Are Certificate-of-Need Laws Barriers to Entry?

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

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January 2016

MERCATUS WORKING PAPER

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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, January 2016.

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Largely because no evidence indicated that CON curtailed healthcare costs, the federal government repealed national CON requirements for many services in 1987, leaving regulation of certificate-of need-programs to individual states.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

[2] The measurement of the dependent variable in the form of $\log(x + c)$ 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

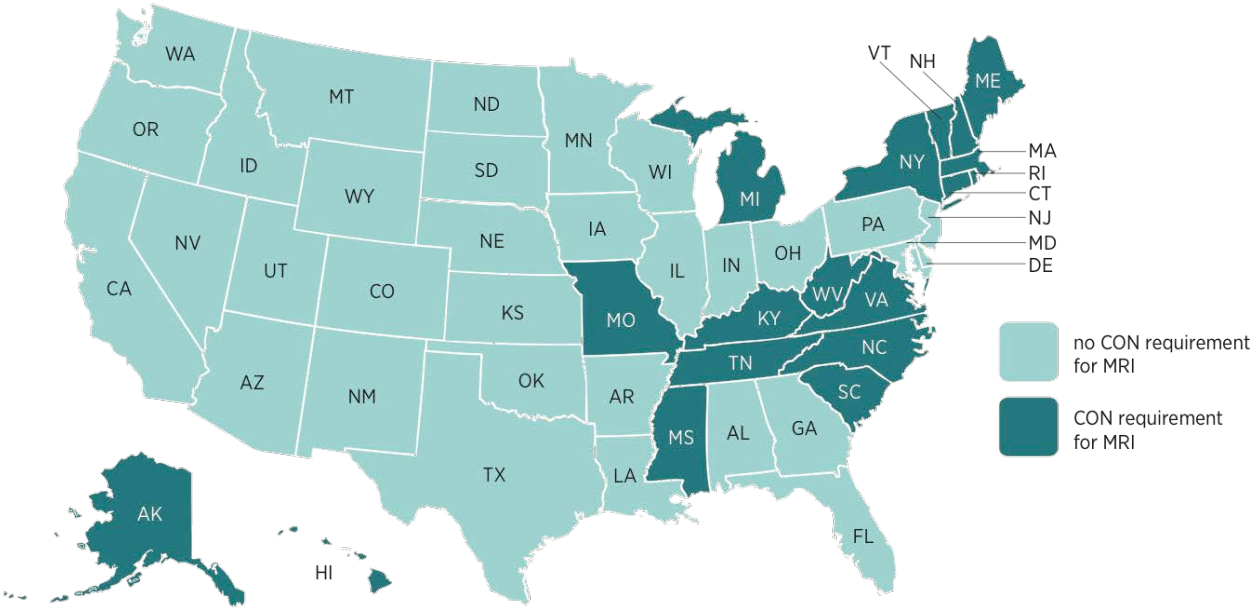

Figure 2. Certificate-of-Need (CON) Requirements for CT Services by State

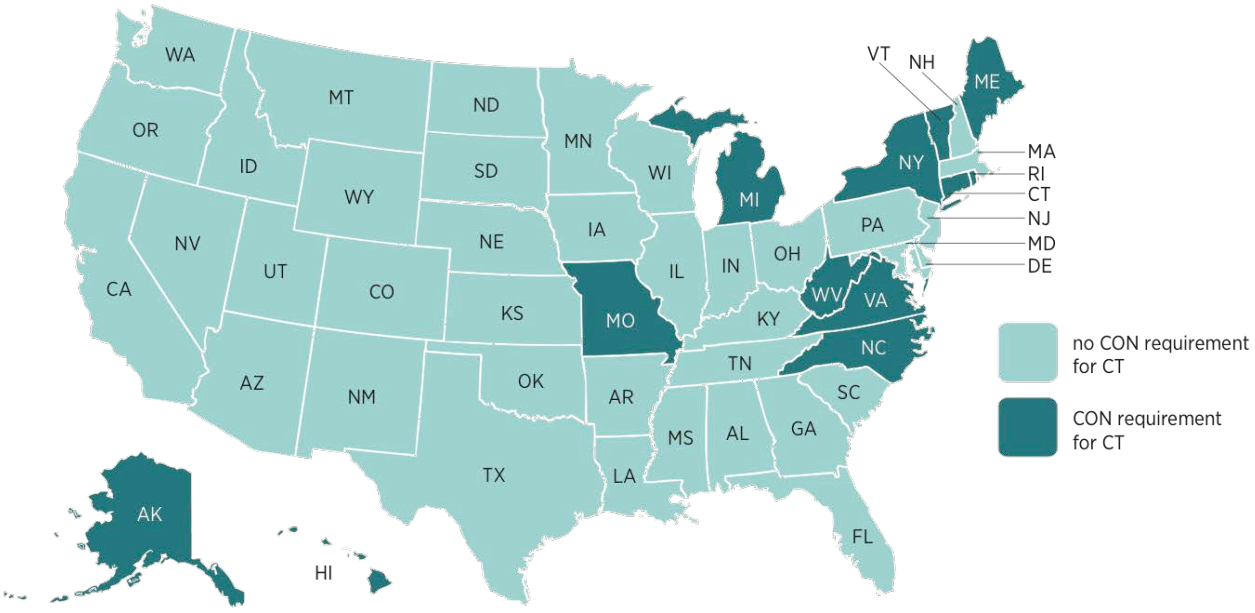

Figure 3. Certificate-of-Need (CON) Requirements for PET Services by State

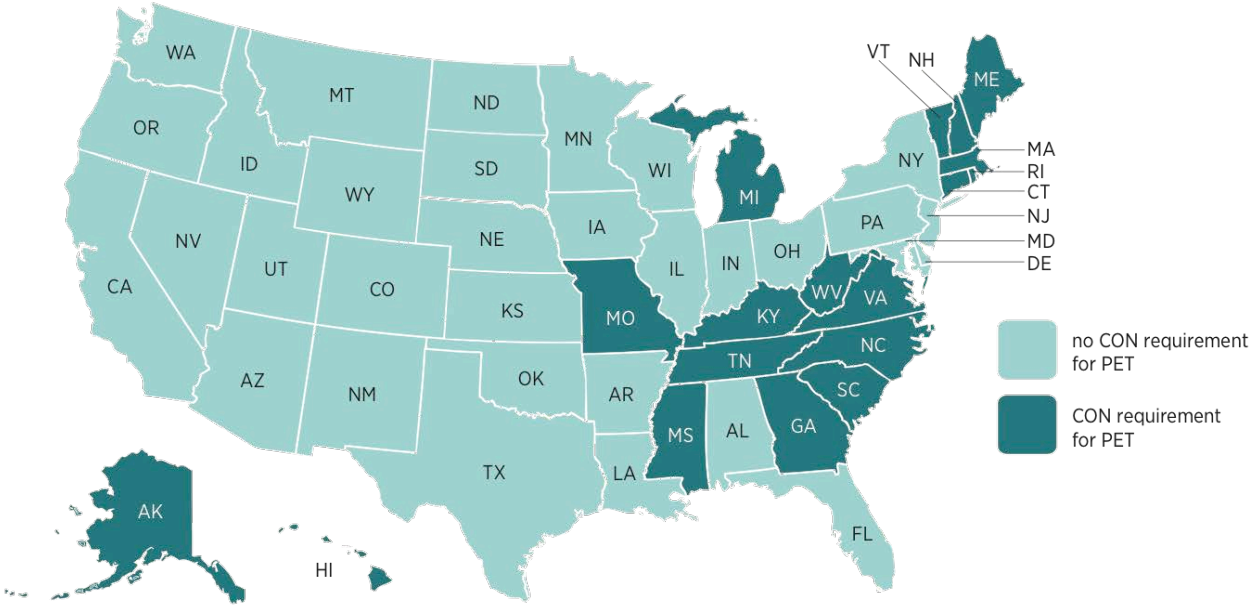

Table 1. Summary Statistics

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.