, including one asking patients to provide an overall rating of their hospital on a 10-point scale. CMS segments the survey data into three tranches: the percentage of patients who rated their hospital as "low," defined as 6 or below; the percentage of patients who rated their hospital as "medium," defined as 7 or 8; and the percentage of patients who rated their hospital as "high," defined as 9 or 10. We use the last measure in our analysis.

The HCAHPS survey is administered to a random sample of eligible hospital patients, which includes all inpatients over age 18 who did not receive a psychiatric diagnosis. Excluded from the sample are patients in hospice and nursing home care, prisoners, patients with foreign home addresses, and patients excluded because of local regulations. Hospitals survey their eligible sample of patients randomly each month, and hospitals are required to complete at least 300 surveys over a 12-month period. Eligible patients in the sample can be surveyed 48 hours to six weeks after being discharged. Hospital-level results are updated on the Hospital Compare website every quarter, and each quarter's measures are based on the previous 12 months of data. CMS adjusts the HCAHPS data on the basis of each hospital's patient mix. This adjustment allows for comparisons across hospitals with heterogeneous patients.[4]

We include six additional hospital quality variables: *Pneumonia Readmission Rate* (READM-30-PN), *Pneumonia Mortality Rate* (MORT-30-PN), *Heart Failure Readmission Rate* (READM-30-HF), *Heart Failure Mortality Rate* (MORT-30-HF), *Heart Attack Readmission Rate* (READM-30-AMI), and *Heart Attack Mortality Rate* (MORT-30-AMI). These variables separately measure the readmission and mortality rates for pneumonia, heart failure, and heart

[4] For more detail about the patient mix adjustment, see CMS (2008b).

attack patients. These measures represent conditions with relatively high morbidity and mortality rates that "impose a substantial burden on patients and the healthcare system" and for which "there is marked variation in outcomes by institution" (CMS 2012, 3). Moreover, these metrics are commonly used to evaluate hospital quality (Werner and Bradlow 2006; Zuckerman et al. 2016).

Readmission rates measure unplanned readmissions for any cause to any acute-care hospital within 30 days of discharge from a hospitalization for the given medical condition. Mortality rates measure deaths from any cause within 30 days of a hospital admission for patients hospitalized with the given medical condition. CMS computes the readmission and mortality rates using a hierarchical model and then "risk standardizes" these measures. Thus, these rates take into account patient characteristics that may make death or unplanned readmission more likely. Further, these rates account for hospital-specific effects, which are CMS estimates based on a specific hospital's impact on its patients' likelihood of being readmitted or dying.

A hospital's risk-standardized readmission rate and risk-standardized mortality rate are defined as the ratio of the number of predicted readmissions or deaths associated with a given condition to the number of expected readmissions or deaths associated with that condition. The predicted rate is an estimate of the number of readmissions or deaths within 30 days at a given hospital for patients discharged for a given condition. This rate takes into account the hospital's patient risk factors (estimated from hospital-specific patient administrative data collected by CMS) and includes an estimate of the hospital-specific effect. The expected readmission and mortality rates are calculated using the same patient risk factors and use the average of all estimated hospital-specific effects in the nation.[5]

[5] For more detail about how these measures are calculated, see QualityNet (2016).

The risk-standardized readmission rate and the risk-standardized mortality rate comprise patients who are Medicare fee-for-service beneficiaries age 65 and older discharged from nonfederal acute-care hospitals with a principal discharge diagnosis of pneumonia, heart failure, or heart attack. The measures exclude admissions for patients who were discharged on the day of their admission or the following day, those who were transferred to another acute care hospital, those who were enrolled in a Medicare hospice program any time in the 12 months before the hospitalization, those who were discharged against medical advice, and those who were not previously hospitalized in the 30 days before death. The data to compute the annual risk-standardized readmission rate and the risk-standardized mortality rate are collected over a three-year period. This approach increases the number of cases per hospital, which allows for a more precise estimate and thus accommodates more variation in hospital performance (CMS 2007). For example, the measures for 2011 were calculated using data collected from July 2007 to June 2010.

CMS collects Hospital Compare data and recalculates the quality measures periodically, usually annually or quarterly. CMS updates the measures analyzed in this study annually. Hospital Compare data might be missing for any given provider for a number of reasons. There might be too few cases or patients to report data for a given condition because the number does not meet the minimum threshold for public reporting, because the number is too small to generate a reliable estimate of hospital performance, or because of protection of personal information. CMS might not include particular provider data because of data inaccuracies, because a particular hospital does not have data that meet the selection criteria, or because no data are available.

Because of variations in data availability, the number of providers differs by the type of quality measure. Some hospitals have no reported data for some measures. Missing data can be a potential drawback of our identification strategy because a hospital's decision about whether to report data may be nonrandom (Werner and Bradlow 2006). For example, missing data might be correlated with lower quality. If this is the case, and if CON laws are indeed associated with lower-quality hospitals, then we would underestimate any negative effect, in absolute value, of CON laws on quality.

More aggregate hospital quality measures became available only recently. As part of the Dartmouth Atlas of Health Care (Dartmouth Atlas Project 2016), a number of aggregate quality measures were constructed to capture the rate of posthospitalization events among Medicare patients. In 2013, Hospital Compare started providing aggregate quality indicators to facilitate high-level hospital comparisons. In addition to medical condition–specific quality measures, we test whether these aggregate quality measures differ between hospitals in CON and non-CON states.

Empirical Framework

Our identification strategy exploits the fact that, on occasion, a local healthcare market is divided between two states, one with a CON law and the other without. Our measure for a local healthcare market is a hospital referral region (HRR), which comes from the Dartmouth Atlas of Health Care (Dartmouth Atlas Project 2016). HRRs are defined on the basis of referral patterns for patients having major cardiovascular surgical procedures and for neurosurgery. There are 306 HRRs in the United States.

Our empirical model is

$$\text{Quality}_{ijm} = \beta_0 + \beta_1\, CON_j + \boldsymbol{\beta_2} \boldsymbol{X}_{ijm} + \boldsymbol{v_m} + \varepsilon_{ijm}, \tag{1}$$

where the dependent variable is a quality measure for hospital i in state j and healthcare market m. Thus, two or more states can be contained in a given market. The variable CON_j

equals 1 if state *j* has a CON law and 0 otherwise. The model also includes market-level fixed effects ($\boldsymbol{v_m}$). In this model, we estimate the coefficient of interest, β_1, based on states that vary in whether they have a CON law and are located in the same healthcare market.

Following Polsky et al. (2014, 3), we use the Dartmouth Atlas of Health Care's HRR as the identifying healthcare market because it "defines a contiguous locality within which most tertiary hospital care referrals are contained, and because it is the area most linked to geographic variation." By estimating the coefficient on CON_j, we control for unobservable heterogeneity, such as geographic variation and illness severity, which varies across HRRs. The applicability of this model assumes that the markets that cross the borders of CON and non-CON states are otherwise the same, and we test this assumption below.

Our empirical model also controls for demographic factors that may vary across CON and non-CON states and that are also determinants of hospital quality. Specifically, we control for the percentage of people over age 65 in provider *i*'s zip code, the percentage of people who are not white, the percentage without a high school diploma, the percentage without insurance, and the average annual income for individuals in provider *i*'s zip code. For example, hospitals in higher-income areas may appear to perform better on the quality metrics because wealthier patients may be healthier, on average, than less wealthy patients. Similarly, hospitals in areas with a larger population of elderly residents may appear to provide worse-quality care because older people may be less healthy than younger people on average.

We also control for hospital-level characteristics that may impact the quality of care. These include the percentage of total patient days used by Medicare beneficiaries and the natural logarithm of the number of patient days at hospital *i.* The number of patient days is an indicator of hospital size and represents the total amount of time that the services of an institution are used by a hospital inpatient. The share of Medicare patient days is an indicator of the demographics of the population the hospital serves. All covariates are contained in the ***X*** vector in equation (1).

In our preferred specification, we calculate the coefficient on CON in equation (1) using a pooled panel regression with hospital-level quality data for the years 2011–2015. We cluster standard errors on the individual hospital level to compensate for the fact that observations are not independent. As a robustness check, we calculate the same equation for each individual year, omitting the year dummy variables. Further, we perform a variety of additional robustness checks to determine whether our results are driven by chance findings.

Table 2 shows the reporting rates for our quality measures for the example year 2011, which has a reporting rate typical for the remaining years in our sample. In the full sample of 4,542 hospitals, between 40 and 90 percent of hospitals reported data for a given measure. The lowest reporting rate is for *Death among Surgical Inpatients with Serious Treatable Complications* (42 percent), and the highest reporting rate is for *Pneumonia Readmission Rate* and *Pneumonia Mortality Rate* (90 percent each).

In our subsample, which consists of the 921 hospitals included in our empirical model for the year 2011, the reporting rate is slightly lower. Specifically, for a given measure, between 30 and 85 percent of hospitals reported data. In this subsample, the reporting rates mirrored those from the overall sample. The lowest reporting rate was for *Death among Surgical Inpatients with Serious Treatable Complications* (32 percent), and the highest reporting rate was for *Pneumonia Readmission Rate* and *Pneumonia Mortality Rate* (86 and 85 percent, respectively).

Table 2. Reporting Rates for Hospital Quality Metrics in the Full Sample and the Restricted Sample, 2011

	Full sample (*n* = 4,542)			Restricted sample (*n* = 921)		
Measure name [CMS code]	**Providers in CON states**	**Providers in non-CON states**	**Overall reporting rate**	**Providers in CON states**	**Providers in non-CON states**	**Overall reporting rate**
Death among surgical inpatients with serious treatable complications [PSI #4]	1,296 (44%)	626 (39%)	42%	122 (30%)	175 (34%)	32%
Postoperative pulmonary embolism or deep vein thrombosis [PSI #12]	2,015 (68%)	1,109 (70%)	69%	202 (50%)	334 (64%)	58%
Percentage of patients giving their hospital a 9 or 10 overall rating [HCAHPS]	2,500 (85%)	1,326 (83%)	84%	286 (71%)	428 (83%)	78%
Pneumonia readmission rate [READM-30-PN]	2,736 (93%)	1,350 (85%)	90%	364 (90%)	425 (82%)	86%
Pneumonia mortality rate [MORT-30-PN]	2,726 (92%)	1,341 (84%)	90%	361 (90%)	423 (82%)	85%
Heart failure readmission rate [READM-30-HF]	2,639 (89%)	1,270 (80%)	86%	329 (82%)	391 (75%)	78%
Heart failure mortality rate [MORT-30-HF]	2,604 (88%)	1,239 (78%)	85%	321 (80%)	384 (74%)	77%
Heart attack readmission rate [READM-30-AMI]	1,603 (54%)	727 (46%)	51%	145 (36%)	216 (42%)	39%
Heart attack mortality rate [MORT-30-AMI]	1,867 (63%)	840 (53%)	60%	172 (43%)	253 (49%)	46%

Notes: CMS = Centers for Medicare & Medicaid Services; CON = certificate of need; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems. The restricted sample reflects our fixed-effects model and includes only providers in HRRs that cross the borders between states with and without CON laws.

Sources: CMS (2014); Hospital Compare Data Archive (2011); Dartmouth Atlas Project (2016); NCSL (2016).

Data on CON laws in each state are available from the National Conference of State Legislatures (NCSL 2016). The number and type of medical devices and procedures regulated by

CON laws vary across states. For example, the District of Columbia has extensive CON legislation, whereas Ohio only regulates nursing home beds. We define a state as having a CON law if it has at least one CON regulation in place. Since none of the 50 states or the District of Columbia changed their CON regulations between 2011 and 2015, state coding remained consistent over our entire sample.

The annual data for the control variables of income, age, education, and race are from the decennial census dataset and the Census Bureau's American Community Survey 5-Year Data averages dataset. We compiled demographic data at the zip code level using the Census Bureau's American FactFinder. The annual data for the control variables of hospital size and the number of Medicare patients served are available at the individual hospital level from CMS's Healthcare Cost Report Information System.

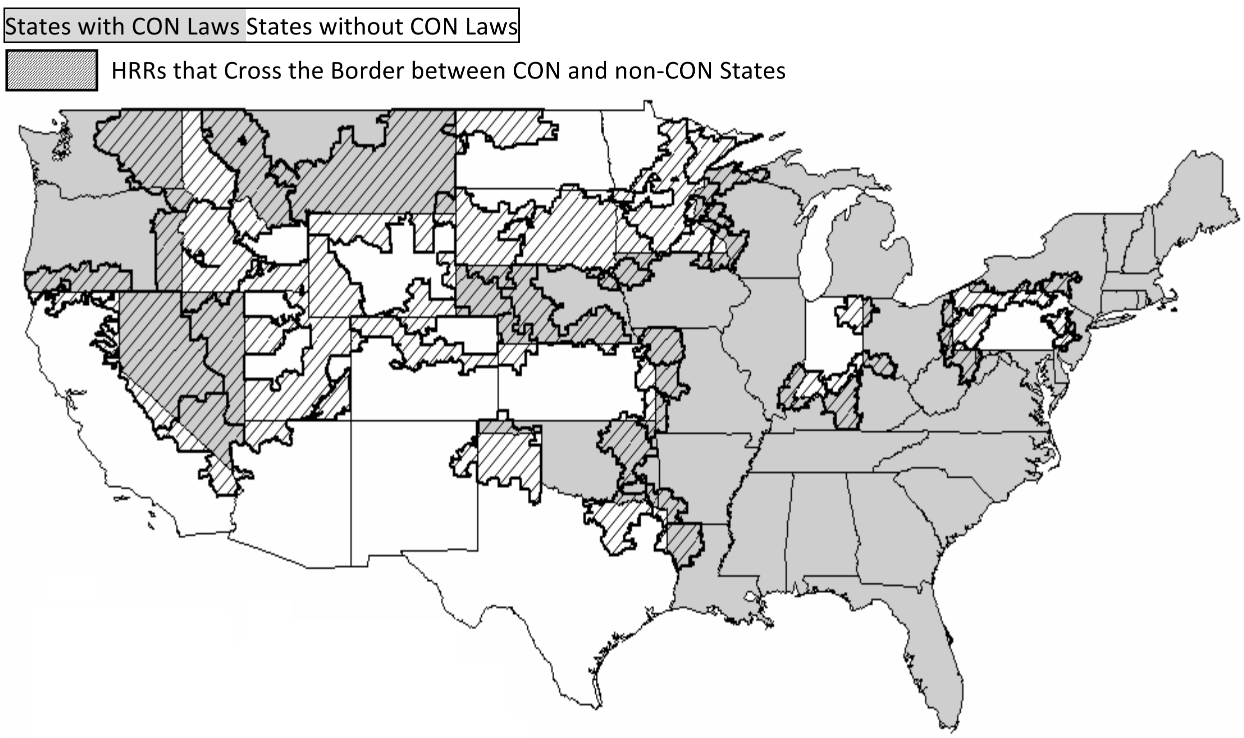
Results

Descriptive Statistics

We began with a dataset that has an average of 4,630 hospitals per year for the years 2011–2015, for a total of 23,152 observations. Of these hospitals, an average of 2,989 per year are located in the District of Columbia and the 36 states that had some form of CON regulations between 2011 and 2015. On average, 1,641 hospitals per year are located in non-CON states.

Next, among all 306 HRRs in the country, we identified 39 HRRs that contained hospitals in both CON and non-CON states in each year except 2014. For 2014, we identified 38 HRRs that included CON and non-CON states. Figure 1 presents a map of the state-border-crossing HRRs in the contiguous United States. Table 3 provides a list of these HRRs, as well as the CON and non-CON states located in each HRR for the year 2011, and table 4 shows the number of providers on the CON side and the non-CON side of the border in each HRR. The state-border-crossing HRRs contain on average 962 hospitals per year, of which 422 are located in CON states and 540 are located in non-CON states. This subsample represents about 21 percent of the observations in our original dataset.

Figure 1. HRRs that Crossed the Borders of States with and without CON Laws, 2011



Note: HRRs = hospital referral regions; CON = certificate of need.
Sources: NCSL (2016); Dartmouth Atlas Project (2016).

Table 3. HRRs that Crossed the Borders of States with and without CON Laws, 2011

HRR number	Non-CON states	CON states	HRR number	Non-CON states	CON states
22	TX	AR, OK	296	PA	NY
103	CO, KS	NE	324	ND	MT
104	CO, WY	NE	327	IN	OH
151	ID	OR	335	PA	OH
179	IN	IL, KY	340	KS	OK
180	IN	OH	343	CA	OR
196	SD	IA, NE	346	PA	NJ
205	IN	KY	351	PA	NY, OH
219	TX	LA	356	PA	NJ
250	MN	MI, WI	357	PA	OH, WV
251	MN	WI	359	PA	NY
253	MN	IA	370	SD	NE
256	MN	WI	371	MN, SD	IA
267	KS	MO, OK	383	KS, NM, TX	OK
268	KS	MO	391	TX	OK
274	WY	MT	423	CO, ID, UT, WY	NV
276	ID	MT	440	ID	OR, WA
277	KS	NE	445	PA	MD, WV
279	AZ, CA	NV	448	MN	IA, WI
280	CA	NV	-	-	-

Note: HRRs = hospital referral regions; CON = certificate of need.

Sources: NCSL (2016); Dartmouth Atlas Project (2016).

Table 4. Number of Providers in HRRs that Crossed the Borders of States with and without CON Laws, 2011

HRR number	Providers in non-CON states	Providers in CON states	HRR number	Providers in non-CON states	Providers in CON states
22	3	5	296	1	5
103	29	10	324	6	1
104	4	1	327	2	21
151	7	2	335	2	7
179	10	11	340	2	38
180	17	5	343	2	7
196	1	13	346	15	1
205	9	21	351	14	3
219	2	17	356	38	6
250	11	4	357	34	10
251	61	11	359	5	1
253	10	2	370	11	2
256	7	7	371	46	7
267	3	8	383	17	2
268	17	30	391	68	2
274	7	26	423	34	1
276	1	14	440	9	23
277	1	32	445	1	9
279	4	17	448	1	10
280	6	11	-	-	-

Note: HRRs = hospital referral regions; CON = certificate of need.

Sources: NCSL (2016); Dartmouth Atlas Project (2016).

Table 5, panel A, shows results from testing whether there are any systematic differences in the population characteristics between states with and without CON regulations, using the year 2015 as an example. In each panel, the unit of observation is a hospital in the year 2015. Given that we know the location of each hospital, we match annual zip code–level variables to each hospital for each year that it appears in our dataset. Panel A shows that zip codes in CON states tend to have a higher number of minorities as a share of the total population than zip codes in non-CON states. Hospitals in states with CON laws also tend to to be larger and serve a larger share of Medicare patients than non-CON hospitals.

Table 5, panel B, shows results from testing whether there are any significant differences within the subsample of hospitals in HRRs that cross state borders, where state CON status varies within an HRR. Here, the comparison of differences in means shows that, although there are statistically significant differences between the CON and non-CON hospitals within a border-crossing HHR, the differences in demographics tend to be quantitatively small. Residents of zip codes on the non-CON side of the border tend to be slightly better educated and to have about 10 percent higher incomes than those on the CON side. Because higher levels of education and income may be associated with higher-quality hospitals, differences in these variables, to the extent they are unmeasured or not included in our regression model, will tend to overstate any negative effect of CON on the quality of hospital services provided. We therefore include controls for both variables in our regression models.

Table 5. Differences-in-Means Tests—Covariates, 2015

Panel A: All CON states versus all non-CON states	Non-CON states	CON states	Difference	*t* Statistic	Observations
Percent over age 65	16.3	15.9	0.3	0.46	51
Percent nonwhite	16.3	24.8	−8.6	−1.98	51
Percent with no high school diploma	17.8	16.6	1.2	1.20	51
Percent uninsured	14	13.2	0.8	0.66	51
Number of patient days	21,460	34,200	−12,740	−2.22	51
Medicare patient days as a share of total patient days	36.3	43	−6.7	−3.20	51
Per capita income (US$)	$26,794	$27,193	−$399	−0.26	51
Panel B: HRRs in both CON and non-CON states	**HRR in non-CON**	**HRR in CON**	**Difference**	***t* Statistic**	**Observations**
Percent over age 65	17	17.5	−0.5	−0.64	77
Percent nonwhite	12.7	14	−1.3	−0.56	77
Percent with no high school diploma	15.7	18.4	−2.7	−2.24	77
Percent uninsured	12.4	13.3	−0.8	−0.82	78
Number of patient days	18,756	15,163	3,593	1.04	77
Medicare patient days as a share of total patient days	39.3	42.4	−3.20	−1.40	68
Per capita income (US$)	$26,977	$24,817	$2,159	1.91	77

Notes: CON = certificate of need; HRRs = hospital referral regions. The unit of analysis is the individual provider. Data for percent over age 65, percent nonwhite, percent with no high school diploma, percent uninsured, and per capita income are the average from the provider's zip code. Data for the number of patient days and Medicare patient days as a share of total patient days are from the individual provider. All *t* statistics are clustered at the individual provider level.

Sources: CMS (2014); Hospital Compare Data Archive (2015).; Dartmouth Atlas Project (2016); American FactFinder (2016); NCSL (2016).

Hospital Quality Indicators

Table 6 provides results from testing whether there are any significant quality differences between hospitals in CON states and hospitals in non-CON states. We find that nearly all the quality measures are statistically significantly worse in CON states than in non-CON states. Among the nine measures of quality of care, readmission rate, and mortality rate, only *Heart Attack Mortality Rate* is not significantly different between CON states and non-CON states. The metrics with the largest-magnitude differences are *Pneumonia Readmission Rate* and *Heart Failure Readmission Rate*: On average, hospitals in CON states have over 0.5 percentage points more pneumonia and heart failure patient readmissions than non-CON states, implying about five additional readmissions per 1,000 patient discharges.

Table 7 provides results from studying differences in outcomes for the 39 HRRs that cross the border between a CON state and a non-CON state. Restricting the analysis to these HRRs, we again find statistically significant quality differences between hospitals on the CON side of the border compared with those on the non-CON side. *Heart Attack Mortality Rate* is the only metric that does not differ between CON states and non-CON states. The largest-magnitude difference is *Pneumonia Mortality Rate*, and the magnitude of this estimate is similar to that shown in table 6.

Table 7 shows that, for these 39 HRRS, hospitals in CON states appear to perform worse on all quality indicators but one: Hospitals in CON states now perform better on average on *Postoperative Pulmonary Embolism* than hospitals in non-CON states by about 4 cases per 1,000 discharges. Nevertheless, these summary statistics of hospital quality indicators provide some preliminary evidence that hospitals in states with CON regulations tend to score lower on quality measures than those in states without CON laws.

Table 6. Differences-in-Means Tests—Hospital Quality Indicators for All CON States vs. All Non-CON States, 2011–2015

Measure name [CMS code]	Mean sample	Non-CON states	CON states	Difference	Clustered *t* statistic	Observations
Death among surgical inpatients with serious treatable complications (deaths per 1,000 surgical discharges with complications) [PSI #4]	115.1	113.2	116.0	−2.9	4.24	9,537
Postoperative pulmonary embolism or deep vein thrombosis (per 1,000 surgical discharges) [PSI #12]	4.5	4.3	4.6	−0.3	4.95	15,390
Percentage of patients giving their hospital a 9 or 10 overall rating (percentage points) [HCAHPS]	69.7	70.5	69.3	1.2	−4.35	19,853
Pneumonia readmission rates (percentage points) [READM-30-PN]	17.8	17.5	17.9	−0.5	13.17	20,645
Pneumonia mortality rate (percentage points) [MORT-30-PN]	11.9	11.8	12.0	−0.3	5.22	20,559
Heart failure readmission rate (percentage points) [READM-30-HF]	23.5	23.2	23.6	−0.5	9.79	19,316
Heart failure mortality rate (percentage points) [MORT-30-HF]	11.7	11.6	11.8	−0.2	3.79	18,901
Heart attack readmission rate (percentage points) [READM-30-AMI]	18.5	18.3	18.7	−0.4	8.20	11,377
Heart attack mortality rate (percentage points) [MORT-30-AMI]	15.1	15.0	15.1	−0.1	1.44	12,792

Notes: CON = certificate of need; CMS = Centers for Medicare & Medicaid Services; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems. The unit of analysis is the individual hospital. Data are collected at the individual hospital level. Readmission and mortality rates are calculated using data from Medicare patients only. All *t* statistics are clustered at the individual provider level.

Sources: CMS (2014); Hospital Compare Data Archive (2011, 2012, 2013, 2014, 2015); Dartmouth Atlas Project (2016).

Table 7. Differences-in-Means Tests—Hospital Quality Indicators for HRRs in Both CON and Non-CON States, 2011–2015

Measure name [CMS code]	Mean sample	HRRs in non-CON states	HRRs in CON states	Difference	Clustered *t* statistic	Observations
Death among surgical inpatients with serious treatable complications (deaths per 1,000 surgical discharges with complications) [PSI #4]	113.1	111.1	116.0	−4.9	3.12	1,539
Postoperative pulmonary embolism or deep vein thrombosis (per 1,000 surgical discharges) [PSI #12]	4.4	4.5	4.2	0.4	−2.99	2,779
Percent of patients giving their hospital a 9 or 10 overall rating (percentage points) [HCAHPS]	71.3	71.9	70.5	1.4	−2.37	4,006
Pneumonia readmission rate percentage points) [READM-30-PN]	17.6	17.5	17.7	−0.2	2.83	4,141
Pneumonia mortality rate (percentage points) [MORT-30-PN]	12.0	11.8	12.2	−0.5	5.12	4,112
Heart failure readmission rate (percentage points) [READM-30-HF]	23.3	23.2	23.5	−0.3	2.64	3,659
Heart failure mortality rate (percentage points) [MORT-30-HF]	11.8	11.6	12.1	−0.4	4.87	3,552
Heart attack readmission rate (percentage points) [READM-30-AMI]	18.5	18.4	18.5	−0.1	0.94	1,806
Heart attack mortality rate (percentage points) [MORT-30-AMI]	15.1	15.0	15.3	−0.3	2.74	2,033

Notes: HRRs = hospital referral regions; CON = certificate of need; CMS = Centers for Medicare & Medicaid Services; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems. The unit of analysis is the individual hospital. Data are collected at the individual hospital level. Readmission and mortality rates are calculated using data from Medicare patients only. All *t* statistics are clustered at the individual provider level.

Sources: CMS (2014); Hospital Compare Data Archive (2011, 2012, 2013, 2014, 2015); Dartmouth Atlas Project (2016).

Pooled Panel Regression Results

Table 8 presents estimates from five regression models that pool annual data on hospital quality from 2011 to 2015. We present estimates only for the coefficient of interest, that is, the coefficient on the *CON* dummy variable in equation (1). In each model specification, the CON coefficient is identified as the difference in the quality of medical services between hospitals in CON states and hospitals in non-CON states. Identification does not come from variation over time in CON laws because none of the 50 states or the District of Columbia changed their CON laws between 2011 and 2015.

In columns A and B, the unit of observation is a hospital in our full sample of 23,151 providers in the country from 2011 to 2015. Column A contains results from the bivariate regression of a given hospital quality measure on the CON dummy variable. Column B contains results from a multivariate regression that controls for average income, age, race, percent uninsured, and education of people in a provider's zip code, as well as the hospital's size, the number of Medicare patients it serves, and year indicators. In columns C through E, the unit of observation is a hospital in the previously identified subsample of HRRs that contain providers in both CON and non-CON states. Columns C and D contain results for the same bivariate and multivariate regressions as in columns A and B but consider only the subsample of hospitals in border-crossing HRRs. Column E is our preferred specification and contains results from the HRR fixed-effects model using the restricted sample of hospitals and including the controls from the multivariate regression.

The estimates from the pooled bivariate and multivariate regressions using both the full sample and the restricted sample contained in table 8, columns A through D, demonstrate that, in the vast majority of cases, hospitals in CON states perform worse on the quality indicators than hospitals in non-CON states. In our preferred specification with HRR fixed effects in table 8, column E, the estimates of the quality indicators of *Death among Surgical Inpatients with Serious Treatable Complications*, *Pneumonia Mortality Rate*, *Heart Failure Mortality Rate*, and

Heart Attack Mortality Rate are statistically significantly higher in states with CON laws than in non-CON states. These findings support the hypothesis that CON regulations lower the quality of medical services. The change in magnitude of the coefficient in column E relative to the other columns suggests that unmeasured or unobserved variables are correlated with quality of care and whether a state has a CON law.

Table 8, column E, shows that the 30-day mortality rate for pneumonia patients is more than 0.6 percentage points higher in CON states than in non-CON states. Further, the 30-day mortality rates for heart failure and heart attack patients are 0.33 and 0.37 percentage points higher in CON states, respectively. This means that the average mortality rates for these conditions in CON states are, respectively, about 2.5 and 3 percent higher than the average in non-CON states. These results imply that the average hospital in a state with CON regulations experiences between 3 and 6 more deaths per 1,000 discharges than hospitals in non-CON states, depending on the illness.

The largest difference for all measures is in *Death among Surgical Inpatients with Serious Treatable Complications*. This measure is a composite of the number of deaths that occur following a serious complication after surgery. The estimate for this measure implies that hospitals in CON states average 6 more deaths per 1,000 surgical discharges that resulted in complications. Put another way, the mortality rate from complications is about 5.5 percent higher in CON states compared with the average mortality rate for the restricted sample.

Table 8, column E, also shows that readmission rates tend to be either the same or higher in states with CON regulations, although none of these differences are statistically significant at the 5 percent level. Furthermore, column E shows that the difference in the rate of *Postoperative*

Pulmonary Embolism or Deep Vein Thrombosis and the percentage of patients giving their hospital an overall HCAHPS rating of 9 or 10 is not significantly different from zero.

Table 8. Pooled Regression Results, 2011–2015

Measure name [CMS code]	(A) Full-sample bivariate model	(B) Full-sample multivariate model	(C) Restricted-sample bivariate model	(D) Restricted-sample multivariate model	(E) HRR fixed-effects model
Death among surgical inpatients with serious treatable complications (deaths per 1,000 surgical discharges with complications) [PSI #4]	2.87*** (0.68) R^2 = 0.00	2.68*** (0.70) R^2 = 0.08	4.90*** (1.59) R^2 = 0.02	4.06*** (1.52) R^2 = 0.16	6.18** (2.45) Adj R^2 = 0.26
Postoperative pulmonary embolism or deep vein thrombosis (per 1,000 surgical discharges) [PSI #12]	0.28*** (0.06) R^2 = 0.01	0.28*** (0.06) R^2 = 0.10	−0.42*** (0.13) R^2 = 0.01	−0.43*** (0.13) R^2 = 0.18	−0.07 (0.17) Adj R^2 = 0.24
Percent of patients giving their hospital a 9 or 10 overall rating (percentage points) [HCAHPS]	−1.18*** (0.27) R^2 = 0.00	−0.43 (0.31) R^2 = 0.14	−1.37** (0.59) R^2 = 0.01	−0.42 (0.68) R^2 = 0.26	−1.04 (1.01) Adj R^2 = 0.34
Pneumonia readmission rate (percentage points) [READM-30-PN]	0.45*** (0.03) R^2 = 0.02	0.49*** (0.05) R^2 = 0.22	0.19*** (0.07) R^2 = 0.00	0.16 (0.11) R^2 = 0.22	-0.01 (0.13) Adj R^2 = 0.35
Pneumonia mortality rate (percentage points) [MORT-30-PN]	0.26*** (0.05) R^2 = 0.01	0.24*** (0.07) R^2 = 0.06	0.49*** (0.09) R^2 = 0.02	0.53*** (0.14) R^2 = 0.07	0.63*** (0.19) Adj R^2 = 0.14
Heart failure readmission rate (percentage points) [READM-30-HF]	0.47*** (0.05) R^2 = 0.01	0.51*** (0.06) R^2 = 0.32	0.27** (0.11) R^2 = 0.00	0.22 (0.15) R^2 = 0.34	0.09 (0.19) Adj R^2 = 0.43
Heart failure mortality rate (percentage points) [MORT-30-HF]	0.17*** (0.04) R^2 = 0.00	0.22*** (0.05) R^2 = 0.10	0.43*** (0.09) R^2 = 0.02	0.48*** (0.12) R^2 = 0.12	0.33** (0.17) Adj R^2 = 0.23
Heart attack readmission rate (percentage points) [READM-30-AMI]	0.36*** (0.04) R^2 = 0.01	0.31*** (0.05) R^2 = 0.46	0.10*** (0.11) R^2 = 0.00	0.10 (0.11) R^2 = 0.47	0.19 (0.14) Adj R^2 = 0.57
Heart attack mortality rate (percentage points) [MORT-30-AMI]	0.07*** (0.05) R^2 = 0.00	0.15*** (0.05) R^2 = 0.19	0.33 (0.11) R^2 = 0.01	0.27** (0.11) R^2 = 0.24	0.37** (0.15) Adj R^2 = 0.30
Controls	*No*	*Yes*	*No*	*Yes*	*Yes*

HRR fixed effects	*No*	*No*	*No*	*No*	*Yes*
Number of providers	*23,151*	*23,151*	*4,811*	*4,811*	*4,811*

Notes: CMS = Centers for Medicare & Medicaid Services; HRR = hospital referral region; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems. The model specifications in columns A and B consider the full sample of hospitals in the United States. The specifications in columns C through E consider only hospitals in HRRs that cross the border between CON and non-CON states. The unit of analysis is the individual provider. Clustered standard errors by provider are in parentheses. Controls for percent over age 65, percent nonwhite, percent with no high school diploma, percent uninsured, and per capita income are the average from the provider's zip code. Controls for the number of patient days and Medicare patient days as a share of total patient days are from the individual provider. Controls also include year dummy variables. Readmission and mortality rates are calculated using data from Medicare patients only. The number of observations varies between the bivariate and multivariate regressions (details are available from the authors on request). *** statistically significant at (at least) the 1% level. ** statistically significant at (at least) the 5% level. * statistically significant at (at least) the 10% level.

Sources: CMS (2014); Hospital Compare Data Archive (2011, 2012, 2013, 2014, 2015); Dartmouth Atlas Project (2016); American FactFinder (2016).

One potentially confounding factor that is not captured in our model is the impact of the Hospital Readmissions Reduction Program (HRRP), a provision of the Affordable Care Act that penalizes hospitals for excess 30-day readmissions following Medicare fee-for-service patient discharges (CMS 2016c). Penalties are assessed on the basis of hospitals' readmission rates for three conditions: heart attack, heart failure, and pneumonia. The new provision became applicable to hospital discharges in 2012, and hospitals with higher-than-expected 30-day readmission rates for the three conditions faced a maximum 1 percent reduction in payments for discharges in 2013, increasing to 2 percent in 2014 and 3 percent in 2015.

The penalties associated with the HRRP may account for the absence of systematic differences in readmission rates, as with those observed for mortality rates. If CON hospitals had higher readmission rates than non-CON hospitals prior to the HRRP, the penalties under the program would incentivize those hospitals to lower their readmission rates more quickly than non-CON hospitals. There is some evidence that hospitals are responding to the HRRP. For example, Zuckerman (2016) finds that readmission rates fell sharply for the conditions targeted by the HRRP and that they fell less sharply for readmissions following discharges for other hospitalizations. Zuckerman notes that “the drop in readmissions mostly occurred during the period between the enactment of the Affordable Care Act in March 2010 and the start of the Hospital Readmissions Reduction Program in October 2012, when hospitals would have taken action to avoid facing penalties” (Zuckerman 2016, 2). This drop in response to the HRRP coincides with the beginning of our study period and may partly explain why we do not observe larger differences in readmission rates between CON and non-CON hospitals.

Overall, our results do not support the hypothesis that CON hospitals deliver better-quality care than non-CON hospitals. In fact, we tend to find the opposite: Nearly all the coefficients in our regressions suggest that CON regulations lead to lower-quality care, although not all estimates are significant in all our specifications.

Robustness Checks

Regression Results by Year, 2011–2015

To test whether the pooled panel regression results are being driven by chance findings, we also present the results of the HRR fixed-effects model for the same quality measures for each individual year from 2011 to 2015. However, our previous results are unlikely to be driven by changes in the number of HRRs crossing state borders because that number stayed very similar from 2011 to 2015. Moreover, the number of providers in these border-crossing HRRs also remained very static during these years.

The results of these additional tests are largely consistent with the pooled regression model. Table 9 summarizes these results. *Death among Surgical Inpatients with Serious Treatable Complications* is statistically significantly higher for hospitals in CON states in each year except 2013, implying a difference of between 4 and 10 additional deaths per 1,000 surgical discharges at CON hospitals. The difference in *Pneumonia Mortality Rate* between CON and non-CON hospitals is also statistically significant in each year, representing between nearly 6 and 8 additional deaths per 1,000 pneumonia discharges. Furthermore, we find that *Heart Failure Mortality Rate* and *Heart Attack Readmission Rate* are higher at CON hospitals than non-CON hospitals, although the differences are not statistically significant in every year.

In our regressions by year, we again find that the readmission rates were generally no different at CON hospitals than non-CON hospitals for 2011–2015. One exception is *Pneumonia Readmission Rate* in 2012, when it was 0.23 percentage points lower in CON hospitals. The other exception is *Heart Attack Readmission Rate,* which is different from zero in 2011 and 2012, has the predicted sign in these two years, and is statistically significant. In these two years, *Pneumonia Readmission Rate* and the *Heart Attack Readmission rate* are, respectively, 0.34 and 0.33 percentage points higher in hospitals located in CON states.

Also consistent with our baseline estimates, the difference in the *Postoperative Pulmonary Embolism* rate between CON and non-CON hospitals was not significantly different from zero in each year except 2011, when the point estimate was 0.43 percentage points lower for CON hospitals than non-CON hospitals. This rate represented a little more than 4 additional deaths per 1,000 discharges for non-CON hospitals.

Table 9. Regression Results by Year, 2011–2015

Measure name [CMS code]	2011	2012	2013	2014	2015
Death among surgical inpatients with serious treatable complications (deaths per 1,000 surgical discharges with complications) [PSI #4]	9.83*** (1.34) Adj R^2 = 0.19	5.93** (2.68) Adj R^2 = 0.19	4.89 (3.57) Adj R^2 = 0.22	3.91** (2.02) Adj R^2 = 0.23	5.56** (2.58) Adj R^2 = 0.22
Postoperative pulmonary embolism or deep vein thrombosis (per 1,000 surgical discharges) [PSI #12]	−0.43** (0.21) Adj R^2 = 0.18	−0.10 (0.14) Adj R^2 = 0.19	0.11 (0.10) Adj R^2 = 0.13	0.06 (0.15) Adj R^2 = 0.14	0.03 (0.14) Adj R^2 = 0.16
Percent of patients giving their hospital a 9 or 10 overall rating (percentage points) [HCAHPS]	0.08 (0.99) Adj R^2 = 0.27	−0.37 (1.04) Adj R^2 = 0.29	−1.80 (1.18) Adj R^2 = 0.32	−0.73 (1.21) Adj R^2 = 0.29	−1.41 (1.06) Adj R^2 = 0.28
Pneumonia readmission rate (percentage points) [READM-30-PN]	0.02 (0.15) Adj R^2 = 0.23	−0.23** (0.11) Adj R^2 = 0.25	−0.10 (0.16) Adj R^2 = 0.24	0.13 (0.17) Adj R^2 = 0.16	0.16 (0.14) Adj R^2 = 0.08
Pneumonia mortality rate (percentage points) [MORT-30-PN]	0.77*** (0.20) Adj R^2 = 0.09	0.62*** (0.18) Adj R^2 = 0.08	0.59*** (0.19) Adj R^2 = 0.07	0.67*** (0.12) Adj R^2 = 0.10	0.57*** (0.15) Adj R^2 = 0.12
Heart failure readmission rate (percentage points) [READM-30-HF]	−0.07 (0.22) Adj R^2 = 0.15	−0.12 (0.14) Adj R^2 = 0.16	0.04 (0.16) Adj R^2 = 0.19	0.14 (0.14) Adj R^2 = 0.23	0.31 (0.21) Adj R^2 = 0.22
Heart failure mortality rate (percentage points) [MORT-30-HF]	0.38** (0.19) Adj R^2 = 0.16	0.31 (0.19) Adj R^2 = 0.15	0.34** (0.17) Adj R^2 = 0.17	0.25 (0.15) Adj R^2 = 0.22	0.28** (0.15) Adj R^2 = 0.23
Heart attack readmission rate (percentage points) [READM-30-AMI]	0.34** (0.17) Adj R^2 = 0.21	0.33* (0.18) Adj R^2 = 0.22	0.21 (0.14) Adj R^2 = 0.18	−0.04 (0.12) Adj R^2 = 0.12	−0.13 (0.17) Adj R^2 = 0.13
Heart attack mortality rate (percentage points) [MORT-30-AMI]	0.49*** (0.15) Adj R^2 = 0.12	0.43*** (0.14) Adj R^2 = 0.13	0.46** (0.15) Adj R^2 = 0.16	0.27 (0.18) Adj R^2 = 0.18	0.21 (0.20) Adj R^2 = 0.11
Number of providers	*921*	*1,060*	*1,076*	*957*	*999*

Note: CMS = Centers for Medicare & Medicaid Services; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems. The unit of analysis is the individual provider. Clustered standard errors by state are in parentheses. Controls for percent over age 65, percent nonwhite, percent with no high school diploma, percent uninsured, and per capita income are the average from the provider's zip code. Controls for the number of patient days and Medicare patient days as a share of total patient days are from the individual provider. Readmission and mortality rates are calculated using data from Medicare patients only. *** statistically significant at (at least) the 1% level. ** statistically significant at (at least) the 5% level. * statistically significant at (at least) the 10% level.

Sources: CMS (2014); Hospital Compare Data Archive (2011, 2012, 2013, 2014, 2015); Dartmouth Atlas Project (2016); American FactFinder (2016).

Regression Results Excluding Low-Provider HRRs

One concern regarding the previous results might be that results from the pooled panel regression model are sensitive to the fact that some HRRs in our subsample have only a few hospitals on one side of the state border that runs through them. Table 4 illustrates the potential issue: In 2011, almost one-third of HRRs that crossed the border between CON and non-CON states had only a few hospitals on one side or both sides of the border. If one or more of those hospitals is abnormally high or low performing on the quality indicators, such skewedness in the data might drive our findings in tables 8 and 9.

To address this issue, we restrict our fixed-effects model to exclude all HRRs with three or fewer providers on one or both sides of the border. We do this for each year from 2011 to 2015.[6] Table 10, column A, contains the results from our original pooled panel regression model with fixed effects. Column B shows the results of the same model while omitting the HRRs with three or fewer providers on one side or both sides of the border, which we find are largely consistent with the results from column A.

The magnitudes of the coefficients on CON in the regressions that do not include low-provider HRRs (column B) are similar to the coefficients in the original model (column A). Differences in *Death among Surgical Inpatients with Serious Treatable Complications* and *Pneumonia Mortality Rate* between CON and non-CON hospitals remain statistically significant. The coefficients on *Heart Failure Mortality Rate* and *Heart Attack Mortality Rate* are similar but lose significance because the standard errors increase. The measures for readmission rate remain statistically insignificantly different from zero. These results provide evidence that the original results were not driven by outliers in the low-provider HRRs.

[6] For 2011, this criterion eliminates 24 HRRs and 417 providers from our subsample. For 2012, we exclude 23 HRRs and 414 hospitals. For 2013, we exclude 23 HRRs and 419 hospitals. For 2014, we exclude 21 HRRs and 401 hospitals. For 2015, we exclude 22 HRRs and 427 hospitals.

Table 10. Robustness Checks, 2011–2015

Measure name [CMS code]	(A) Original fixed-effects model	(B) Omitting low HRRs	(C) Omitting unbalanced HRRs	(D) Omitting low-CON states
Death among surgical inpatients with serious treatable complications (deaths per 1,000 surgical discharges with complications) [PSI #4]	6.18** (2.45) Adj R^2 = 0.26	7.59*** (2.37) Adj R^2 = 0.26	5.09** (2.52) Adj R^2 = 0.25	6.74*** (2.44) Adj R^2 = 0.24
Postoperative pulmonary embolism or deep vein thrombosis (per 1,000 surgical discharges) [PSI #12]	−0.07 (0.17) Adj R^2 = 0.24	0.02 (0.21) Adj R^2 = 0.28	0.08 (0.24) Adj R^2 = 0.21	−0.11 (0.18) Adj R^2 = 0.25
Percent of patients giving their hospital a 9 or 10 overall rating (percentage points) [HCAHPS]	−1.04 (1.01) Adj R^2 = 0.34	−1.77* (1.04) Adj R^2 = 0.37	−2.00* (1.10) Adj R^2 = 0.39	−3.19*** (1.09) Adj R^2 = 0.34
Pneumonia readmission rate (percentage points) [READM-30-PN]	−0.01 (0.13) Adj R^2 = 0.35	0.19 (0.15) Adj R^2 = 0.36	0.19 (0.18) Adj R^2 = 0.33	0.19 (0.15) Adj R^2 = 0.35
Pneumonia mortality rate (percentage points) [MORT-30-PN]	0.63*** (0.19) Adj R^2 = 0.14	0.61*** (0.23) Adj R^2 = 0.17	0.55** (0.26) Adj R^2 = 0.17	0.48** (0.23) Adj R^2 = 0.12
Heart failure readmission rate (percentage points) [READM-30-HF]	0.09 (0.19) Adj R^2 = 0.43	0.05 (0.20) Adj R^2 = 0.43	−0.05 (0.21) Adj R^2 = 0.43	0.32* (0.20) Adj R^2 = 0.44
Heart failure mortality rate (percentage points) [MORT-30-HF]	0.33** (0.17) Adj R^2 = 0.23	0.33 (0.21) Adj R^2 = 0.26	0.32 (0.24) Adj R^2 = 0.26	0.37* (0.19) Adj R^2 = 0.25
Heart attack readmission rate (percentage points) [READM-30-AMI]	0.19 (0.14) Adj R^2 = 0.57	0.22 (0.17) Adj R^2 = 0.57	0.08 (0.19) Adj R^2 = 0.57	0.36** (0.17) Adj R^2 = 0.57
Heart attack mortality rate (percentage points) [MORT-30-AMI]	0.37** (0.15) Adj R^2 = 0.30	0.25 (0.19) Adj R^2 = 0.32	0.30 (0.22) Adj R^2 = 0.32	0.33** (0.17) Adj R^2 = 0.29
Number of providers	*4,811*	*2,765*	*1,934*	*3,447*

Notes: CMS = Centers for Medicare & Medicaid Services; HRRs = hospital referral regions; CON = certificate of need; HCAHPS = Hospital Consumer Assessment of Healthcare Providers and Systems. Column A contains original fixed-effects regression results. Column B contains results after dropping HRRs with three or fewer hospitals on either side of the border. Column C contains results after dropping HRRs that have at minimum four times fewer the number of providers on one side of the border than the other. Column D contains results after dropping observations in states with below the median number of CON laws. The unit of analysis is the individual provider. Clustered standard errors by provider are in parentheses. Controls for percent over age 65, percent nonwhite, percent with no high school diploma, percent uninsured, and per capita income are the average from the provider's zip code. Controls for the number of patient days and Medicare patient days as a share of total patient days are from the individual provider. Controls also include year dummy variables. Readmission and mortality rates are calculated using data from Medicare patients only. *** statistically significant at (at least) the 1% level. ** statistically significant at (at least) the 5% level. * statistically significant at (at least) the 10% level.

Sources: CMS (2014); Hospital Compare Data Archive (2011, 2012, 2013, 2014, 2015); Dartmouth Atlas Project (2016); American FactFinder (2016).

Regression Results Excluding Unbalanced HRRs

Another concern regarding our estimates in the pooled panel regression model is that some of the border-crossing HRRs contain a highly unbalanced number of hospitals on one side of the market compared with the other side. Table 4 again illustrates the potential issue. For instance, in 2011, HRR number 371 contained 46 hospitals on the non-CON side of the border but only 7 on the CON side. To address this potential issue, we further restrict our model to exclude all HRRs in which there are at least four times more providers on one side of the border than the other. This omits 23 HRRs and 2,877 providers from our subsample. Table 10, column C, contains the pooled panel regression results omitting these unbalanced HRRs, and we find the results are very similar to those in columns A and B.

Regression Results Excluding States with Few CON Laws

In our original model, a state is defined as a CON state if it had at least one CON regulation. However, the effects of CON regulations may be cumulative, meaning that states with a lot of entry restrictions may see larger quality differences than states with relatively few. In this case, we would expect states with only a few CON laws to look more like non-CON states in terms of hospital quality than states with more comprehensive CON programs. By treating all CON states the same, our model could be missing these cumulative effects and thus be underestimating the true impact of CON laws on hospital quality.

To address this issue, we further restrict our subsample to exclude hospitals in any CON state that has fewer than four CON laws, the median number of laws for the CON states in our subsample. This omits 1,364 providers and 10 HRRs from the subsample. The results are again consistent with the original pooled regression model and, further, provide evidence that states with the most restrictive CON programs have systematically lower-quality hospitals than non-CON states.

Table 10, column D, contains the pooled panel regression results omitting states with the fewest CON laws. As in the original model, we find that differences between CON and non-CON hospitals in *Death among Surgical Inpatients with Serious Complications*, *Pneumonia Mortality Rate, Heart Failure Mortality Rate*, and *Heart Attack Mortality Rate* remain statistically significant. Furthermore, estimates for the difference in *Heart Failure Readmission Rate* and *Heart Attack Readmission Rate* are also statistically significant using the restricted sample. We also find that CON hospitals have, on average, three percentage points fewer patients rating their hospital a 9 or 10 overall on the HCAHPS survey than do non-CON hospitals.

Aggregate Hospital Quality Measures

One possible limitation of our previous findings may be that our individual quality variables do not fully capture all aspects of provider quality. This limitation stems from two issues: The first is that there is no consensus about the most important individual variables to examine when assessing overall hospital quality, and the second is that until recently there were no aggregate measures that were designed to allow for high-level comparisons across hospitals. In this section, we attempt to compensate for the second issue by incorporating five additional quality measures that are meant to capture hospital quality at a more aggregate level.

Goodman, Fisher, and Chang (2011) use data on Medicare patients to construct five hospital-level metrics that capture the quality of care for patients who have had medical and surgical procedures. The first post-discharge event is *30-Day Readmission Rate after Medical Discharge*, which captures readmissions within 30 days of discharge as a percentage of all Medicare patients classified as having a "medical" hospital visit.[7] The second event is *14-Day Ambulatory Visit Rate after Medical Discharge*, which measures the percentage of medical patients who required outpatient care within 14 days of discharge. The third event is *30-Day Emergency Room Visit Rate after Medical Discharge*, which measures the percentage of medical patients who visited the emergency room within 30 days of discharge. The final two events are *30-Day Readmission Rate after Surgical Discharge* and *30-Day Emergency Room Visit Rate after Surgical Discharge*, which capture the percentage of Medicare patients who underwent a "surgical" procedure and were readmitted within 30 days of discharge and the percentage that visited the emergency room within 30 days of discharge, respectively.

Hospital-level data for those five indicators are available from the Dartmouth Atlas Project for the years 2011–2013. The data were collected from CMS's Medicare Provider Analysis and Review File. Patients included in the case mix were Medicare fee-for-service beneficiaries with full Medicare Part A and Part B coverage during the study period. Patients who left against medical advice, who were discharged to hospice care, or who died while in the hospital were excluded from the sample. The rates were adjusted for age, gender, and race. For more detail about how this measure was constructed, see Goodman, Fisher, and Chang (2011).

We also analyze a second set of indicators that became available in 2013, when CMS began calculating a number of composite quality measures meant to be better indicators of

[7] For a list of conditions and procedures categorized as "medical" and "surgical," see CMS (2008a).

hospital performance across a class of metrics. These include an all-cause hospital readmissions rate and a composite rate of complications after surgery. Hospital-level data for these two indicators were available from Hospital Compare for the years 2013–2015.

The *Hospital-Wide 30-Day Readmission Rate* (READM-30-HOSP-WIDE) is a summary rate of unplanned readmissions within 30 days of discharge for all medical, surgical, cardiorespiratory, cardiovascular, and neurological conditions and procedures. According to Rosen et al. (2016), these five patient cohorts represent almost 90 percent of all hospital admissions. Patients included are from the Medicare fee-for-service population age 65 and older who were discharged from any nonfederal, short-stay, acute-care hospital or critical-access hospital (Horwitz et al. 2011). Like the other CMS readmission and mortality rates used in this study, the all-causes readmission rate is risk standardized to take into account an individual hospital's case mix. The all-causes readmission rate also adjusts for each hospital's patients' primary diagnosis to take into account variations in conditions and procedures, allowing for comparison across heterogeneous providers. For more detail about how this measure is constructed, see CMS (2015).

The *Aggregate Patient Safety Indicator* (PSI #90) is meant to capture how well a hospital prevents complications after surgery compared to other hospitals with a similar case mix. This measure is a weighted average of the hospital's performance on the following complications: pressure ulcer, iatrogenic pneumothorax, central venous catheter–related bloodstream infection, postoperative hip fracture, postoperative hemorrhage or hematoma, postoperative physiologic and metabolic derangement, postoperative respiratory failure, postoperative pulmonary embolism or deep vein thrombosis, postoperative sepsis, postoperative wound dehiscence, and accidental puncture or laceration (note that the composite measure does not include deaths from serious complications after surgery). The resulting composite ratio is scaled to an expected score of 1, given a hospital's individual case mix. A score of more than 1 indicates that the hospital had more complications than other hospitals with a similar case mix, whereas a score of less than 1 indicates fewer complications than hospitals with a similar case mix. For more detail about how this measure is constructed, see AHRQ (2010).

Table 11 contains summary statistics of these measures. Panel A compares these aggregate quality measures in CON and non-CON states, and panel B compares the indicators at hospitals in the subsample of HRRs that cross the border between CON and non-CON states. As in the previous robustness checks, the results of the pooled regression model with fixed effects when using these aggregate quality measures are largely consistent with our original model. In general, we find that hospitals in CON states perform either worse or the same as non-CON hospitals on these additional quality measures, although not all differences are statistically significant at conventional levels.

Table 12 contains the results for the pooled panel regression with HRR fixed effects using these new aggregate quality indicators. We find that the *14-Day Ambulatory Visit Rate after Medical Discharge* is almost 1.5 percentage points higher at CON hospitals than non-CON hospitals and that this result is statistically significant at (at least) the 10 percent level. We also find that the *30-Day Emergency Room Visit Rate after Medical Discharge* and the *30-Day Readmission Rate after Surgical Discharge* are, respectively, 0.71 and 0.84 percentage points higher at CON hospitals. These estimates are statistically significant at (at least) the 5 percent level. The differences in the *30-Day Readmission Rate after Medical Discharge* and the *30-Day Emergency Room Visit Rate after Surgical Discharge* are not significantly different from zero. Similarly, the *Hospital-Wide 30-Day Readmission Rate* and the *Aggregate Patient Safety Indicator* are not significantly different from zero.

Table 11. Difference-in-Means Tests—Aggregate Quality Measures

Panel A: All CON states versus all non-CON states	Non-CON states	CON states	Difference	Clustered *t* statistic	Observations
30-day readmission rate after medical discharge (percentage points)	15.0	15.5	−0.5	7.05	9,341
14-day ambulatory visit rate after medical discharge (percentage points)	63.8	64.2	−0.4	1.32	11,811
30-day emergency room visit rate after medical discharge (percentage points)	19.3	20.1	−0.9	9.26	10,163
30-day readmission rate after surgical discharge (percentage points)	11.2	12.0	−0.8	6.41	5,387
30-day emergency room visit rate after surgical discharge (percentage points)	15.0	15.8	−0.8	6.69	6,150
Hospital-wide 30-day readmission rate (percentage points)	15.4	15.7	−0.3	13.42	13,235
Aggregate patient safety indicator (ratio)	0.75	0.75	0.0	−0.51	9,815

Panel B: HRRs in both CON and non-CON states	HRRs in non-CON states	HRRs in CON states	Difference	Clustered *t* statistic	Observations
30-day readmission rate after medical discharge (percentage points)	15.1	15.4	−0.3	1.67	1,600
14-day ambulatory visit rate after medical discharge (percentage points)	62.2	63.8	−1.7	2.02	2,215
30-day emergency room visit rate after medical discharge (percentage points)	19.3	19.9	−0.6	2.78	1,774
30-day readmission rate after surgical discharge (percentage points)	11.2	11.5	−0.2	0.74	877
30-day emergency room visit rate after surgical discharge (percentage points)	14.9	15.4	−0.5	1.62	988
Hospital-wide 30-day readmission rate (percentage points)	15.4	15.6	−0.1	3.01	2,735
Aggregate patient safety indicator (ratio)	0.77	0.77	0.0	−1.53	1,690

Note: CON = certificate of need; HRRs = hospital referral region. Rates of readmissions, ambulatory visits, and emergency room visits are from the Dartmouth Atlas of Health Care for the years 2011–2013 (Dartmouth Atlas Project 2016). The hospital-wide readmission rate and aggregate patient safety indicator are from Hospital Compare for the years 2013, 2014 and 2015 (Hospital Compare Data Archive 2013, 2014, 2015). The unit of analysis is the individual hospital. Data are collected at the individual hospital level. All rates except the aggregate patient safety indicator are calculated using data from Medicare patients only. All *t* statistics are clustered at the individual provider level.

Sources: CMS (2014); Hospital Compare Data Archive (2013, 2014, 2015); Dartmouth Atlas Project (2016); American FactFinder (2016).

Table 12. Regression Results for Aggregate Quality Measures

Measure name	Coefficient on CON	Observations
30-day readmission rate after medical discharge, 2011–2013 (percentage points)	0.22 (0.22) Adj R^2 = 0.21	1,253
14-day ambulatory visit rate after medical discharge, 2011–2013 (percentage points)	1.42* (0.82) Adj R^2 = 0.45	1,371
30-day emergency room visit rate after medical discharge, 2011–2013 (percentage points)	0.71** (0.33) Adj R^2 = 0.15	1,295
30-day readmission rate after surgical discharge, 2011–2013 (percentage points)	0.84** (0.37) Adj R^2 = 0.44	774
30-day emergency room visit rate after surgical discharge, 2011–2013 (percentage points)	0.61 (0.49) Adj R^2 = 0.31	871
Hospital-wide 30-day readmission rate, 2013–2015 (percentage points)	0.13 (0.08) Adj R^2 = 0.36	1,435
Aggregate patient safety indicator, 2013–2015 (ratio)	−0.01 (0.02) Adj R^2 = 0.39	1,457

Note: CON = certificate of need. Rates on readmissions, ambulatory visits, and emergency room visits are from the Dartmouth Atlas of Health Care for the years 2011–2013 (Dartmouth Atlas Project 2016). The hospital-wide readmission rate and aggregate patient safety indicator are from Hospital Compare for the years 2013–2015 (Hospital Compare Data Archive 2013, 2014, 2015). The unit of analysis is the individual provider. Clustered standard errors by provider are in parentheses. Controls for percent over age 65, percent nonwhite, percent with no high school diploma, percent uninsured, and per capita income are the average from the provider's zip code. Controls for the number of patient days and Medicare patient days as a share of total patient days are from the individual provider. Controls also include year dummy variables. All rates except the aggregate patient safety indicator are calculated using data from Medicare patients only. ** statistically significant at (at least) the 5% level. * statistically significant at (at least) the 10% level.

Sources: CMS (2014); Hospital Compare Data Archive (2013, 2014, 2015); Dartmouth Atlas Project (2016); American FactFinder (2016).

Conclusion

As of 2015, 36 states and the District of Columbia had some form of regulation requiring healthcare providers to demonstrate a need for their medical services before building new facilities, expanding existing facilities, or offering new procedures.

Theoretically, the effect of CON regulations on the quality of health care supplied by providers is ambiguous. Supporters claim that CON laws increase equilibrium quality by restricting the number of providers and ensuring that each provider supplies a higher volume of patients than the provider otherwise would, making such providers more proficient. Opponents of CON regulations argue that healthcare providers, as with providers of other goods and services, compete with each other on a variety of margins and that quality of care is one margin on which they compete. Thus, by artificially restricting the number of providers in a market, CON laws reduce the competitive pressures for incumbent providers, which in turn results in lower-quality services.

Empirical research on the effect of CON laws on the quality of health care generally finds no significant differences between providers in states with and without these regulations. However, most of these studies suffer from two drawbacks: the lack of a measure that captures the overall quality of a hospital's medical services and an inability to isolate the causal effect of CON laws on hospital quality.

We develop an empirical framework that allows us to estimate the effect of the presence of CON laws on the quality of hospitals. Analyzing nine quality indicators and estimating the effect of CON laws on the basis of only how hospital quality varies within the same healthcare market, we find no evidence that CON laws increase the quality of care. Instead, we find evidence consistent with the hypothesis that limiting entry results in lower hospital quality.

For example, we find that mortality rates are statistically significantly higher at hospitals in CON states than in non-CON states. Our findings show that the estimated average 30-day mortality rate for patients discharged with pneumonia, heart failure, or heart attack from hospitals in CON states is between 2.5 and 5 percent higher than the average mortality rate for all hospitals in our subsample of HRRs that contains providers in both CON and non-CON states, depending on the illness. These findings are largely robust to a variety of alternative samples and quality measures.

One caveat to our empirical approach is the potential that, within each of our border-crossing healthcare markets, hospitals on the CON side of a border may compete with hospitals on the non-CON side. Hospitals in CON states might improve the quality of their care because they face competition with potentially higher-quality hospitals in non-CON states. Given that our approach still finds a quality differential despite this caveat, hospitals in CON states outside HRR market areas may provide even worse quality than hospitals in CON states that are competing with hospitals in non-CON states in the same market. Future research might explore this aspect of nonprice competition.

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Entry Regulation and Rural Health Care

Certificate-of-Need Laws, Ambulatory Surgical Centers, and Community Hospitals

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Abstract

Certificate-of-need (CON) laws disallow hospitals, nursing homes, ambulatory surgical centers (ASCs), and other healthcare providers from entering new markets, expanding their practice, or making certain capital investments without first receiving approval from state regulators. These laws are currently in effect in 36 states. Over the past 40 years, CON laws have been justified as a way to achieve numerous public policy goals, such as controlling costs, increasing charity care, and protecting access to health care in rural communities by shielding hospitals from increased competition. However, the effects of CON laws on rural health care are not well understood. We examine the effect of entry regulation on ASCs and community hospitals and find that there are both more rural hospitals and more rural ambulatory surgical centers per capita in states without a CON program regulating the opening of an ASC. This finding indicates that CON laws may not be protecting access to rural health care, but are instead correlated with decreases in rural access.

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Entry Regulation and Rural Health Care:

Certificate-of-Need Laws, Ambulatory Surgical Centers, and Community Hospitals

Thomas Stratmann and Christopher Koopman

I. Introduction

Certificate-of-need (CON) laws currently restrict the entry or expansion of healthcare facilities in 36 states.[1] These laws prohibit hospitals, nursing homes, ambulatory surgical centers, and other healthcare providers from expanding their practice in the same area, from creating new facilities in a different location in the state, or from making certain capital investments without first receiving approval from state regulators. These programs are implemented with the expressed purpose of achieving a number of public policy goals. Three primary goals are consistent across most certificate-of-need programs: controlling cost, increasing charity care, and providing medical access in rural healthcare markets.

In order to achieve the third goal—protecting medical access in rural markets (as well as other geographical areas that are deemed underserved)—many states have sought to regulate the entry and expansion of "hospital substitutes,"[2] which include ambulatory surgical centers (ASCs) (Cimasi 2005). The theory is that allowing competition between general hospitals and ASCs will

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[1] While 36 states have CON programs, they vary significantly in both the stringency of the review process and the services and equipment covered. For example, Ohio regulates only one service (long-term acute care) while Vermont regulates 30 categories of medical services and equipment (AHPA 2012).

[2] To understand the theoretical underpinnings for using CON programs to protect access, see Colon Health Centers of America v. Hazel et al., No. 14-2283, slip op. at 23 (4th Cir. 2016), which notes,

> A related purpose of the CON program is geographical in nature. For reasons not difficult to discern, medical services tend to gravitate toward more affluent communities. The CON program aims to mitigate that trend by incentivizing healthcare providers willing to set up shop in underserved or disadvantaged areas such as Virginia's Eastern Shore and far Southwest. "In determining whether" to issue a certificate, for example, Virginia considers "the effects that the proposed service or facility will have on access to needed services in areas having distinct and unique geographic, socioeconomic, cultural, transportation, or other barriers to access to care." Va. Code Ann. § 32.1-102.3(B)(1).

The CON program may also aid underserved consumers in a more indirect fashion. By reducing competition in highly profitable operations, the program may provide existing hospitals with the revenue they need not only to provide indigents with care, but also to support money-losing but nonetheless important operations like trauma centers and neonatal intensive care units.

result in “cream skimming,” meaning that ASCs will accept only the more profitable, less complicated, and well-insured patients while hospitals will be left to treat the less profitable, more complicated, and uninsured patients (Tynan et al. 2009). Some raise the concern that allowing free entry by ASCs will increase cream-skimming, which may harm the financial sustainability of hospitals and in addition adversely affect access to health care in rural areas (Piper 2004; Tynan 2009). As a result, states have chosen to regulate how these providers enter a market, with the goal of protecting access to health care by protecting community hospitals. Currently, 26 states regulate the entry of ASCs through their CON programs. Moreover, Piper (2004) notes that a number of states have considered creating additional, special criteria for these providers in an effort to further protect against cream-skimming and to protect access to hospitals in rural areas.

But are these programs achieving their intended goals? There have already been studies on cost control (Sloan and Steinwald 1980; Sloan 1981; Joskow 1980; Joskow 1981) and on charity care (Stratmann and Russ 2014). However, little is known about the effects that specific entry regulations for ASCs have on healthcare access in rural, or otherwise traditionally underserved, communities.

In this paper, we analyze whether CON programs, by regulating entry of nonhospital providers, have affected competition between nonhospitals and hospitals, as measured by the number of these respective providers. We find that, contrary to the intended goal of protecting access, the presence of a CON program in a state is correlated with both fewer community hospitals per capita and fewer ASCs per capita across an entire state and specifically within its rural areas. Our finding that non-CON states have both more community hospitals and more ASCs per capita is not consistent with the hypothesis that ASCs divert the most profitable patients from community hospitals and are therefore a threat to their existence. If the presence of many ASCs drives community hospitals out of the market, then it is unlikely that they would both be more concentrated in the same areas.

Our paper is organized as follows: Section II provides a brief history of the healthcare certificate-of-need programs. Section III discusses the various justifications for CON programs since the 1960s and also surveys the research on CON laws. Section IV provides a brief discussion of the hypotheses we intend to test. Section V includes our description of the data used and outlines our empirical strategy. We present our results in section VI and discuss these results in section VII. The conclusion in section VIII outlines the implications of these findings for policymakers.

II. A Brief History of State Certificate-of-Need Programs

While CON laws were initially a creation of some state governments, their diffusion across the country is the result of policies created by the federal government. New York was the first state to adopt a CON program in 1964. The purpose was to strengthen regional health planning programs by creating a process for prior approval of certain capital investments (Simpson 1985). Between 1964 and 1974, 26 other states adopted CON programs. However, with the passage of the National Health Planning and Resources Development Act of 1974 (NHPRDA), the availability of certain federal funds was made contingent on enactment of CON programs. That is, if states wanted to remain eligible for federal funding, they had to enact CON programs. In the seven years following the passage of NHPRDA, nearly every state implemented some version of a CON program.

In the early 1980s, as the evidence accumulated that CON regulations were not achieving their goals, federal support for CON began to wane (Cimasi 2005). In particular, federal legislators became increasingly concerned that CON programs "failed to reduce the nation's aggregate healthcare costs, and it was beginning to produce a detrimental effect in local communities" (McGinley 1995). In 1986, the NHPRDA was repealed,[3] and state CON programs were no longer subsidized by federal funding.

After the repeal of the NHPRDA, states began repealing their CON laws. Twelve states (Arizona, California, Colorado, Idaho, Kansas, Minnesota, New Mexico, South Dakota, Texas, Utah, Wisconsin, and Wyoming) repealed their CON programs during the 1980s. Between 1990 and 2000, three more states (Indiana, North Dakota, and Pennsylvania) repealed their CON programs. From 2000 to the present, Wisconsin has been the only state to repeal its program.[4]

III. Evolving Justifications for Certificate-of-Need Programs

Since their beginnings, CON laws have been justified on the basis that they achieve numerous public policy goals. In particular, policymakers have seen CON programs as a way for governments to control costs, regulate the level of capital investments, increase charity care, protect the quality of medical services, and protect access to services across geographic locations. However, some studies have called into question the success of CON laws at controlling costs and hospital investments.

After the passage of the National Health Planning and Resources Development Act of 1974 and the subsequent implementation of CON programs across the country, most early studies found no evidence that CON laws serve as a cost-control measure (Sloan and Steinwald 1980; Sloan 1981; Joskow 1980; Joskow 1981). However, more recent research has been mixed. For example, studies released by Chrysler, Ford, and General Motors find that healthcare costs in

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[3] For a fuller discussion of the NHPRDA, see Madden (1999).
[4] Wisconsin has repealed its CON program twice.

non-CON states are higher than in states with CON laws (DaimlerChrysler Corporation 2002; Ford Motor Company 2000; General Motors Corporation 2002). Conover and Sloan (1998) find that CON laws have only modest cost-control effects and that the removal of CON is not associated with a surge in costs. Rosko and Mutter (2014) find that CON laws are associated with increased cost efficiency, while other studies return mixed results (Bates, Mukherjee, and Santerre 2006; Ferrier, Leleu, and Valdmanis 2010). Rivers, Fottler, and Frimpong (2010), however, find no evidence that CON laws are associated with reduced hospital costs; in fact, they find the opposite: that stringent CON programs increase costs by 5 percent.

The early studies on the effect of CON laws on hospital investments also find no evidence of success (Hellinger 1976; Salkever and Bice 1976). Salkever and Bice (1976) conclude that CON programs have had little effect on hospital investments, stating that there is "no empirical evidence to suggest that [certificate-of-need legislation] has decreased investment." Hellinger (1976) finds that CON laws do not reduce the volume of hospital investments but they are altering their composition. That is, restricting investments via a CON program does not reduce how much hospitals invest, but it does change what investments hospitals make. Instead of investing less, hospitals simply direct investments toward unregulated items.

Thus, researchers have studied the issues of cost control and hospital investment, but the effects of CON laws on the provision and quality of care—both charity and rural care—have not received as much attention. Stratmann and Russ (2014) were the first to empirically test the relationship between CON programs and charity care; they found no evidence associating CON programs with an increase in such care. Others have tried to measure the effect CON programs have on the overall quality of care (Robinson et al. 2001).

There has been little scholarly work that has focused on CON laws and the provision of rural care. A recent study finds evidence that the presence of a CON program may actually be correlated with decreased rural access to hospice care (Carlson et al. 2010). Others hypothesize that CON programs may explain the uniform geographic disbursement of renal services in CON states compared to non-CON states (Rodriguez, Hotchkiss, and O'Hare 2013), although this claim has yet to be the subject of empirical analysis.

While little is known about the effects of CON programs on rural care, access to health care in rural communities has remained a central focus of CON programs. Congress had explicitly made rural access a central goal of state-based CON legislation with the passage of the National Health Planning and Resources Development Act of 1974.[5] Many states continue to use rural access as a primary rationale for continued implementation of CON programs, explicitly including geographic considerations.[6] For example, North Carolina's CON statute states that "access to health care services and health care facilities is critical to the welfare of rural North Carolinians, and to the continued viability of rural communities, and that the needs of rural North Carolinians should be considered in the certificate of need review process."[7] Virginia also includes references to protecting rural health care through its CON program. For example, the stated goal of Virginia's CON program is to support the "geographical distribution of medical facilities and to promote the availability and accessibility of proven technologies."[8] Moreover, states have issued CON regulations—even beyond their CON statutes—that explicitly reference

[5] The NHPRDA included National Health Priorities, which begin with the goal of "the provision of primary care services for medically underserved populations, especially those which are located in rural or economically depressed areas."
[6] See, e.g., Arkansas (A.C.A. § 20-8-103(b)-(c)); Florida (Fla. Stat. Ann. § 408.034(3)); Georgia (Ga. Code Ann., § 31-6-1); Kentucky (KRS § 216B.010); North Carolina (N.C. Gen. Stat. Ann. § 131E-175(3a)); Tennessee (Tenn. Code Ann. § 68-11-1625(c)(7)); Virginia (12 Va. Admin. Code 5-230-30(2)).
[7] N.C. Gen. Stat. Ann. § 131E-175(3a) (2015).
[8] 12 Va. Admin. Code 5-230-30(2) (2015).

rural care as additional justification for CON programs. For example, the West Virginia Health Care Authority, which administers the state's CON program, has included in its regulations the justification for its program that CON is a way to provide "some protection for small rural hospitals . . . by ensuring the availability and accessibility of services and to some extent the financial viability of the facility."[9]

A mentioned above, a primary rationale for CON programs is to protect against cream-skimming by ASCs. The basic theory is that, in order to protect access to a wide array of services in rural areas, it is necessary to protect community hospitals from competition by nonhospital providers. Specifically, the fear is that, as the number of nonhospitals increase, they will accept only the most profitable patients and offer the most profitable procedures, leaving hospitals with the unprofitable procedures and the uninsured patients. (Schactman 2005). Moreover, as the more profitable, less complicated, well-insured patients seek care elsewhere, a hospital's ability to cross-subsidize charity care and other essential services will be reduced. This development threatens the financial sustainability of rural community hospitals and could lead to their closures. Given that there are perhaps only one or two hospitals in many rural areas, a hospital closure might have disproportionate negative effects on the rural population residing in that area. In this context, states justify CON programs as a way to protect the ability of community hospitals to cross-subsidize the less profitable services and patients by reducing competition from other providers, such as ASCs. (Tynan et al. 2009).

Some scholars have researched cream-skimming behavior by ASCs (Plotzke and Courtemance 2011; Munnich and Parente 2014) and others have researched cream-skimming arguments (Cimasi 2005; Piper 2004; Tynan et al. 2009). In this paper, we do not explicitly test

[9] West Virginia Health Care Authority, *Annual Report to the Legislature 1998*, http://www.hca.wv.gov/data/Reports/Documents/annualRpt98.pdf.

whether ASCs are cream-skimming; instead, we test for some of the implications of this hypothesis.

IV. Hypotheses

Our hypotheses test two claims—not based on textbook economics—made in support of CON laws: that CON programs protect hospitals from competition by regulating the entry and expansion of nonhospital providers and that they protect access to rural care by regulating the entry and expansion of nonhospital providers.

Hypothesis 1: *States that administer a CON program have more total community hospitals, and more community hospitals in rural areas, than states without a CON program.*

Our first hypothesis focuses on one of the primary goals of CON laws: providing hospital services by restricting competition. CON laws are intended to accomplish the goal by regulating the entry of new providers or the expansion of existing providers based on the current capacity of established providers.

Although the individual items covered by a particular state's CON program may target specific aspects of health care, the general goal of such a program is to reduce competition to community hospitals by regulating entry and expansion by nonhospital providers, thereby preventing cream-skimming. Therefore, we predict that states that regulate entry via CON laws have more hospitals than those that do not. In particular, CON laws are intended to assure survival of marginally profitable hospitals (such as those in rural areas) that would not otherwise survive in a competitive market with open entry. If CON laws are effective barriers to entry, we expect these hospitals to remain open, protected from cream-skimming by nonhospital providers.

Thus, we predict that we should find more total hospitals and more rural hospitals in states that have CON laws than in those that do not.

Hypothesis 2: *States with ASC-specific CON laws have fewer total ASCs, and fewer ASCs in rural areas, than states without ASC-specific CON laws.*

Ambulatory surgical centers are competitors to hospitals, and they tend to be charged with cream-skimming. Our second hypothesis focuses more specifically on a second intended goal of CON laws, that is, to protect access to medical services by regulating entry of nonhospital providers. If ASCs cannot open shop and engage in cream-skimming, existing hospitals will be more profitable and thus more likely to survive. Given that the stated goal of ASC-specific CON laws is to reduce the number of ASCs in a state, we predict that states that regulate ASC entry via CON laws have fewer ASCs. Second, we predict that there will be fewer ASCs in rural communities, given the focus of CON laws to regulate entry based on the current capacity of established providers, and for the reasons outlined in hypothesis 1.

V. Data and Empirical Strategy

We use two state-level annual measures of healthcare providers: the number of community hospitals per 100,000 state population and the number of ASCs per 100,000 state population, both from 1984 through 2011. We obtained these data series from the Centers for Medicare and Medicaid Services Provider of Services (POS) file. The POS file contains data collected by CMS regional offices on characteristics of hospitals and other types of healthcare facilities. This file includes the medical provider type, name, and address of each facility.

To determine whether providers were located in a rural or urban community, we used their zip codes in the POS file to see if they were within or outside a core-based statistical area (CBSA). A CBSA is a geographic designation defined by the Office of Management and Budget as having an urban center of at least 10,000 people. A CBSA includes both metropolitan and micropolitan areas. We classified providers as urban if they were located within a CBSA and rural if they were located outside a CBSA.

Data on state-level certificate-of-need laws from 1984 through 2011 come from two sources: the American Health Planning Association (AHPA) and HeinOnline's Digital Session Laws Library. The AHPA publishes its annual survey of state CON laws in annual national directories. From these directories we assembled a data set on state CON regulations from 1992 through 2011. As the AHPA did not publish directories before 1992, we obtained that data from HeinOnline's Digital Session Laws Library.

The source for our state-level socioeconomic control variables is the Census Bureau. These variables include population size, poverty level, percentages of white, black, and Hispanic citizens, and the population below age 18 and above age 65. Data on nominal per capita state income come from the Bureau of Economic Analysis. We converted this data to real income using the consumer price index from the Bureau of Labor Statistics, using 2011 as the base year. State-level unemployment data also come from the Bureau of Labor Statistics. To control for residents' health status in a given state, we collected mortality rates due to lung cancer or diabetes for state residents 18 years and older, both by year and by state. This last information comes from the Centers for Disease Control and Prevention.

Table 1A (page 23) shows summary statistics for each of our measures. Column 1 reports the number of observations per variable. In column 2, the mean for the CON indicator is approximately 0.76, indicating that 76 percent of our annual state observations are associated with a CON law. The mean for the ASC CON indicator, measuring whether the CON law requires permission from state regulators to open an ASC, is approximately 0.50. In the last year of our data—as figure 1 (page 26) shows—approximately three-quarters of states (36 states) implemented a CON program, and—as figure 2 (page 27) shows—in the last year of our data approximately half of all states (26 states) have ASC-specific CON requirements.

Table 1B (page 24) provides summary statistics for states with a CON program, and table 1C (page 25) provides summary statistics for states that specifically regulate ASCs with a CON program.

We estimate the two models:

$$\text{Ln Hospital}_{it} = \alpha + \gamma\text{CON}_{it} + \boldsymbol{\beta}\mathbf{X}_{it} + \mu_t + \varepsilon_{it}, \quad (1)$$

$$\text{Ln ASC}_{it} = \nu + \lambda\text{ASC-CON}_{it} + \rho\mathbf{X}_{it} + \mu_\text{t} + \eta_{it}. \quad (2)$$

In the first model, we are interested in the impact of having any CON laws in the state on the number of hospitals. In this model, the CON variable is an indicator variable equal to 1 if there is a CON law in place in states i in year t. For equation (1) we estimate two specifications for our dependent variable. In one specification the dependent variable is the natural logarithm of the number of hospitals per 100,000 population in state i in year t. In the other specification, it is the corresponding natural logarithm of the number of rural hospitals per 100,000 rural state population.

In the second model, we consider the impact of CON laws that regulate ASCs on the number of ambulatory surgical centers. In equation (2), the ASC-CON variable is a binary indicator equal to 1 if the state has a CON law that regulates ASCs in a given year and 0 otherwise. Similarly to what we did for equation (1), for equation (2) we estimate two specifications for our dependent variable. In one case, the specification of the dependent variable is the natural logarithm of the number of ambulatory surgical centers per 100,000 state population. In the other specification, it is the natural logarithm of the number of ambulatory surgical centers per 100,000 rural state population.

For both equation (1) and equation (2), we will estimate various versions of these regressions, starting with a simple bivariate model. In other version, we add different sets of control variables. This approach allows us to assess the sensitivity of the point estimate that is of most of interest to us, that is, the estimated coefficient on CON requirements, with respect to adding or dropping control variables.

The vector **X** includes the aforementioned control variables. We include variables for year fixed effects, μ_t, and cluster the standard errors by states.

VI. Results

Before estimating equations (1) and (2), we show the estimated relationship between the presence of a CON program and the number of total hospitals per 100,000 state population by year (figure 3, page 28). These estimates come from a bivariate regression with our hospital measure on the left hand side of the equation and a dummy variable for states with CON regulations on the right hand side, plus an intercept. We estimate this regression for each year, using all states in each year. We plot these results in figure 3 to test whether we observe the hypothesized negative relationship between CON laws and the number of hospitals, both when not including control variables and when considering each year separately. Examining estimates on a yearly basis also allows us to determine whether CON laws have any negative cumulative effects on the number of hospital providers.

The dots in figure 3 show the point estimates and the whiskers show the corresponding 95 percent confidence intervals. Figure 3 shows a slight negative relationship in the number of hospitals per 100,000 state population in a state with a CON program relative to states without a CON program, although the relationship is not statistically significant. Given that the confidence interval contains zero for all years included, without controlling for any other factors, this approach provides no evidence that the presence of a CON program is associated with a statistically significant lower number of hospitals. Nonetheless, all point estimates are negative, as hypothesized.

Figure 4 (page 28) presents point estimates and confidence intervals from a bivariate regression of CON programs and rural hospitals. The plots show a statistically significant negative correlation in the number of rural hospitals per 100,000 rural population and CON programs. This negative correlation is consistent across all years.

The sum of the evidence in figure 4 suggests that CON programs are not associated with more rural hospitals in rural areas. In fact, CON programs are associated with fewer rural hospitals in all states. Moreover, and interestingly, the point estimates in figure 4 are larger in absolute value than the point estimates in figure 3. This suggests that CON programs have an even more negative effect on the number of hospitals in rural areas in a state than they do on the overall number of hospitals in the same state.

Figures 5 and 6 (page 29) are based on the same methodology as the previous two figures. Now the dependent variable is the number of ASCs in a state (figure 5) and the number of ASCs in rural areas in the same state (figure 6). Both figures 5 and 6 show a negative correlation between ASC-specific CON programs and the total number of ASCs per 100,000 state population, as well as rural ASCs per 100,000 rural population. Further, absolute value of these negative correlations increases over time. Moreover, toward the end of our sample period, this negative correlation appears to be about 20 percent larger for rural ASCs (figure 6) than for all ASCs (figure 5), suggesting that the reduction in ASCs in rural areas is larger than the reduction in ASCs in a state overall.

Table 2 (page 30) shows estimates for the effect of the presence of a CON program on the log of the number of hospitals per 100,000 population for an entire state. All specifications reported in table 2, as well as the subsequent tables, have standard errors clustered by state. The results show that the estimated coefficients on CON are negative and statistically significant across all specifications. This indicates that the presence of a CON program is correlated with fewer hospitals across a state. When controlling for demographics and year-specific effects, we find that the presence of a CON program is associated with 30 percent ($1-\exp(-.35)$) fewer hospitals per capita across an entire state (table 2, column 4).

Table 3 (page 31) shows estimates for the effect of the presence of a CON program on the number of rural hospitals within a state. These point estimates on the CON variable are similar to those in table 2. Again, the estimated coefficients on the CON measures are negative across all specifications and are statistically significant. In particular, when controlling for demographics and year-specific effects, the presence of a CON program is associated with 30 percent ($1-\exp(-.36)$) fewer rural hospitals per 100,000 rural population (table 3, column 4).

Tables 4 and 5 (pages 32–33) show estimates for the effect of ASC-specific CON requirements on the number of all ASCs per 100,000 state population, and rural ASCs per 100,000 rural population for an entire state. Table 4 shows estimates for the effect of ASC-specific CON requirements on the total number of ASCs in a state. Our findings are consistent with the findings reported above in that our coefficients of interest—state ASC CON laws—are negative and statistically significant across all specifications. We estimate that the presence of an ASC-specific CON requirement within a state is associated with 14 percent $(1-\exp(-.156))$ fewer total ASCs per capita when controlling for demographics and year-specific effects (table 4, column 4).

Table 5 shows estimates for the effect of ASC-specific CON requirements on the total number of rural ASCs per 100,000 rural population per state. As in table 4, the estimated coefficients for ASC-specific CON requirements are negative and statistically significant across all specifications. When controlling for demographics and year-specific effects, ASC-specific CON requirements are associated with 13 percent $(1-\exp(-.135))$ fewer rural ASCs per 100,000 rural population.

Overall, these findings show that states with CON programs have fewer total hospitals and fewer rural hospitals. Further, these findings show that states with ASC-specific CON requirements have fewer total ASCs and fewer rural ASCs.

VII. Discussion

As we noted in our introduction, a number of states continue to implement CON programs with an expressed purpose of protecting access to health care in rural communities by protecting community hospitals from competition. If this is an effective tool, however, we predict that we would find more rural hospitals in those states that regulate entry of ASCs. Our findings demonstrate that is not the case.

Our findings do show that ASC CON programs are effective barriers to entry into rural communities for hospital substitutes. The data show that the presence of an ASC-specific CON requirement is correlated with approximately 14 percent fewer ASCs compared to states without a CON program. This finding suggests that ASC CON programs act as a significant barrier for new alternatives to compete with established rural hospitals.

However, even though we find that CON requirements are associated with fewer ASCs in rural areas, this barrier to entry does not seem to protect rural access to health care as measured by the number of rural community hospitals. Specifically, while the presence of a CON program is associated with fewer "hospital substitutes" in rural communities, it is also associated with 30 percent fewer rural hospitals. This suggests that CON programs are limiting both hospitals and hospital substitutes.

The cream-skimming hypothesis predicts that the entry of new nonhospital providers, such as ASCs, and other hospital substitutes leads to fewer hospitals over time. According to this hypothesis, this happens because nonhospitals will siphon off the more profitable patients and procedures, and consequently hospitals will have lower revenues and less ability to cross-subsidize charity care and other essential services.

If the anti–cream-skimming justification for CON requirements is correct, then we expect to find a higher number of hospitals in states with a CON program versus those without. However, the data show that this is not the case. The regression results show that there are 30 percent fewer total hospitals per capita in states with a CON program when compared to those that do not have a CON program.

Moreover, our findings are also not consistent with the claim that CON programs protect access to health care in rural areas. In particular, as a tool for protecting rural health care, our findings suggest that these CON programs have failed. CON requirements are associated with fewer rural hospitals and rural ASCs. While CON programs may be viewed as a protective measure to ensure access in rural communities, the data show otherwise.

There are two limitations to this study. First, while we are able to present correlations, we do not have an identification strategy that would allow us to provide any causal interpretation to our results. Second, while we use community hospitals and ASCs per 100,000 population as the measure of access to health care, this may not fully capture all options available to those seeking care in rural communities.

VIII. Conclusion

Twenty-six states limit the entry of ASCs into their healthcare markets. These restrictions have been justified on a number of grounds, including protecting access to health care in rural communities by protecting hospitals from cream-skimming. If these claims are correct, then we expect to find both more hospitals per capita and more rural hospitals in states that restrict entry and competition through a CON program.

Our findings show that the opposite is true. We find that states with a CON program have fewer total and fewer rural hospitals per capita. We estimate that, when controlling for demographics and year-specific effects, the presence of a CON program is associated with 30 percent fewer total hospitals per 100,000 state population and 30 percent fewer rural hospitals per 100,000 rural population. Moreover, we find 14 percent fewer total ASCs per 100,000 state population and 13 percent fewer rural ASCs per 100,000 rural population. These findings suggest that CON programs do not protect access in rural healthcare markets. Policymakers looking to protect rural health care may want to look elsewhere.

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Table 1. Summary Statistics from State Annual Data, 1984–2011

Panel A. Summary Statistics for All States

Variables	(1) N	(2) Mean	(3) Std. dev.	(4) Min	(5) Max
State certificate-of-need regulation (yes = 1)	1,400	0.759	0.428	0	1
State ASC certificate-of-need regulation (yes = 1)	1,400	0.500	0.500	0	1
Black percentage	1,400	0.100	0.0939	0.00243	0.372
White percentage	1,400	0.809	0.133	0.227	1.005
Hispanic percentage	1,400	0.0729	0.0873	0.00472	0.467
Elderly percentage (65 and over)	1,400	0.119	0.0203	0.00651	0.187
Youth percentage (under 18)	1,400	0.256	0.0264	0.0707	0.379
Unemployment rate (seasonally adjusted)	1,400	5.739	1.945	2.300	14.77
Population (logged)	1,400	15.02	1.011	13.03	17.44
Adults diagnosed diabetes and lung cancer percentage (18+, age adjusted, logged)	1,400	4.326	0.237	3.296	4.877
Hospitals per 100,000 state population	1,400	3.112	1.728	1.045	10.39
Hospitals per 100,000 state population (logged)	1,400	1.008	0.490	0.0436	2.341
Rural hospitals per 100,000 rural population	1,400	4.850	4.167	0	17.00
Rural hospitals per 100,000 rural population (logged)	1,400	1.522	0.718	0	2.890
ASCs per 100,000 state population	1,400	1.018	0.905	0	6.312
ASCs per 100,000 state population (logged)	1,400	0.623	0.382	0	1.990
Rural ASCs per 100,000 rural population	1,400	0.488	0.671	0	5.107
Rural ASCs per 100,000 rural population (logged)	1,400	0.326	0.351	0	1.810

Panel B. Summary Statistics for States with and without a Certificate-of-Need Program

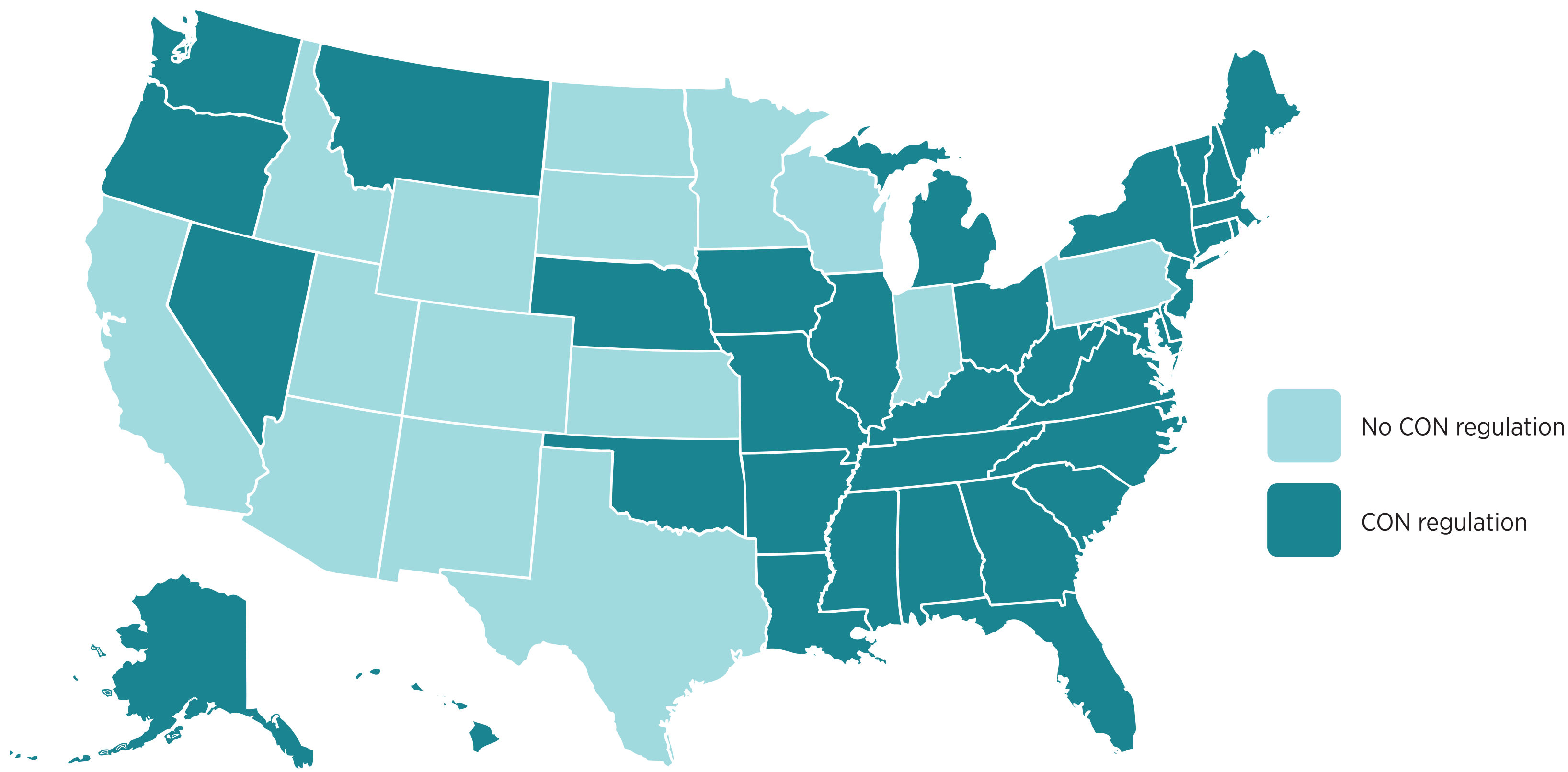
	CON law			No CON law		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	N	Mean	Std. dev.	N	Mean	Std. dev.
Black percentage	1,062	0.117	0.098	338	0.047	0.515
White percentage	1,062	0.803	0.133	338	0.825	0.132
Hispanic percentage	1,062	0.051	0.050	338	0.141	0.133
Elderly percentage (65 and over)	1,062	0.121	0.201	338	0.113	0.018
Youth percentage (under 18)	1,062	0.251	0.024	338	0.272	0.028
Unemployment rate (seasonally adjusted)	1,062	5.845	1.948	338	5.407	1.900
Population (logged)	1,062	15.03	0.946	338	14.99	1.195
Adults diagnosed diabetes and lung cancer percentage (18+, age adjusted, logged)	1,062	4.376	0.210	338	4.168	0.247
Hospitals per 100,000 state population	1,062	2.908	1.545	338	3.754	2.084
Hospitals per 100,000 state population (logged)	1,062	0.952	0.465	338	1.181	0.526
Rural hospitals per 100,000 rural population	1,062	4.069	3.724	338	7.307	4.520
Rural hospitals per 100,000 rural population (logged)	1,062	1.383	0.703	338	1.960	0.576
ASCs per 100,000 state population	1,062	0.912	0.901	338	1.348	0.836
ASCs per 100,000 state population (logged)	1,062	0.569	0.375	338	0.792	0.355
Rural ASCs per 100,000 rural population	1,062	0.378	0.556	338	0.832	0.859
Rural ASCs per 100,000 rural population (logged)	1,062	0.264	0.313	338	0.522	0.390

Panel C. Summary Statistics for States with and without an Ambulatory Surgical Center Certificate-of-Need Requirement

	ASC-CON law			No ASC-CON law		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	N	Mean	Std. dev.	N	Mean	Std. dev.
Black percentage	699	0.077	0.079	701	0.123	0.102
White percentage	699	0.819	0.129	701	0.798	0.137
Hispanic percentage	699	0.096	0.111	701	0.050	0.047
Elderly percentage (65 and over)	699	0.118	0.023	701	0.120	0.017
Youth percentage (under 18)	699	0.263	0.031	701	0.250	0.018
Unemployment rate (seasonally adjusted)	699	5.652	1.886	701	5.827	5.827
Population (logged)	699	15.01	1.064	701	15.03	0.957
Adults diagnosed diabetes and lung cancer percentage (18+, age adjusted, logged)	699	4.270	0.267	701	4.382	0.187
Hospitals per 100,000 state population	699	3.582	1.953	701	2.643	1.313
Hospitals per 100,000 state population (logged)	699	1.143	0.510	701	0.873	0.429
Rural hospitals per 100,000 rural population	699	6.131	4.590	701	3.574	3.229
Rural hospitals per 100,000 rural population (logged)	699	1.749	0.684	701	1.297	1.297
ASCs per 100,000 state population	699	1.115	0.784	701	0.921	1.003
ASCs per 100,000 state population (logged)	699	0.683	0.362	701	0.563	0.392
Rural ASCs per 100,000 rural population	699	0.597	0.739	701	0.378	0.575
Rural ASCs per 100,000 rural population (logged)	699	0.391	0.371	701	0.261	0.317

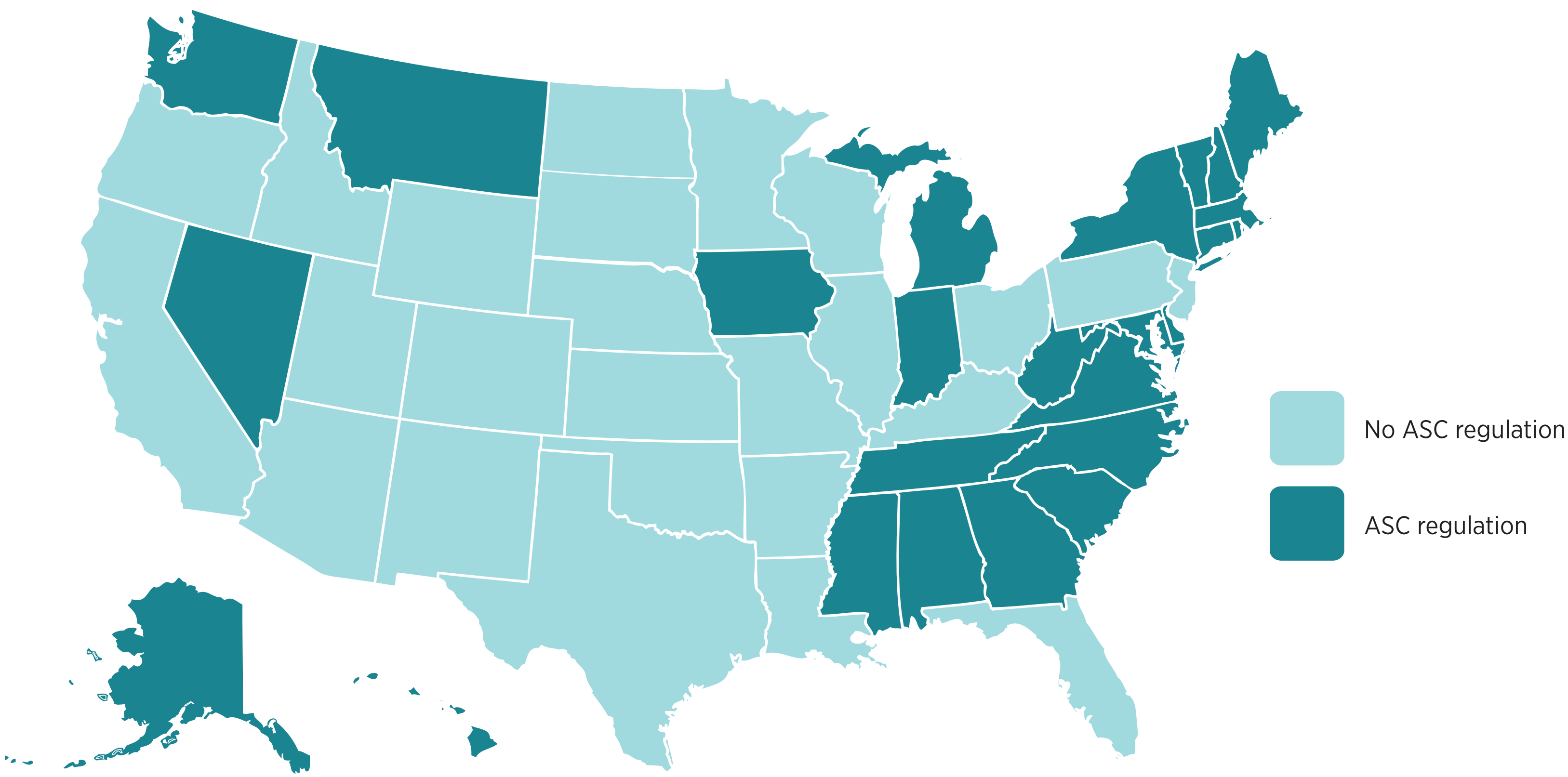
Note: ASC = ambulatory surgical center, CON = certificate of need.

Figure 1. Certificate-of-Need (CON) Regulation in the United States



Source: "Certificate of Need: State Health Laws and Programs," National Conference of State Legislatures, January 2016, http://www.ncsl.org/research/health/con-certificate-of-need-state-laws.aspx.

Figure 2. Certificate-of-Need Requirements for Ambulatory Surgical Centers (ASCs) by State



Source: "Certificate of Need: State Health Laws and Programs," National Conference of State Legislatures, January 2016, http://www.ncsl.org/research/health/con-certificate-of-need-state-laws.aspx.

Figure 3. Relationship between Certificate-of-Need (CON) Programs and Total Hospitals per 100,000 Population, by Year

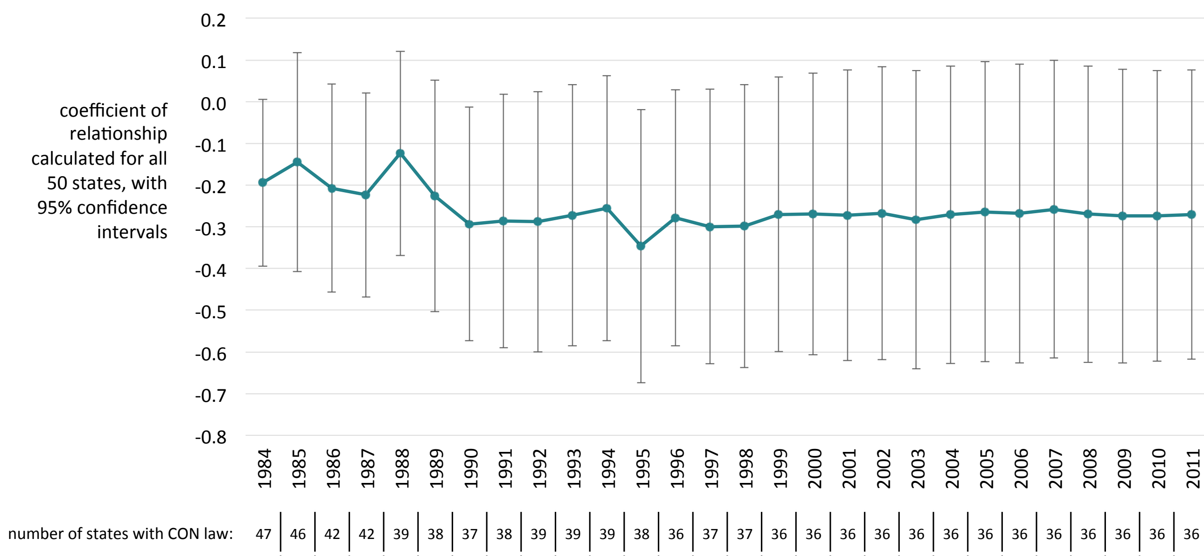


Figure 4. Relationship between Certificate-of-Need (CON) Programs and Rural Hospitals per 100,000 Rural Population, by Year

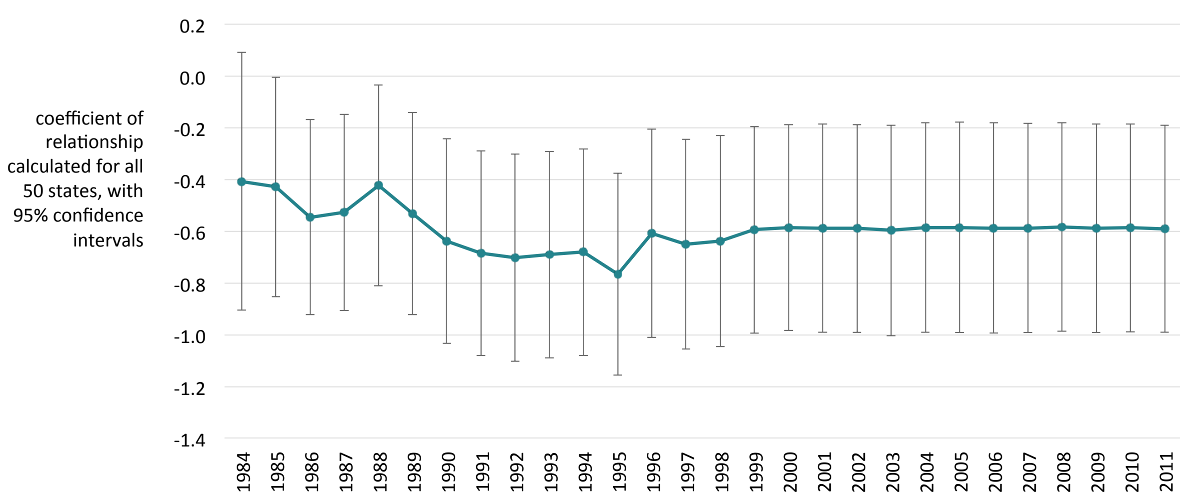


Figure 5. Relationship between Ambulatory Surgical Center Certificate-of-Need (CON) Requirements and Ambulatory Surgical Centers per 100,000 Population, by Year

Figure 6. Relationship between Ambulatory Surgical Center Certificate-of-Need (CON) Requirements and Rural Ambulatory Surgical Centers per 100,000 Rural Population, by Year

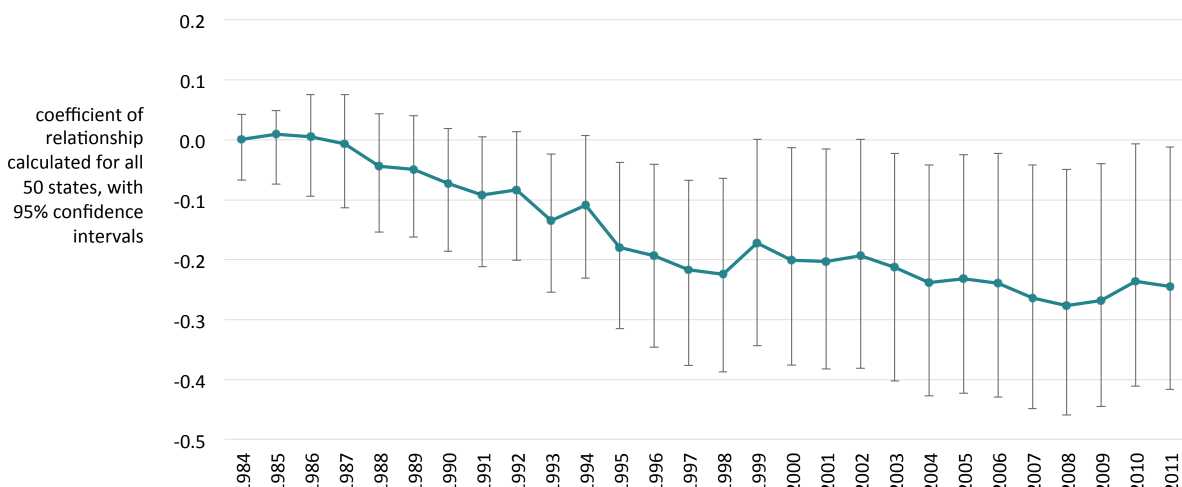


Table 2. Determinants of Number of Hospitals per 100,000 Population per State

	(1)	(2)	(3)	(4)
State certificate-of-need regulation (yes = 1)	−0.265*	−0.247**	−0.338***	−0.350***
	(0.146)	(0.108)	(0.110)	(0.106)
Population (logged)		−0.264***	−0.209***	−0.192**
		(0.054)	(0.075)	(0.074)
Elderly percentage (65 and over)			2.766	−2.594
			(2.722)	(3.341)
Youth percentage (under 18)			3.017	6.330**
			(3.243)	(2.850)
Unemployment rate (seasonally adjusted)			0.009	−0.018
			(0.026)	(0.027)
White percentage			0.188	−0.170
			(0.333)	(0.308)
Hispanic percentage			−1.623**	−1.466**
			(0.713)	(0.622)
Black percentage			−0.049	−0.977
			(0.798)	(0.771)
Adults diagnosed diabetes and lung cancer percentage (18+, age adjusted, logged)				0.929***
				(0.296)
Observations	1,400	1,400	1,400	1,400
R^2	0.110	0.404	0.493	0.537
Year fixed effects	yes	yes	yes	yes

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Note: The dependent variable in these regressions is the log of the number of hospitals per 100,000 population per state. Clustered standard errors at the state level are in parentheses.

Table 3. Determinants of Number of Rural Hospitals per 100,000 Population per State

	(1)	(2)	(3)	(4)
State certificate-of-need regulation (yes = 1)	−0.600***	−0.579***	−0.355*	−0.363*
	(0.177)	(0.140)	(0.182)	(0.181)
Population (logged)		−0.314***	−0.143	−0.132
		(0.090)	(0.125)	(0.124)
Elderly percentage (65 and over)			−3.038	−6.464
			(4.238)	(5.435)
Youth percentage (under 18)			8.052*	10.169**
			(4.729)	(4.613)
Unemployment rate (seasonally adjusted)			−0.015	−0.033
			(0.039)	(0.041)
White percentage			−0.694**	−0.922**
			(0.335)	(0.411)
Hispanic percentage			−1.964*	−1.864*
			(1.126)	(1.084)
Black percentage			−2.789**	−3.382***
			(1.178)	(1.200)
Adults diagnosed diabetes and lung cancer percentage				0.594
(18+, age adjusted, logged)				(0.455)
Observations	1,400	1,400	1,400	1,400
R^2	0.129	0.322	0.448	0.457
Year fixed effects	yes	yes	yes	yes

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Note: The dependent variable in these regressions is the log of the number of rural hospitals per 100,000 rural population per state. Clustered standard errors at the state level are in parentheses.

Table 4. Determinants of Number of Ambulatory Surgical Centers per 100,000 Population per State

	(1)	(2)	(3)	(4)
ASC-specific certificate-of-need requirement (yes = 1)	−0.159**	−0.159**	−0.158**	−0.156**
	(0.063)	(0.063)	(0.059)	(0.059)
Population (logged)		−0.023	−0.053	−0.051
		(0.029)	(0.041)	(0.041)
Elderly percentage (65 and over)			−0.242	−0.922
			(1.220)	(1.677)
Youth percentage (under 18)			0.899	1.336
			(0.679)	(0.991)
Unemployment rate (seasonally adjusted)			−0.001	−0.004
			(0.016)	(0.015)
White percentage			0.012	−0.032
			(0.167)	(0.160)
Hispanic percentage			0.339	0.366
			(0.587)	(0.615)
Black percentage			0.617	0.497
			(0.492)	(0.551)
Adults diagnosed diabetes and lung cancer percentage				0.117
(18+, age adjusted, logged)				(0.189)
Observations	1,400	1,400	1,400	1,400
R^2	0.503	0.507	0.530	0.531
Year fixed effects	yes	yes	yes	yes

** $p < 0.05$.

Note: The dependent variable in these regressions is the log of the number of ambulatory surgical centers (ASCs) per 100,000 population per state. Clustered standard errors at the state level are in parentheses.

Table 5. Determinants of Number of Rural Ambulatory Surgical Centers per 100,000 Population per State

	(1)	(2)	(3)	(4)
ASC-specific certificate-of-need requirement (yes=1)	−0.157**	−0.156***	−0.137**	−0.135**
	(0.060)	(0.053)	(0.057)	(0.056)
Population (logged)		−0.092***	−0.078*	−0.076*
		(0.034)	(0.043)	(0.044)
Elderly percentage (65 and over)			0.788	0.026
			(1.702)	(1.943)
Youth percentage (under 18)			0.445	0.934
			(1.065)	(1.267)
Unemployment rate (seasonally adjusted)			−0.009	−0.013
			(0.014)	(0.015)
White percentage			−0.468*	−0.516**
			(0.236)	(0.247)
Hispanic percentage			−0.130	−0.101
			(0.408)	(0.401)
Black percentage			−0.586	−0.720
			(0.495)	(0.529)
Adults diagnosed diabetes and lung cancer percentage (18+, age adjusted, logged)				0.131
				(0.164)
Observations	1,400	1,400	1,400	1,400
R^2	0.354	0.423	0.447	0.449
Year fixed effects	yes	yes	yes	yes

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Note: The dependent variable in these regressions is the log of the number of rural ambulatory surgical centers (ASCs) per 100,000 rural population per state. Clustered standard errors at the state level are in parentheses.