MERCATUS WORKING PAPER

THE IMPACT OF DEREGULATION ON LONG-TERM ACUTE CARE HOSPITALS

EVIDENCE FROM CERTIFICATE-OF-NEED REPEALS

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SUGGESTED CITATION

Markus Bjoerkheim and Ali Melad, "The Impact of Deregulation on Long-Term Acute Care Hospitals: Evidence from Certificate-of-Need Repeals," Mercatus Working Paper, Mercatus Center at George Mason University, January 2025.

ABSTRACT

Demographic shifts are making healthcare access increasingly crucial for the elderly, but regulatory barriers, such as certificate-of-need (CON) laws, prevent the entry of new providers. This study examines the impact of the repeal of CON laws in 10 states on access to long-term acute care hospitals (LTACs). Using staggered difference-in-difference estimators, we show that repealing CON laws causes an increase of 6.3 LTACs per million elderly, or approximately 69 percent, relative to the sample mean. In contrast to existing research, which finds that LTACs are primarily cost-increasing institutions, we find that the entry of LTACs into nursing home markets leads to reduced hospitalization rates and to reduced falls in skilled nursing facilities, indicating that LTACs serve an important role in long-term care markets.

METADATA

JEL Classification: I11, I180, L510

Keywords: deregulation, long-term care hospitals, certificate of need, healthcare regulation

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The Impact of Deregulation on Long-Term Acute Care Hospitals

Evidence from Certificate-of-Need Repeals

1. Introduction

A century ago, only 5 percent of Americans were senior citizens (65 years and older). Today, that figure is estimated to be nearly 16.7 percent (one in six), and by 2050, it is projected that more than 20 percent (one in five) of Americans will be elderly (Caplan 2023). This demographic shift poses a challenge: How can adequate access to healthcare be provided for a growing population with extensive and increasingly specialized healthcare needs? One barrier to this access is regulatory: 35 states restrict entry and expansion of healthcare facilities through certificate-of-need (CON) laws. Since the 1980s, several states have eliminated CON laws either completely or partially; however, CON programs for long-term care services have been a notable exception, and these programs remain in place despite the growing healthcare needs of an aging population (NCSL 2024). The absence of CON repeal in this area has made it challenging to estimate the causal effects of CON programs on long-term healthcare services, and thus the effects on access to care are not well understood.

One area of long-term care services that has been deregulated is the entry of long-term acute care hospitals (LTACs). The LTAC is a unique type of healthcare institution that is not found outside the United States (Einav, Finkelstein, and Mahoney 2023).[1] LTACs were created as a purely regulatory—not medical—construct from a loophole included in payment reforms in the 1980s that shielded about 40 former tuberculosis hospitals from the shift to a prospective payment system. The presence of LTACs has since grown 10-fold, and their unique regulatory and institutional aspects have sparked research into provider incentives, strategic discharges, and healthcare waste.

This paper studies the staggered repeal of CONs for LTACs in 10 states to estimate the causal effect on the number of facilities and the number of available certified beds. Using staggered difference-in-difference estimators, we find that the repeal of CON laws causes an increase of approximately 6.3 LTACs per million elderly and an increase of 558 certified beds per million elderly.[2] We generally estimate larger increases in states without other entry barriers.

Recent research has consistently found LTACs to be cost-increasing institutions. Several studies have found that patients treated in LTACs do not have lower mortality rates compared with those treated in skilled nursing facilities (SNFs) (Einav, Finkelstein, and Mahoney 2023). In addition, Eliason et al. (2018) and Einav, Finkelstein, and Maloney (2018) have found that hospitals strategically discharge patients to LTACs to procure more Medicaid reimbursement, with no measurable health benefits when measured by mortality. This finding creates a compelling case to replace LTACs with SNFs to reduce healthcare costs because the United States already spends 50 percent more on healthcare than does any other country in the Organisation for Economic Co-operation and Development (Anderson et al. 2005). CON repeal causes a substantial increase in LTAC entry; thus CON repeal could increase costs without improving health outcomes. One caveat is that existing studies have exclusively measured health benefits using mortality.

[1] The literature uses several different acronyms interchangeably to describe long-term acute care hospitals, including LTACs, LTCHs, and LTACHs (pronounced “el-tacks”). For simplicity, the authors use LTAC throughout the paper.

[2] Although a study by Kahn et al. (2012) looked at factors associated with LTAC utilization, of which CON was one of many variables included, no studies have investigated the causal impact of CON laws on access to, or entry of, LTACs.

To investigate this question in more detail, we therefore estimate the effects of LTAC entry into nursing home markets using patient outcomes. In contrast to the existing literature, we find that after LTAC entry into a market, the 30-day SNF rehospitalization rate decreased by about 1 percentage point, corresponding to an approximate 5.9 percent relative reduction in rehospitalizations. We also find evidence that fewer residents experience falls with injury. In general, our findings are consistent across a host of specifications, including controls for population health, economic indicators, and the share of elderly in the state. We obtain similar findings using various aggregation methods and control groups. These findings suggest that the entry of LTACs complements existing nursing facilities, likely by treating high-acuity patients.

Our findings also contribute to a growing literature on the causal effects of CON programs. Existing research finds CON repeal causes an increase in access to hospitals (Melo et al. 2024), to surgeries and hospital services (Cutler, Huckman, and Kolstad 2010; Perry 2017), and to ambulatory surgical centers (Stratmann, Bjoerkheim, and Koopman 2024; Yu 2023). Moreover, a comprehensive review of the literature by Mitchell (2024) found that a CON is correlated not only with reduced access, but also with lower quality.

This paper is organized as follows. Section 2 provides a detailed policy background and reviews related literature. Section 3 describes the identification strategy, data, summary statistics, and estimation methods. Section 4 presents the results and discusses how we dealt with heterogeneity issues. Section 5 investigates the impact of LTAC entry on rehospitalization rates, restraint use, and falls for SNF residents. Section 6 concludes with policy implications of our findings and avenues for future research.

2. Policy Background and Related Literature

This section lays out the institutional setting and existing literature on LTACs, with a focus on changes in the regulatory environment, including certificate-of-need laws, and other entry barriers, such as moratoriums and Section 1122 waivers, as well as federal reimbursement policies.

2.1 Long-term care hospitals and CONs

Policymakers have used CON laws and other supply restrictions such as moratoriums since the 1960s. New York was the first state to implement CON-type laws in 1964 to regulate the expansion of healthcare facilities. By 1972, this policy had spread to nearly 20 states because of Section 1122 of the 1972 Social Security Amendments, which withheld federal Medicare and Medicaid reimbursement if states did not have certification reviews for healthcare projects with capital expenditure of more than $100,000, addition in bed capacity, or substantial change in service (Bicknell and Walsh 1976; Coyte 1987; Dorsey 1973).

Congress passed the National Health Planning and Resources Development Act of 1974 (NHPRDA), which enhanced the requirements for CON programs and linked federal healthcare funding and reimbursement to the adoption of the act by the states.[3] These state CON laws required healthcare facilities to demonstrate a need for the services they proposed to offer in their intended operating areas. The act aimed to contain healthcare costs and improve regional healthcare planning (Simpson 1985). NHPRDA, along with Section 1122, led to an increase in the number of CON states to 46 by 1975.

The first LTACs can be traced to 1982 with the passing of the Tax Equity and Fiscal Responsibility Act (TEFRA), which aimed to lower healthcare spending by introducing a

[3] National Health Planning and Resources Development Act, Pub. L. No. 93-641, 88 Stat. 2225 (1975).

fixed payment system.[4] Under this new system, payments were determined using the patient's diagnostic related group at a fixed amount, a process that moved away from the previous length-of-stay payment model. This shift presented a financial challenge for approximately 40 hospitals in the United States specializing in chronic diseases, where patient stays were inherently prolonged because of medical complications.

To mitigate this challenge, an exemption was introduced that allowed hospitals with an average stay exceeding 25 days to retain the per diem billing model. Initially, no regulations specified the type of care LTACs provide; to qualify for reimbursement, an LTAC facility was expected to maintain an average length of stay of 25 days or more (MedPAC 2018). This exemption laid the groundwork for the establishment and classification of the original LTACs (Einav, Finkelstein, and Mahoney 2023). CON laws affected LTACs because providers had to demonstrate the necessity for establishing new facilities. The per diem payment system had the unintended consequence of creating a whole new sector of hospitals because it gave providers an incentive to establish more facilities, which fueled increased admissions of patients to LTACs.

The landscape changed in 1986 when the National Health Planning and Resources Development Act was repealed as a result of concerns that CON laws had not been effective in reducing costs, had led to reduced access to healthcare services, or both (Anderson et al. 2005; Ford and Kaserman 1993). Following the federal repeal, 12 states had repealed almost all their CON laws leading into the early 1990s.[5] Over the next three decades, many states repealed their CON programs either completely or specifically for LTACs (Ohlhausen 2015).

The proliferation of LTACs—often referred to as hospitals within hospitals—led to ballooning costs because these facilities are reimbursed at three times the cost of SNFs (Einav, Finkelstein, and Mahoney 2018). LTACs are close substitutes for SNFs; Einav, Finkelstein, and Mahoney (2023) show that 80 percent of LTAC patients would otherwise receive treatment at SNFs. To address the rising costs associated with LTACs, a series of policies were introduced over the past three decades. Following TEFRA, the first significant regulatory changes were the Balanced Budget Act of 1997 and the Balanced Budget Refinement Act of 1999.[6] These acts transitioned LTAC payments to a prospective payment system, under which LTACs received a fixed sum once a patient stayed beyond a predetermined length of time.

In the early 2000s, several federal moratoriums were enacted to limit the expansion of specialized hospitals, including LTACs. The 2003 Medicare Prescription Drug, Improvement, and Modernization Act introduced an 18-month federal moratorium on the development of specialty hospitals.[7] This regulatory effort was succeeded in 2007 by a three-year moratorium on the construction and expansion of LTACs, implemented by the Centers for Medicare and Medicaid Services (CMS) (Hamilton 2008). A subsequent federal moratorium was in place from 2014 to 2017 (Hamilton 2014).[8]

These policies aimed to control escalating expenses; however, the structure of this lump-sum payment inadvertently incentivized LTACs to retain patients until they reached the "minimum discharge date" stipulated by the new guidelines. Consequently, many LTACs would discharge patients shortly after that date to secure the substantial payment (Einav, Finkelstein, and Mahoney 2018, 2023; Eliason et al. 2018; Kim et al. 2015). According to

[4] Tax Equity and Fiscal Responsibility Act, Pub. L. No. 97-248, 96 Stat. 324 (1982).

[5] Indiana reinstated its CON laws in 2018. Wisconsin repealed and reinstated its CON laws several times. Arizona and New Mexico retained CONs for ambulance services through transportation statutes.

[6] Balanced Budget Act of 1997, Pub. L. No. 105-33; Balanced Budget Refinement Act of 1999 (incorporated into the Consolidated Appropriations Act, 2000, Pub. L. No. 106-113).

[7] Medicare Prescription Drug, Improvement, and Modernization Act of 2003, Pub. L. No. 108-173.

[8] 42 C.F.R. § 412.534 (2014).

Einav, Finkelstein, and Mahoney (2023), this practice by providers is the reason the average length of stay at LTACs is 26 days.

Today there are more than 350 long-term care hospitals in the United States that account for almost $4 billion per year in Medicaid spending (MedPAC 2021). These hospitals are part of post-acute care (PAC). In PAC settings, patients are cared for while transitioning from acute care, such as while recovering from major surgeries. PAC encompasses a range of services including those provided by LTACs, SNFs, home health agencies, and inpatient rehabilitation facilities (MedPAC 2015).

2.2 Related literature

Einav, Finkelstein, and Mahoney (2023) use an event study to observe the impact on patient outcomes of entry to long-term acute care hospitals in long-term care markets. The results of their study indicate that four-fifths of the patients discharged to long-term care hospitals could instead be discharged to SNFs. The study also shows that patients discharged to an LTAC did not have better health outcomes when compared with patients discharged to SNFs. This result was coupled with the fact that LTACs cost significantly more than SNFs and that by replacing LTAC admissions with SNF admissions, Medicare could save $4.5 billion a year with no harm to patients.

Similarly, Einav, Finkelstein, and Mahoney (2018) explore the effects of Medicare's payment incentives on LTACs using a dynamic discrete choice model to analyze discharge behaviors under the current and counterfactual payment systems. Their research reveals that LTACs likely extend patient stays to meet Medicare's payment thresholds as discussed earlier, yet the research finds no significant evidence that this practice reduces patient mortality rates. They also conclude that adopting constant per diem rates or aligning LTAC payments with SNFs could lead to substantial Medicare savings without compromising patient care quality.

Eliason, Finkelstein, and Mahoney (2018) also highlight this strategic discharge practice of LTACs. The study notes that this strategic behavior is more prevalent in for-profit LTACs and in those acquired by large LTAC chains or colocated with other hospitals. Using a dynamic structural model, the authors propose alternative reimbursement schemes, such as a smoothed reimbursement scheme, which reduces the sharp jump in payments at the short-stay outlier threshold. Similar discharge patterns with LTACs were also observed in a study by Kim et al. (2015).

Kahn et al. (2013) use a retrospective cohort design, multivariate analyses, and instrumental variable techniques to conclude that LTAC transfer patients experienced similar survival rates compared with those in continued intensive care unit care, with lower total hospital-related costs but higher overall Medicare payments. However, studies such as those by Koenig et al. (2015) deviate from this perspective when they state that in specific cases, such as prolonged mechanical ventilation, LTAC services are more cost-effective and have lower mortality as compared to traditional care.

While existing literature addresses the costs associated with LTACs and the factors driving their expansion, there remains a notable gap in research specifically exploring the impact of CON laws on LTAC cost containment and growth. In contrast, there is an abundance of studies on the broader implications of CON laws, providing comprehensive insights into their effects on healthcare spending and access and on the overall quality of services provided. In PAC, skilled nursing facilities are the closest substitute to LTACs. Grabowski, Ohsfeldt, and Morrisey (2003) use state-level data for 16 states from 1981 to 1998 in a fixed-effects model to examine the impact of CON repeal on Medicaid expenditures for nursing homes and long-term care. The study concludes that CON laws did not limit nursing home expenditure by limiting nursing home growth, and thus the effectiveness of CON laws is questionable.

Similarly, a paper by Horwitz et al. (2024) adds to this literature by focusing on the effects of CON laws on diagnostic imaging and finds that while CON policies do reduce low-value imaging services, they do not significantly affect high-value care. This finding further suggests that the effectiveness of CON laws can vary widely depending on the healthcare service being regulated, an observation that underscores the need for more specific studies on LTACs. Buntin (2007) adds that Medicare payment systems influence the availability and use of PAC services, and Rahman et al. (2016) use a fixed-effects model using state-level Medicare and Medicaid spending data from 1992 to 2009 to find that states with both nursing home and home healthcare CON laws experienced the slowest growth in community-based care expenditures.

In a comprehensive review of the impact of all CON laws, Mitchell (2024) identifies in detail the published literature on the impacts of CON laws. Much of the CON literature points toward the argument that, on average, CON laws have led to higher expenditures for hospitals and higher Medicare costs (Bailey 2016; Ettner et al. 2020; Rahman et al. 2016). The literature further states that CON laws have also led to lower availability of healthcare services in areas where CON laws regulate healthcare services (Bailey 2016; Chen, Vanness, and Golestanian 2011; Stratmann and Russ 2014). In a more recent study, Mitchell and Stratmann (2021) find that states with CON regulations for hospital beds faced higher bed utilization rates and capacity issues during the COVID-19 pandemic because CON laws created bottlenecks during times of increased demand.

Some studies point to how CON laws can also lower healthcare costs (Malik et al. 2019; Ziino, Bala, and Cheng 2020). While CON laws have been extensively studied, relatively few studies have estimated the causal effects of CON laws. Although Melo et al. (2024) and Stratmann, Bjoerkheim, and Koopman (2024) have conducted studies with similar methodologies for other kinds of healthcare providers, including hospitals and ambulatory surgical centers, to our knowledge, no one has yet studied the causal effects of CON laws on access to LTACs.

3. Data and Empirical Strategy

3.1 Identification strategy

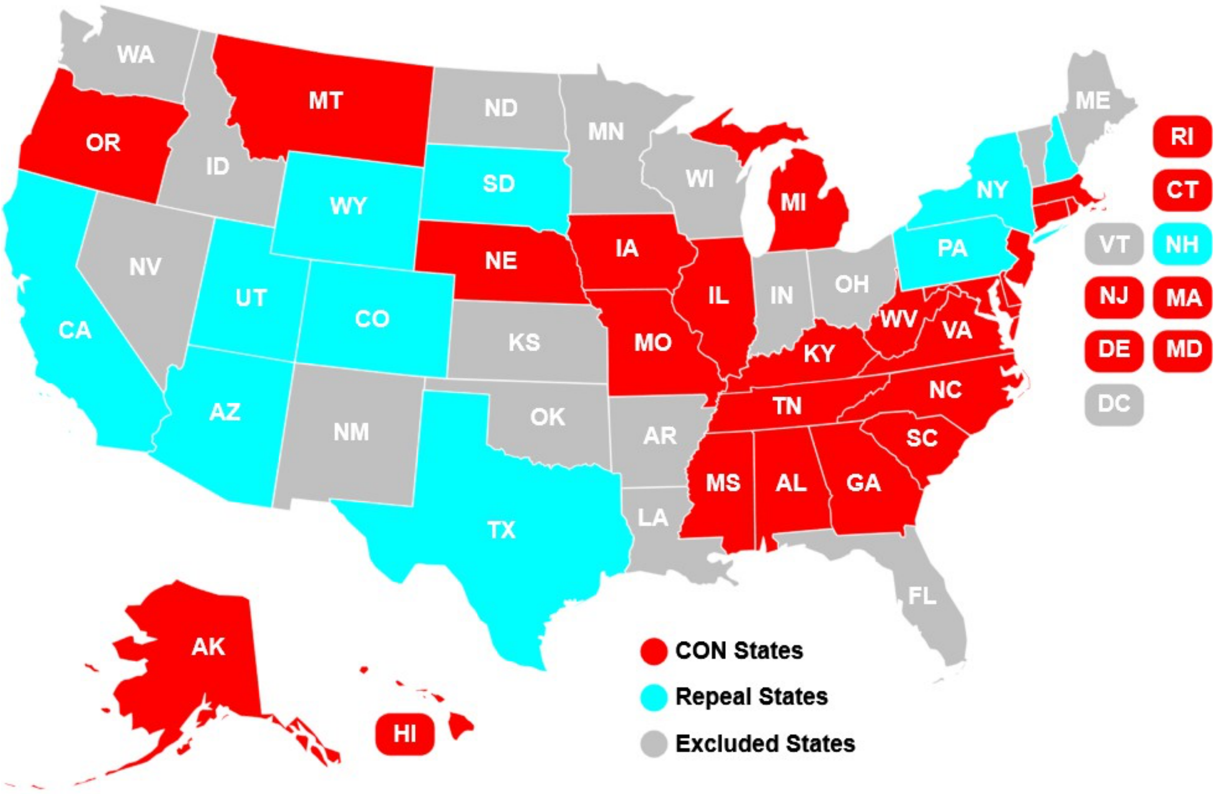
We aim to test the hypothesis that CON laws serve as regulatory entry barriers that limit the entry of healthcare facilities. We use the staggered repeals of CON laws for long-term acute care in a difference-in-difference framework to identify the causal effect of repealing CON laws, and we predict that removing these barriers would increase entry and access to LTACs.

We cross-referenced multiple sources to determine which states repealed CON laws for LTAC during our study period, including the 2016 National Directory of Certificate of Need Programs and Health Planning Agencies published by the American Health Planning Association. The directory provides a comprehensive overview of the CON programs that were in effect in each state each year. To determine which states had LTAC CONs at the end of our sample period (2018), we used reports from the National Conference of State Legislatures (NCSL 2024).

To determine LTAC CON repeals before 1996, we consulted the early CON literature published after the federal repeal. This allowed us to study CON repeals in 10 states: Utah (1985), Arizona (1986), Texas (1986), California (1988), Colorado (1988), South Dakota (1989), Wyoming (1990), Pennsylvania (1996), New York (2006), and New Hampshire (2016). We excluded New Mexico and Idaho, which repealed their CON programs in 1983 and 1984, respectively, because those repeals took place before data were available to estimate their effects. Furthermore, there are partial CON repeals in two states, Arizona and New York, which means those states repealed LTAC CONs but retained other CONs. In contrast, a full repeal, as seen in the other states, indicates that the states repealed all CONs.

Our control group consists of states that maintained CON programs for LTACs throughout our sample period. These states are Alabama, Alaska, Connecticut, Delaware, Georgia, Hawaii, Illinois, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Montana, Nebraska, New Jersey, North Carolina, Oregon, Rhode Island, South Carolina, Tennessee, Virginia, and West Virginia. The repeal states are presented visually in figure 1 (they are also referenced in table A.1), along with the states that maintained LTAC CONs through our sample period.

FIGURE 1. Certificate of need repeals for long-term care hospitals



Note: Repeal states and control states used in the analysis. See table A.1 for more specific information regarding states.

The staggered timing and broad geographic distribution of the repeals reduce the likelihood of unobserved time- or region-specific shocks confounding our estimates. The staggering also ensures that the impact of CON repeals is not concentrated in one area, thereby reducing the risk that regional shocks could skew the results.

One challenge with estimating the causal effect of CON repeals on LTAC access is that some states simultaneously implemented other entry barriers, such as moratoriums on the construction or expansion of long-term care hospitals or hospitals in general (Simpson 1985). Including those states in our treatment group would introduce a downward bias in our estimated effects. Therefore, we consulted existing literature and based our analysis on states that repealed CONs for long-term acute care hospitals without permanently replacing them with alternative entry barriers (Simpson 1985; Stiles and Johnson 1976). This led us to exclude Kansas and Minnesota from our sample.

We did include states that briefly instituted alternative entry barriers or that had their repeals coincide with federal policies that temporarily prevented the establishment or expansion of LTACs (Sagness 2007). We explore these heterogeneous treatment effects further in section 4.2 of this paper.

3.2 Data and descriptive statistics

Our analysis uses data from several sources. We obtained the annual Provider of Services (POS) files for 1984 to 2018 from the Centers for Medicare and Medicaid Services. The POS files provide facility-level details on healthcare providers in the United States, including the number of LTACs and certified beds in each state. Our dependent variable for our first estimation is the number of LTACs per million people ages 65 and older. Our dependent variable for our second estimation is the number of LTAC certified beds available per million people ages 65 and older. We construct these measures to account for variations in the elderly population over time, using data from the National Cancer Institute's SEER (Surveillance, Epidemiology, and End Results) Program. Standardizing the number of LTACs relative to the size of the elderly population in each state ensures comparability both over time and across states.[9] Our dependent variables are thus

$$LTACs\ per\ million\ elderly_{st} = \left(\frac{LTACs_{st}}{Population\ 65+_{st}}\right) \times 1{,}000{,}000 \quad (1)$$

$$LTAC\ certified\ beds\ per\ million\ elderly_{st} = \left(\frac{LTACs\ certified\ beds_{st}}{Population\ 65+_{st}}\right) \times 1{,}000{,}000 \quad (2)$$

where s represents states and t represents year.

For our estimations comparing nursing home outcomes after LTAC entry into the market, we use nursing home data that start in 2000 provided by the Centers for Medicare and Medicaid Services' Nursing Home Compare dataset[10] and the LTCFocus database at the Brown University Center for Gerontology and Healthcare Research.[11] The three outcomes that we estimate are 30-day rehospitalization rates, restraint use rates used, and fall rates or dependent variables for these estimations, as thus:

$$Y_{it} = \frac{30-day\ rehospitalization_{it}}{Discharges_{it}} \quad (3)$$

where i represents a nursing facility and t represents the year.

Table 1 presents summary statistics for the measures used in our analysis for the overall sample, with the upper half of the table presenting data from SEER and the lower half of the table presenting data from LTCFocus. Notably, the highest number of LTACs in a single state is 77, which, in our sample, corresponds to Texas. The sample mean for the number of LTACs per million elderly is 9.12, and the mean for the number of LTAC certified beds available per million elderly is 892. We can also observe that the mean 30-day rehospitalization rate for nursing home residents in our sample is 18.33 percent.

[9] Scaling by the elderly population is the natural choice given that most LTAC patients are elderly. However, we show in appendix C that our findings are robust to scaling by the state's total population in each year.

[10] Centers for Medicare and Medicaid Services, Nursing Home Compare (dataset), https://www.medicare.gov/care-compare/?redirect=true&providerType=NursingHome, accessed 2024.

[11] Brown University, LTCFocus (database), Shaping Long-Term Care in America Project at Brown University Center for Gerontology and Healthcare Research, supported in part by the National Institute on Aging (1P01AG027296), accessed 2024.

TABLE 1. Descriptive statistics

	Mean	SD	Min.	Max.	Count
Long-term care hospitals	5.29	9.58	0	77	1,190
Long-term care hospitals (per million 65+)	9.12	9.25	0	49.57	1,190
Certified beds	481	842	0	5,216	1,190
Certified beds (per million 65+)	892	1,560	0	9,944	1,190
Population 65+ (million)	0.54	0.57	0	3.80	1,190
Elderly (65+) (% of state population)	8.90	1.69	1.69	13.33	1,190
Unemployment rate	5.70	1.96	2.30	14.80	1,190
Diabetes diagnoses (per million)	218.54	59.96	45	470	1,122
LTAC entry	0.03	0.17	0	1	197,980
Rehospitalizations (%)	18.33	7.45	0	100	155,674
Fall (%)	18.53	8.00	0	100	104,988
Restraints (%)	4.82	8.54	0	100	208,105
Counties (%)	0.29	0.456	0	1	208,297

Note: Population data are drawn from the National Cancer Institute's SEER Program, and the number of long-term care hospitals in each state is sourced from the Provider of Services files from the Centers for Medicare and Medicaid Services. Additionally, data on diabetes diagnoses are from the Centers for Disease Control and Prevention, and unemployment rates are from the Bureau of Labor Statistics. We source the rehospitalizations, fall, and restraints data from the LTCFocus database at the Brown University Center for Gerontology and Healthcare Research. Counties = the share of observations that are in a county that was impacted by an LTAC entry. In some specifications, we include control variables to account for potential sources of endogeneity between repeal and CON states that may influence LTAC access. These controls include the share of elderly individuals in each state, the rate of diabetes diagnoses, and unemployment rates. We use unemployment rates as a proxy for the economic environment and the number of diabetes diagnoses per million as an indicator of healthcare needs.

3.3 Estimation

In our analysis, we adopt a difference-in-difference approach using the staggered nature of CON law repeals across different states as a natural experiment. Formally, we aim to estimate the average treatment effect on the treated (ATT), defined as the expected change in *LTACs per million elderly* or *LTAC certified beds per million elderly* between the treated and untreated potential outcomes for the repeal states:

$$\theta_{ATT} = \mathbb{E}[Y(1) - Y(0) \mid D = 1] \tag{4}$$

where:

- $Y(1)$ is the potential number of *LTACs/LTAC certified beds per million elderly* when CON laws are repealed,
- $Y(0)$ is the potential number of *LTACs/LTAC certified beds per million elderly* when CON laws are not repealed, and
- $D = 1$ indicates the repeal states.

Recent studies by Borusyak, Jaravel, and Spiess (2021), Goodman-Bacon (2021), and Callaway and Sant'Anna (2021) demonstrate that the two-way fixed-effects (TWFE) estimator may produce biased estimates when treatments are staggered over time or when treatment effects vary across time or cohorts. We confirm the presence of this bias in our context by implementing a Bacon Decomposition of the TWFE estimate, which is presented in appendix B. To address this bias and estimate the unbiased causal effects of repealing CON laws, we apply the difference-in-difference estimator proposed by Callaway and Sant'Anna (2021).

We estimate the change in *LTACs per million elderly* by estimating variations of the following model:

$$\Delta LTAC_{it} = \mathbb{E}\left[\frac{G_g}{\mathbb{E}(G_g)}\left(y_t - y_{g-1} - m_{g,t}(X)\right)\right] \tag{5}$$

where

- G_g is an indicator equal to 1 if a state was first treated (CON law repealed) in cohort g, and 0 otherwise,
- $\Delta LTAC_{it}$ is the change in the number of *LTACs per million elderly* in state i at time t,
- y_t is the observed number of *LTACs per million elderly* at time t,
- y_{g-1} is the observed number of *LTACs per million elderly* at time $g - 1$ (pretreatment), and
- $m_{g,t}(X) = \mathbb{E}(y_t - y_{g-1} \mid X, C^*_{g,t} = 1)$ is the expected change in outcomes for the control group, conditional on covariates X.

For each treatment group, this model allows us to estimate the *group-time average treatment effects ATT(g,t),* which capture the treatment effects for group, g, at time t. We present three aggregations of the overall ATT: a simple ATT, a group-ATT, and a calendar-time ATT. The *simple ATT* is a weighted average of the treatment effects across all treated states and time periods. One limitation of the simple ATT is that it disproportionately weights states that repealed CON laws early. To address this, we present the *group-specific ATT*, which estimates the treatment effects for each treatment group/cohort and aggregates them by giving equal weight to each cohort. Finally, we also include the *calendar-time ATT*, which aggregates treatment effects by averaging the effects for each calendar year.

To assess the robustness of our estimates, we estimate a total of six models (three models times two control groups). We first estimate baseline models without controls, one with states that never repeal CON as the control group and one that includes not-yet-treated states. We also estimate models that control for the rate of diabetes diagnoses and unemployment rates for both control groups. We include the rate of diabetes diagnoses as a control variable as this is a commonly used measure of population health because it predicts healthcare needs and therefore potentially predicts entry of LTACs. Unemployment rates are included to control for the state of the economy, which may also predict LTAC entry. Finally, we estimate models that *also* control for the share of the population ages 65 and older, again for both control groups. By comparing results across these six models, we ensure that our findings are robust to different control group specifications and the inclusion of different sets of covariates. We cluster standard errors at the state level in all models.

4. Results

4.1 Does CON repeal increase LTAC access?

Table 2 presents our estimates of our first model. We observe the estimated ATT of repealing CON laws for long-term acute care on the number of operating long-term care hospitals per one million people ages 65 and older.

TABLE 2. Effect of CON repeal on long-term care hospitals per one million state population 65+

	(1)	(2)	(3)	(4)	(5)	(6)
ATT	6.334*	7.010**	7.435**	6.474*	6.987*	7.422**
	(3.044)	(2.922)	(2.916)	(3.006)	(2.893)	(2.887)
ATT: Group	5.363**	5.850***	6.415***	5.488***	5.831***	6.403***
	(2.043)	(1.928)	(1.861)	(2.006)	(1.899)	(1.827)
ATT: Calendar	5.930*	6.569*	6.934***	6.050*	6.544*	6.917**
	(2.766)	(2.650)	(2.633)	(2.733)	(2.622)	(2.605)
Economic controls		✓	✓		✓	✓
Health controls		✓	✓		✓	✓
Demographic controls			✓			✓
Observations	1,190	1,190	1,190	1,190	1,190	1,190

Note: This table reports aggregated treatment effect parameters for the estimated impact of LTAC-CON repeal on long-term care hospitals per one million population ages 65 and older. The sample period spans 1984–2018. Columns (1) through (6) apply the estimators proposed by Callaway and Sant'Anna (2021). The row labeled "ATT" in columns (1) through (6) represents the simple weighted average of all available group-time average treatment effects. The row "ATT: Group" aggregates the average treatment effects by the timing of the CON repeals, while the row "ATT: Calendar" aggregates them by year. Control groups in columns (1) through (3) consist of never-treated states, while columns (4) through (6) use not-yet-treated states. Column (2) adjusts for the state's unemployment rate and diabetes diagnosis rate, while column (3) controls for the unemployment rate, diabetes diagnosis rate, and share of the population ages 65 and older. Column (5) includes not-yet-treated states with controls for unemployment and diabetes diagnosis rates, and column (6) additionally controls for the share of the population ages 65 and older. Sources include the Provider of Services files from the Centers for Medicare and Medicaid Services, unemployment rates from the Bureau of Labor Statistics, diabetes diagnoses from the Centers for Disease Control and Prevention, and population data from the National Cancer Institute's SEER Program. Standard errors are clustered at the state level and shown in parentheses.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The estimated ATT (standard error) for column 1 in table 2, with never-treated states as the control group, is 6.334 (3.044)—specifically, a 69 percent increase, relative to the overall sample mean (9.12). To ensure our findings are robust to alternative specifications, we sequentially incorporate economic, health, and demographic control variables. Column 2 adds the unemployment rate and rate of diabetes diagnoses. We find that this produces a slightly larger estimate of 7.010 (2.922), significant at the 1 percent level. Column 3 adds to this specification the share of the population ages 65 and older, which also slightly increases the ATT to 7.435 (2.916), also significant at the 1 percent level.

We see a similar result when we include not-yet-treated states in our control group in column 4, where the ATT is 6.474 (3.006) and is statistically significant at the 5 percent level.

For the not-yet-treated states in our control group, we follow a similar approach: economic and health controls in column 5 and the addition of the demographic variable in column 6. The resulting ATTs are 6.987 (2.893), significant at the 5 percent level, and 7.422 (2.887), significant at the 1 percent level.

The "ATT: Group" row in table 2 displays aggregate treatment effects based on the timing and grouping of states involved in the CON repeal. The group ATT estimated using the Callaway and Sant'Anna approach is 5.363 (2.043), significant at the 1 percent level. For column 2, which includes never-treated states as controls and health and economic controls, the group ATT increases to 5.850 (1.928), highly significant at the 0.1 percent level. Adding the demographic control in column 3 raises the group ATT to 6.415 (1.861), also highly significant at the 0.1 percent level.

When not-yet-treated states are included as the control group in column 4, the group ATT is estimated at 5.488 (2.006), with high significance at the 0.1 percent level. Column 5 extends this approach by incorporating economic and health controls with not-yet-treated states as the control group, yielding a group ATT of 5.831 (1.899), again significant at the 0.1 percent level. Column 6, with added demographic controls, reports a group ATT of 6.403 (1.827), highly significant at the 0.1 percent level.

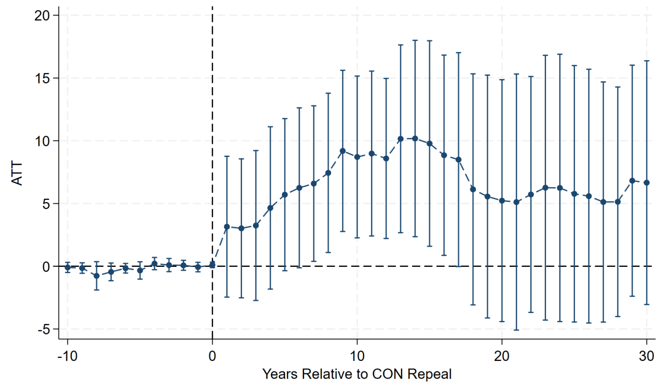
The "ATT: Calendar" row in table 2 displays aggregate effects by calendar year. The calendar ATT under the Callaway and Sant'Anna approach is estimated at 5.930 (2.766), significant at the 5 percent level. In column 2, which uses never-treated states as the control and includes controls for economic and health, the calendar ATT is 6.569 (2.650), significant at the 5 percent level. Extending the model with the demographic control in column 3 increases the calendar ATT to 6.934 (2.633), with high significance at the 0.1 percent level.

For models using not-yet-treated states as controls in column 4, the calendar ATT is estimated at 6.050 (2.733), significant at the 5 percent level. Column 5, with economic and health controls, yields a calendar ATT of 6.544 (2.622), significant at the 5 percent level, while column 6, with additional demographic controls, produces a calendar ATT of 6.917 (2.605), significant at the 1 percent level.

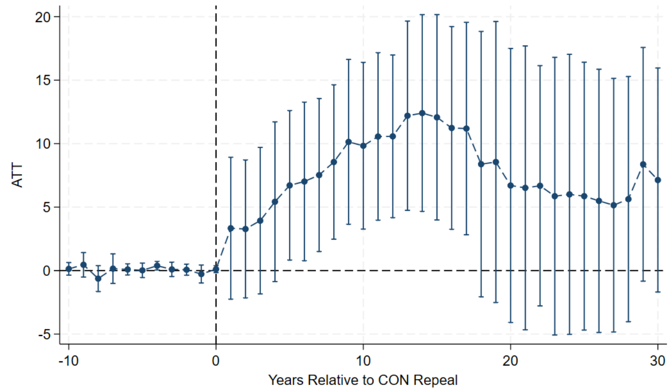
Figures 2 and 3 show that the estimated ATTs are closely centered around zero leading up to the CON repeals, supporting the parallel trends assumption. The ATTs turn positive shortly after repeal and are statistically significant after six years. The estimated ATTs 10 years after CON repeals suggest an increase of approximately 8 to 10 LTACs per million individuals ages 65 and older. The estimated ATTs are lower 20–30 years after the repeal, potentially reflecting federal moratoriums implemented in 2003, 2007, and 2014. The similarity of these plots indicates that our results are not sensitive to the choice of model and that our findings are consistent across all six model specifications.

FIGURE 2. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care hospitals, never-treated observations included in control group

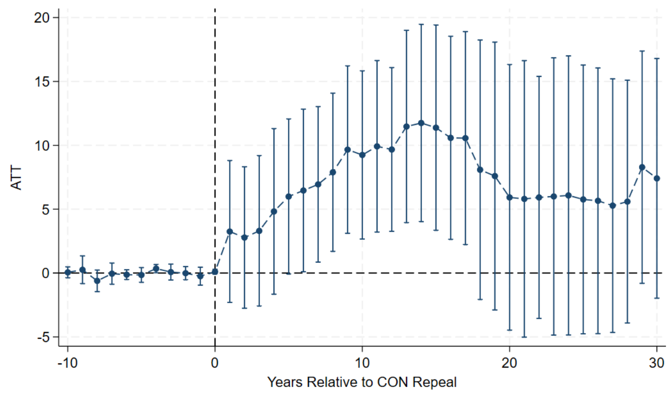
(1) No controls



(2) Health and economic controls

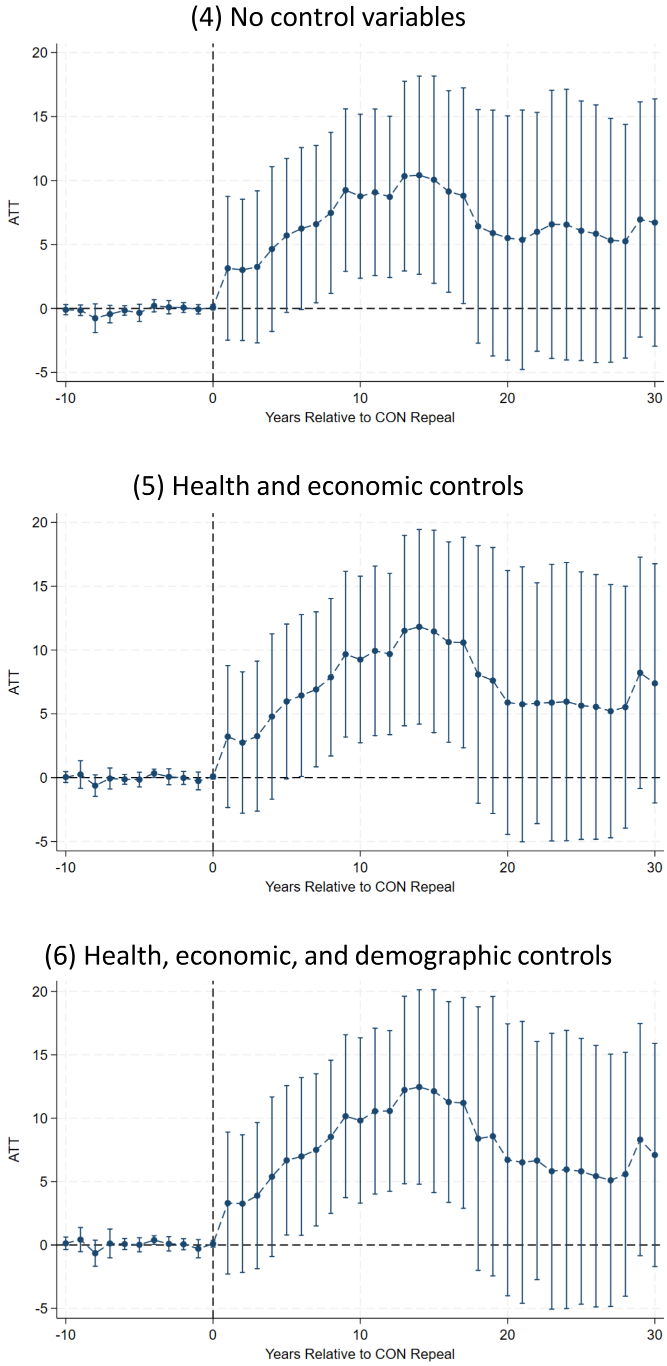


(3) Health, economic, and demographic controls



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on LTACs per million elderly, estimated using the Callaway and Sant'Anna difference-in-difference estimator including only never-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table 2. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

FIGURE 3. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care hospitals, not-yet-treated observations included in control group



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on LTACs per million elderly, estimated using the Callaway and Sant'Anna difference-in-difference estimator including not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table 2. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

Table 3 presents the results of our model, which estimates the change in the number of certified beds per million individuals ages 65 and older. Certified beds are those approved under regulatory standards established by CMS. The results indicate an estimated 558 bed increase in the number of certified beds after the CON repeal, which is a 62 percent increase compared with the sample mean, with consistent results across different aggregation methods. Figures 4 and 5 also show that estimated ATTs for certified beds are centered around zero before repeal and that the estimated ATTs turn positive after the repeal, with slight decreases around the implementation of federal moratoriums.[12]

TABLE 3. Effect of CON repeal on certified beds per million state population ages 65+

	(1)	(2)	(3)	(4)	(5)	(6)
ATT	558.9*	568.6*	608.5*	549.8*	546.0*	585.9*
	(245.2)	(249.9)	(261.0)	(238.1)	(245.6)	(257.0)
ATT: Group	465.5*	473.4**	525.4**	458.3**	454.6**	506.7**
	(182.8)	(175.8)	(187.8)	(175.4)	(170.7)	(182.2)
ATT: Calendar	509.5*	521.4*	555.8*	499.7*	499.6*	534.0*
	(222.9)	(228.3)	(236.5)	(216.4)	(224.0)	(232.5)
Economic controls		✓	✓		✓	✓
Health controls		✓	✓		✓	✓
Demographic controls			✓			✓
Observations	1,190	1,190	1,190	1,190	1,190	1,190

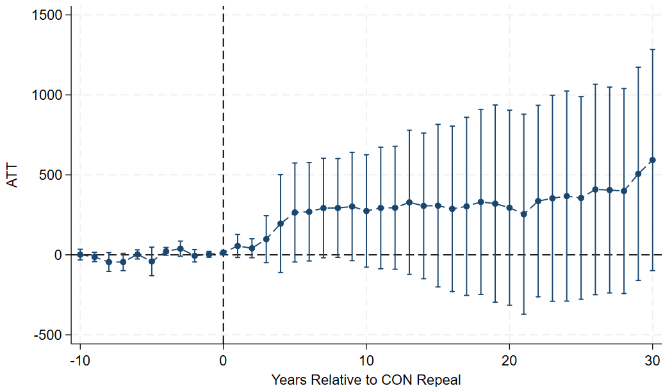
Note: This table reports aggregated treatment effect parameters for the estimated impact of LTAC-CON repeal on long-term care certified beds per one million population ages 65 and older. The sample period spans 1984–2018. Columns (1) through (6) apply the estimators proposed by Callaway and Sant'Anna (2021). The row labeled "ATT" in columns (1) through (6) represents the simple weighted average of all available group-time average treatment effects. The row "ATT: Group" aggregates the average treatment effects by the timing of the CON repeals, while the row "ATT: Calendar" aggregates them by year. Control groups in columns (1) through (3) consist of never-treated states, while columns (4) through (6) use not-yet-treated states. Column (2) adjusts for the state's unemployment rate and diabetes diagnosis rate, while column (3) controls for the unemployment rate, diabetes diagnosis rate, and share of the population ages 65 and older. Column (5) includes not-yet-treated states with controls for unemployment and diabetes diagnosis rates, and column (6) additionally controls for the share of the population ages 65 and older. Sources include the Provider of Services files from the Centers for Medicare and Medicaid Services, unemployment rates from the Bureau of Labor Statistics, diabetes diagnoses from the Centers for Disease Control and Prevention, and population data from the National Cancer Institute's SEER Program. Standard errors are clustered at the state level and shown in parentheses.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

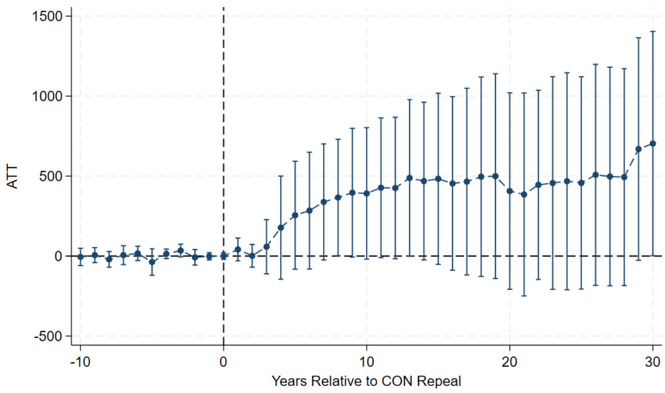
[12]The results of the impact of CON law repeals on noncertified beds and corresponding event studies can be found in table C.2 in appendix C.

FIGURE 4. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care certified beds, never-treated observations included in control group

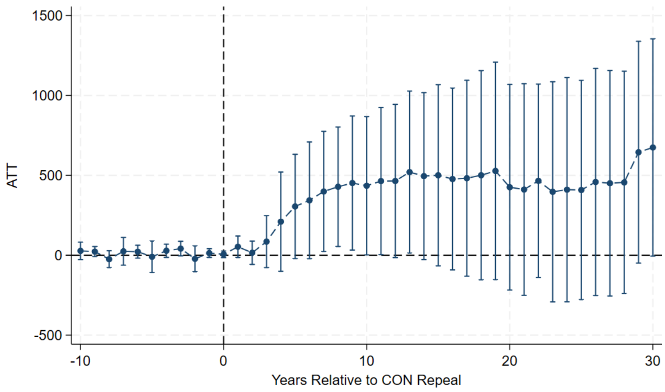
(1) No controls



(2) Health and economic controls



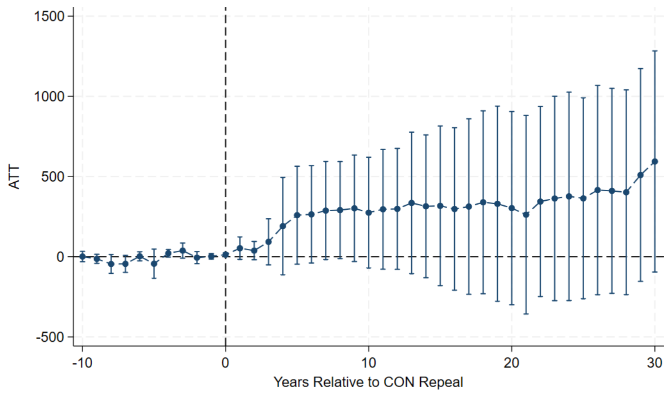
(3) Health, economic, and demographic controls



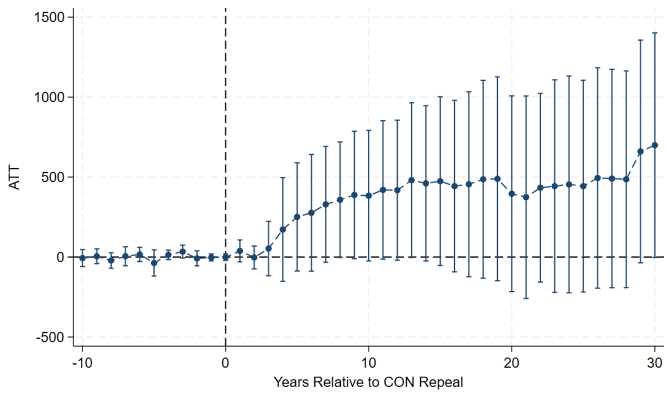
Note: These figures display the dynamic treatment effects of LTAC-CON repeal on LTAC certified beds per million elderly, estimated using the Callaway and Sant'Anna difference-in-difference estimator including only never-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table 3. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

FIGURE 5. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care certified beds, not-yet-treated observations included in control group

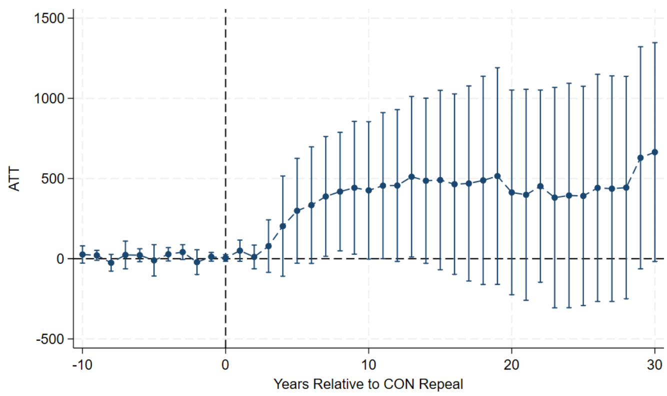
(4) No control variables



(5) Health and economic controls



(6) Health, economic, and demographic controls



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on LTAC certified beds per million elderly, estimated using the Callaway and Sant'Anna difference-in-difference estimator including not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table 3. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

Across all specifications, our estimates consistently find a statistically significant effect of CON repeal on the number of LTACs per capita.

4.2 Heterogeneity

As discussed, one challenge with estimating the causal effect of CON repeal on LTAC access is that repeals sometimes coincide with the state or federal policies that also act as entry barriers, including moratoriums and Section 1122 programs (Simpson 1985). These policies include an 18-month federal moratorium on the construction and expansion of long-term care hospitals implemented in 2003, as stipulated by the Medicare, Medicaid, and SCHIP Extension Act.[13] That act was followed by federal moratoriums from 2007 to 2010 and from 2014 to 2017 (Hamilton 2008; Stratmann and Russ 2014). Our hypothesis predicts that the estimated effects will be smaller in states when these policies were in place, which would particularly influence effects estimated in New York (2006) and New Hampshire (2016).

We investigate this prediction by estimating the treatment effects on the number of facilities and the number of certified beds for each repeal cohort, as presented in table 4. The estimated cohort ATTs for New York and New Hampshire are significantly smaller than the other cohorts. In the case of New York, the ATT for facilities and beds is negative, estimated as a reduction of −1.520 (1.163) for facilities and −92.5 (75.7) for beds; however, these estimates are not statistically significant. The estimated ATT in New Hampshire is an increase of 1.173 (0.278) for facilities and 81.7 (19.8) for certified beds per million elderly. While these ATTs are significant at the 0.1 percent level, they are substantially smaller in magnitude than the overall group ATTs and most of the cohort ATTs presented in table 4.

We estimate increases in the number of LTACs per million elderly in most other cohorts. The exception is Utah, where the cohort ATT is estimated as a reduction of −2.407 (1.564) LTACs per million elderly, but the number of certified beds increases (333.5). However, this result is not statistically significant. Moreover, this particular ATT is potentially challenging to interpret given that only a single pretreatment year is available.

The other ATTs are all positive and statistically significant. For Arizona and Texas (1986), the estimated treatment effect on facilities is 12.791 (6.341), which is statistically significant at the 5 percent level, and the effect on certified beds is 1,019.9 (381.2), significant at the 1 percent level. The repeals in California and Colorado (1988) are estimated as an increase of 6.145 (5.314) facilities, which is not statistically significant, but the effect on certified beds is an increase of 768.9 (313.0), significant at the 5 percent level. The repeal in South Dakota (1989) is estimated to increase the number of LTACs per million elderly by 4.256 (1.641), statistically significant at the 1 percent level, while the effect on certified beds is an increase of 274.2 (205.8), which is not statistically significant. The repeal in Wyoming (1990) is estimated as an increase of 10.698 (1.666) LTACs per million elderly, significant at the 0.1 percent level, with a smaller, nonsignificant increase of 110.3 (204.9) certified beds. Finally, the repeal in Pennsylvania (1996) is estimated as an increase of 3.558 (1.415) facilities, statistically significant at the 5 percent level, and an increase of 370.2 (178.6) certified beds, also significant at the 5 percent level.

[13] Medicare, Medicaid, and SCHIP Extension Act of 2007, Pub. L. No. 110-173.

TABLE 4. Estimated effects of LTAC-CON repeal on long-term care hospitals and long-term care certified hospital beds per million population 65+ by repeal cohort

	Cohort ATT: Facilities	Cohort ATT: Certified beds
1985 (Utah)	−2.407	333.5
	(1.564)	(211.2)
1986 (Arizona, Texas)	12.791*	1,019.9**
	(6.341)	(381.2)
1988 (California, Colorado)	6.145	768.9*
	(5.314)	(313.0)
1989 (South Dakota)	4.256**	274.2
	(1.641)	(205.8)
1990 (Wyoming)	10.698***	110.3
	(1.666)	(204.9)
1996 (Pennsylvania)	3.558*	370.2*
	(1.415)	(178.6)
2006 (New York)	−1.520	−92.5
	(1.163)	(75.7)
2016 (New Hampshire)	1.173***	81.7***
	(0.278)	(19.8)
Observations	1,190	1,190

Note: Each cohort includes a state or a group of states that repealed their LTAC CON laws from 1984 to 2018. The repeals in New York and New Hampshire coincided with Centers for Medicare and Medicaid Service moratoriums on LTAC construction or expansion. Standard errors are clustered at the state level and shown in parentheses.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In other words, the majority of the ATTs for repeals that we study that do not coincide with state or federal entry restrictions (1986, 1989, 1990, 1996) are positive and statistically significant. The repeals that coincided with other entry barriers are smaller and sometimes negative. These findings support the hypothesis that it is the removal of entry barriers that is causing LTACs to enter long-term care markets.

5. Results: Does LTAC Entry Affect Outcomes in Nursing Homes?

Ideally, we would like to estimate the effect of CON repeal on nursing home outcomes. Unfortunately, data limitations mean that 8 of the 10 CON repeals we study take place before there are available data that can be used for testing their effect. Moreover, there are very limited post-treatment data for the repeal in New Hampshire.

To test the hypothesis, we use nursing home data starting in the year 2000, provided by the CMS Nursing Home Compare database and Brown University's LTCFocus database.[14] We

[14] LTCFocus is sponsored by the National Institute on Aging (1P01AG027296) through a cooperative agreement with the Brown University School of Public Health. The database is available at https://doi.org/10.26300/h9a2-2c26.

employ a variation of the difference-in-difference design from section 4 of this paper, where the treatment is defined as an LTAC entering a post-acute care market. We define the market at the county level using FIPS (Federal Information Processing Standards) codes. Given our focus on CON repeal, we limit our analysis to the same sample of 34 states used in section 4.[15]

The existing literature has shown that these providers are close substitutes: According to Einav, Finkelstein, and Mahoney (2023), approximately 80 percent of LTAC patients would have been admitted to nursing homes in absence of an operating LTAC. The same authors estimate that LTAC admission has no discernible effect on mortality but note:

> [W]e are not able to measure nonmortality dimensions of health (such as pain, functional limitations, and other quality-of-life metrics) or non-health dimensions of utility (such as the quality of the room and board provided). Again, this is a common feature of nearly all health economics research on patient outcomes.
>
> Another way to interpret our findings, therefore, is to note that if the excess spending on LTACs provides unmeasured health benefits or non-health "amenity benefits," they would need to be valued (by the social planner) at about $1,000 per day in the LTAC to "justify" the incremental Medicare spending. (Einav, Finkelstein, and Mahoney 2023, 746)

Because they are close substitutes, we predict the entry of long-term care hospitals would lead the highest-acuity patients to be admitted to LTACs rather than to nursing homes. We further hypothesize that this would free up nursing home staff and ultimately lead to improvements in nonmortality dimensions of health among residents in nursing homes, particularly for high-acuity patients.

We test specialized outcomes, including 30-day rehospitalization rates, the use of restraints on patients, and number of patients who have fall injuries while in care. We find evidence consistent with LTACs serving a more specialized role in long-term care markets, likely by serving certain high-acuity patients that nursing homes may not be equipped to care for. The results are displayed in table 5.[16]

Table 5 shows that across our specifications there is approximately a 1 percentage point decrease in 30-day hospitalization rates as a result of an LTAC entering a nursing home market, which is a 5.9 percent relative reduction in rehospitalizations. Similarly, there is approximately a 1 percentage point reduction in the number of falls and 0.6 percentage point reduction in the number of restraints used, which is a 5.3 percent and 13 percent reduction compared with the sample mean. These results are either statistically significant or marginally significant across all our model specifications.[17]

The reduction in 30-day rehospitalization rates observed following LTAC entry may partly reflect compositional changes in patient distribution across care settings. However, even if some compositional change occurred, the scale of the reduction in rehospitalization rates—approximately 5.9 percent—suggests that this effect is unlikely to be the sole driver of our findings.

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[15]Additionally, the Callaway and Sant'Anna (2021) estimator excludes any counties that already had an LTAC in 2000 from estimations to isolate the effect of LTAC entry on nursing home resident outcomes.

[16] For readability, we present only the simple ATTs for these results; however, these ATTs are consistent with the group and calendar ATTs (results available upon request).

[17] The construction of publicly available quality measures changed in 2010 as Minimum Data Set (MDS) 2.0 was replaced with MDS 3.0. We combine the measures across different versions in table 5. As a robustness measure, we also run the analysis using a sample period from 2000 to 2010 using only MDS 2.0. These are presented in appendix D, table D.3. Our estimated effects using this sample period are smaller, and for falls and restraints, the effects are no longer significant. Our finding of reduced 30-day rehospitalization rates remains statistically significant at the 0.1 percent level in all specifications.

TABLE 5. Effect of entry of LTACs into market on nursing home outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Rehospitalization rate	−1.001***	−0.974***	−1.001***	−1.011***	−0.984***	−1.011***
	(0.129)	(0.130)	(0.130)	(0.129)	(0.130)	(0.131)
N	141,257	141,257	141,257	141,257	141,257	141,257
Falls	–0.988***	–0.976***	–1.004***	–0.984***	–0.971***	–0.997***
	(0.144)	(0.145)	(0.145)	(0.144)	(0.145)	(0.146)
N	92,842	92,842	92,842	92,842	92,842	92,842
Restraints	–0.626***	–0.249	–0.028	–0.699***	–0.273	–0.052
	(0.193)	(0.195)	(0.195)	(0.194)	(0.196)	(0.196)
N	202,777	202,777	202,777	202,777	202,777	202,777
Economic controls		✓	✓		✓	✓
Health controls		✓	✓		✓	✓
Demographic controls			✓			✓

Note: This table reports aggregated treatment effects of entry of LTACs into market on nursing home outcomes. The sample period spans 2000–18. Columns (1) through (6) apply the estimators proposed by Callaway and Sant'Anna (2021). The row labeled "Rehospitalization rate" in columns (1) through (6) represents the simple weighted average of all available group-time average treatment effects for patients who were hospitalized 30 days after being discharged. The row "Restraints" represents the simple weighted average of the admitted residents who had to be restrained while in care. The row "Falls" represents the simple weighted average of the admitted residents who fell in the past 30 days while in care. Control groups in columns (1) through (3) consist of never-treated states, while columns (4) through (6) use not-yet-treated states. Column (2) adjusts for the state's unemployment rate and diabetes diagnosis rate, while column (3) controls for the unemployment rate, diabetes diagnosis rate, and share of the population ages 65 and older. Column (5) includes not-yet-treated states with controls for unemployment and diabetes diagnosis rates, and column (6) additionally controls for the share of the population ages 65 and older. The overall ATTs are consistent with the group and calendar ATTs. Sources include the Provider of Services files from the Centers for Medicare and Medicaid Services, unemployment rates from the Bureau of Labor Statistics, diabetes diagnoses from the Centers for Disease Control and Prevention, population data from the National Cancer Institute's SEER Program. Falls, 30-day rehospitalization, and restraints data are from the LTCFocus database at the Brown University Center for Gerontology and Healthcare Research. Standard errors are clustered at the nursing home level using FIPS codes and shown in parentheses.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6. Conclusion

Our study provides clear insights into the effects of CON repeal on the development and accessibility of LTACs, with important implications for both healthcare policy and market outcomes. Our findings demonstrate that repealing CON laws leads to an increase in the number of LTACs—specifically, the repeal will lead to 6.3 more LTACs per million elderly individuals, which is a 69 percent increase. We also see that this leads to a 63 percent increase in the number of certified beds. This shows the role CON laws play as barriers to entry within healthcare, and it shows how their removal fosters greater access to specialized, high-acuity medical care, particularly for aging populations.

The growth is most significant in states that eliminated other regulatory hurdles alongside CON laws, pointing to the need for deregulation efforts. This action enhances competition in long-term care markets, allowing new LTACs to challenge incumbent providers. This could lead to greater efficiency, innovation, and potentially better cost control as providers adapt to a more competitive environment. In addition to increasing access, we find that the repeal of CON laws and the subsequent entry of LTACs into SNF markets decreases 30-day rehospitalizations, reduces the use of restraints, and reduces falls in SNFs, likely because of high-acuity patients being treated in LTACs instead of SNFs.

We also addressed the possible limitations inherent to our model, such as possible heterogeneity issues, by conducting a cohort estimation and event study to ensure the robustness and reliability of the outcomes of our analysis. This helped us verify that our results hold across different states and time periods, confirming the consistency of the effects we observed. Furthermore, we used both the increase in the number of LTACs and the number of beds as a measure of access, which helps focus on market entry and capacity.

Our findings show that repealing CON laws leads to a meaningful increase in LTAC availability. Moreover, reduced rehospitalizations suggest this entry helps relieve pressure on SNFs and other healthcare providers by offering more options for patients with high-acuity needs. States that still maintain CON laws for LTACs could reconsider this approach, especially in the face of an aging population.

7. Appendixes

Appendix A: CON repeals for long-term acute care

TABLE A.1. Summary of states repealing certificate of need laws for long-term acute care

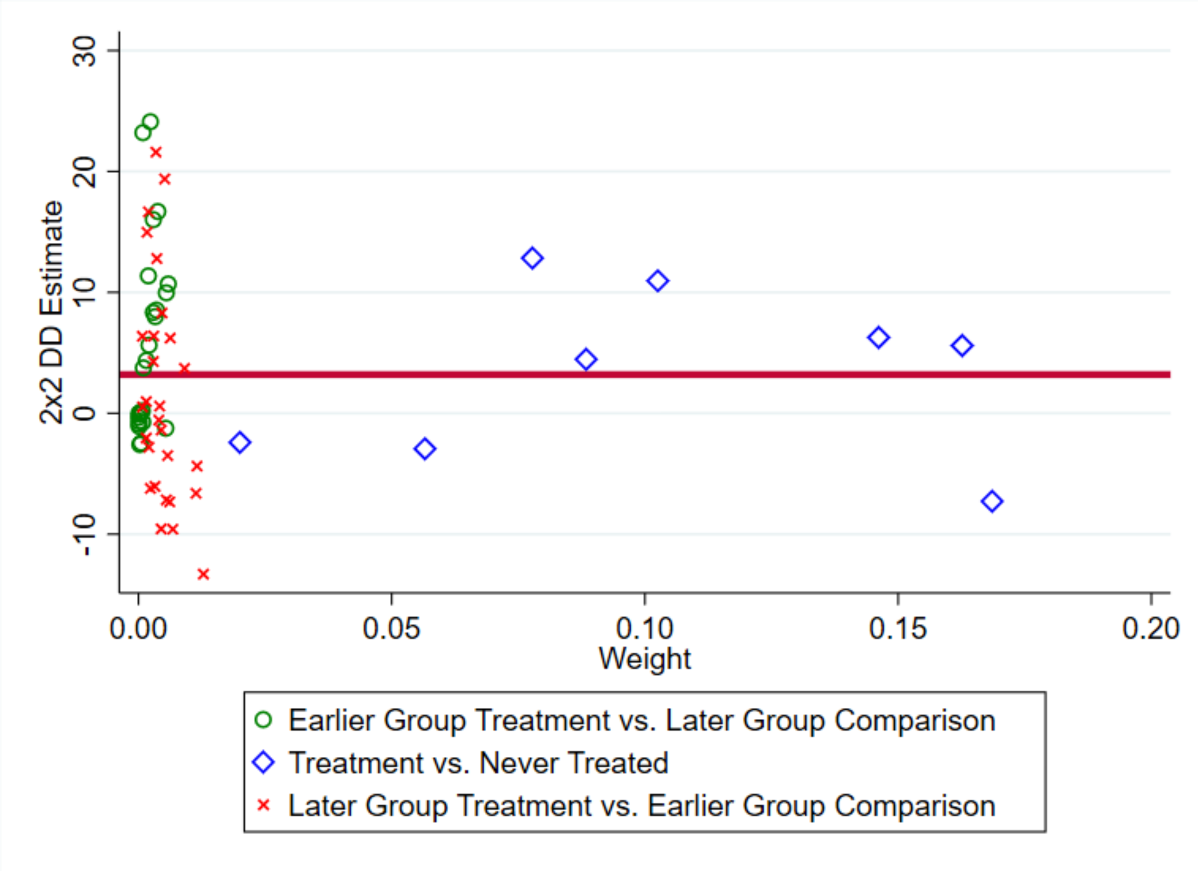
State	Year of repeal	Repeal state in analysis	Other entry barrier	Control state in analysis
Alabama				Yes
Alaska				Yes
Arizona	1986	Yes		No
Arkansas				No
California	1988	Yes		No
Colorado	1988	Yes		No
Connecticut				Yes
Delaware				Yes
Florida				No
Georgia				Yes
Hawaii				Yes
Idaho	1984	No		No
Illinois				Yes
Indiana	1999	No		No
Iowa				Yes
Kansas	1986	No	Section 1122	No
Kentucky				Yes
Louisiana				No
Maine				No

State	Year of repeal	Repeal state in analysis	Other entry barrier	Control state in analysis
Maryland				Yes
Massachusetts				Yes
Michigan				Yes
Minnesota	1986	No	Section 1122	No
Mississippi				Yes
Missouri				Yes
Montana				Yes
Nebraska				Yes
Nevada				No
New Hampshire	2016	Yes	Temporary federal moratorium	No
New Jersey				Yes
New Mexico	1983	No		No
New York	2006	Yes	Temporary federal moratorium	No
North Carolina				Yes
North Dakota				No
Ohio				No
Oklahoma				No
Oregon				Yes
Pennsylvania	1996	Yes		No
Rhode Island				Yes
South Carolina				Yes
South Dakota	1989	Yes		No
Tennessee				Yes
Texas	1986	Yes		No
Utah	1985	Yes		No
Vermont				No
Virginia				Yes
Washington				No
West Virginia				Yes
Wisconsin				No
Wyoming	1990	Yes		No

Note: The sources for the retention of Section 1122 in Minnesota and Kansas can be found in Simpson (1985) on pages 1226 and 1228, respectively. The table shows entry barriers for repeal states only.

Appendix B: Bacon decomposition of two-way fixed-effects estimate

FIGURE B.1. Bacon decomposition



Source: 1984–2018 POS files of the Centers for Medicaid and Medicare Services, and state population estimates for population aged 65+ from the SEER Program of the National Cancer Institute.

Note: The figure illustrates the Bacon decomposition of the two-way fixed effect model (TWFE), as referenced in table B.1. It shows the estimated overall treatment effect, represented by a horizontal line in each plot, which equals a weighted average of all potential two-group/two-period difference-in-difference (DD) estimates (Goodman-Bacon 2021). Each point on the plots corresponds to these estimates, marked with their respective weights.

TABLE B.1. Bacon decomposition for TWFE on long-term care hospitals

DD comparison	Weight	Average DD estimate
TWFE estimate		3.199
Earlier T vs. later C	0.048	8.837
Later T vs. earlier T	0.129	–0.983
T vs. never-treated	0.823	3.529
Observations		1,190

Note: This table presents the Bacon decomposition as presented by Goodman-Bacon (2021) for the two-way fixed-effects (TWFE) model. DD = difference-in-difference; T = treatment group; C = control group. The weight refers to the percentage of weight assigned by the model to each group.

Appendix C: Robustness: Dependent variable scaled by state population

TABLE C.1. Effect of CON repeal on long-term care hospitals per one million state population

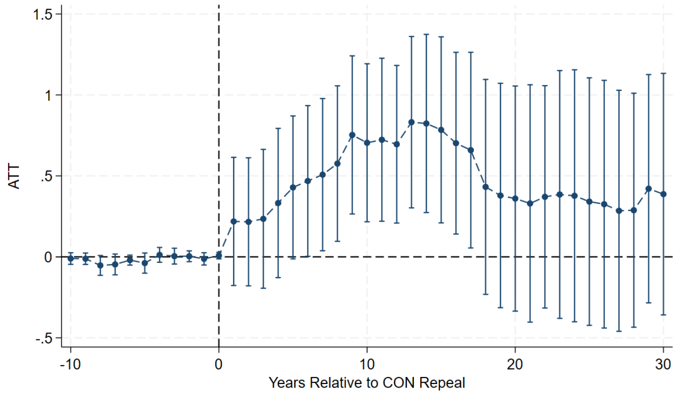
	(1)	(2)	(3)	(4)	(5)	(6)
ATT	0.4614*	0.5633**	0.5938**	0.4758*	0.5644**	0.5951**
	(0.2164)	(0.2089)	(0.2157)	(0.2129)	(0.2052)	(0.2126)
ATT: Group	0.3909**	0.4759**	0.5151***	0.4036**	0.4768***	0.5161***
	(0.1486)	(0.1410)	(0.1431)	(0.1455)	(1.374)	(0.1398)
ATT: Calendar	0.4343*	0.5262**	0.5525**	0.4470*	0.5272**	0.5538**
	(0.1943)	(0.1872)	(0.1918)	(0.1913)	(0.1837)	(0.1889)
Economic controls		✓	✓		✓	✓
Health controls		✓	✓		✓	✓
Demographic controls			✓			✓
Observations	1,190	1,190	1,190	1,190	1,190	1,190

Note: This table reports aggregated treatment effect parameters for the estimated impact of LTAC-CON repeal on long-term care hospitals per one million population. The sample period spans 1984–2018. Columns (1) through (6) apply the estimators proposed by Callaway and Sant'Anna (2021). The row labeled "ATT" in columns (1) through (6) represents the simple weighted average of all available group-time average treatment effects. The row "ATT: Group" aggregates the average treatment effects by the timing of the CON repeals, while the row "ATT: Calendar" aggregates them by year. Control groups in columns (1) through (3) consist of never-treated states, while columns (4) through (6) use not-yet-treated states. Column (2) adjusts for the state's unemployment rate and diabetes diagnosis rate, while column (3) controls for the unemployment rate, diabetes diagnosis rate, and share of the population ages 65 and older. Column (5) includes not-yet-treated states with controls for unemployment and diabetes diagnosis rates, and column (6) additionally controls for the share of the population ages 65 and older. Sources include the Provider of Services files from the Centers for Medicare and Medicaid Services, unemployment rates from the Bureau of Labor Statistics, diabetes diagnoses from the Centers for Disease Control and Prevention, and population data from the National Cancer Institute's SEER Program. Standard errors are clustered at the state level and shown in parentheses.

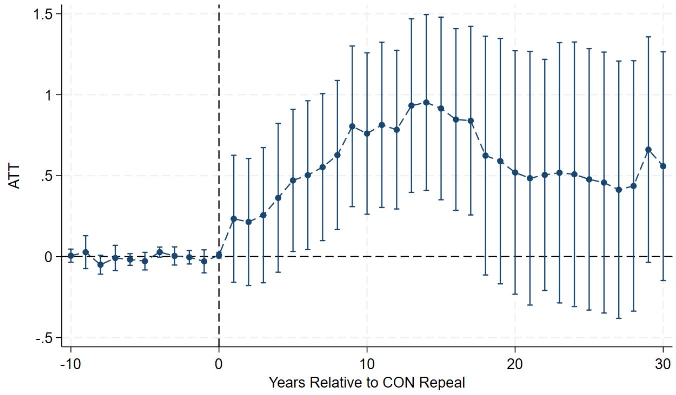
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

FIGURE C.1. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care hospitals, never-treated observations included in control group

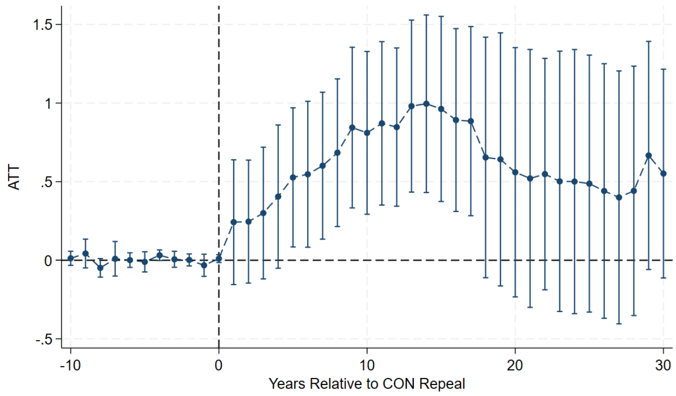
(1) No controls



(2) Health and economic controls



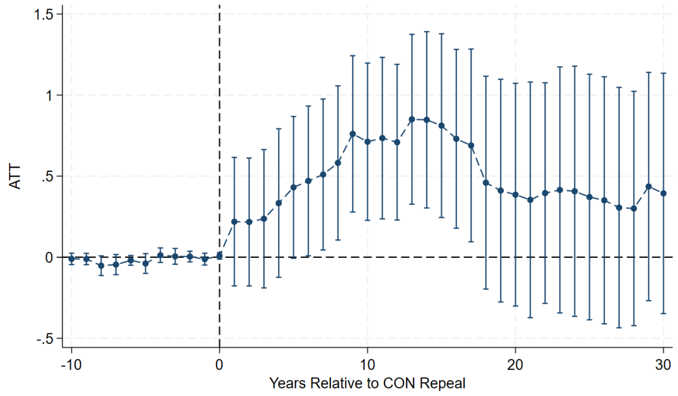
(3) Health, economic, and demographic controls



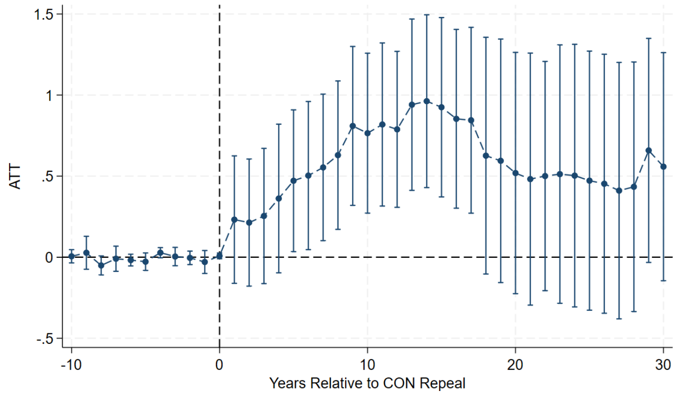
Note: These figures display the dynamic treatment effects of LTAC-CON repeal on long-term care hospitals per one million population, estimated using the Callaway and Sant'Anna difference-in-difference estimator including only never-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table C.1. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

FIGURE C.2. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care hospitals, not-yet-treated observations included in control group

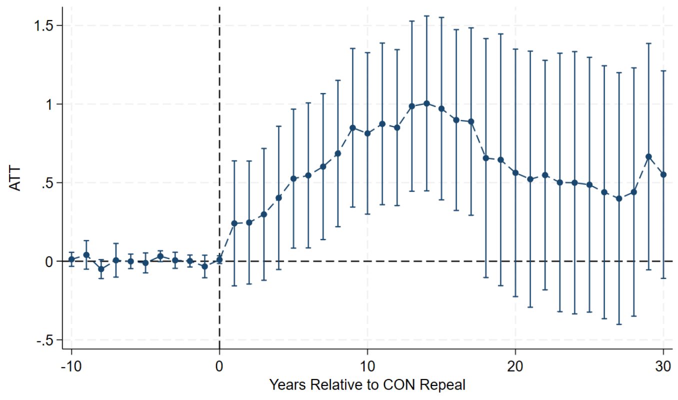
(4) No control variables



(5) Health and economic controls



(6) Health, economic, and demographic controls



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on long-term care hospitals per one million population, estimated using the Callaway and Sant'Anna difference-in-difference estimator including not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table C.1. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

TABLE C.2. Effect of CON repeal on beds per million state population 65+

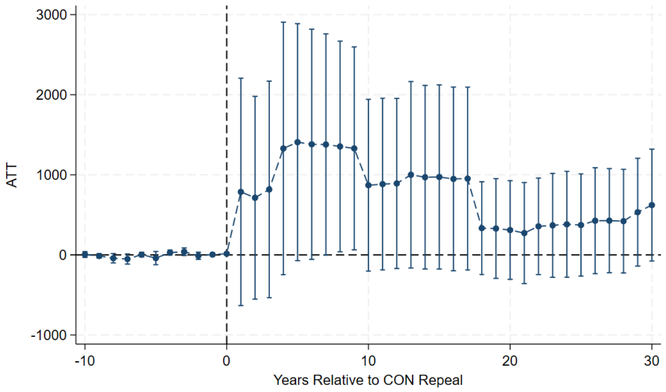
	(1)	(2)	(3)	(4)	(5)	(6)
ATT	1,058.0**	1,071.1**	1,114.6***	1,048.8**	1,046.9**	1,091.3**
	(391.0)	(338.8)	(332.8)	(387.4)	(339.8)	(333.0)
ATT: Group	911.5***	920.1***	976.7***	904.0***	899.8***	957.3***
	(198.5)	(174.7)	(184.4)	(192.1)	(171.8)	(179.8)
ATT: Calendar	1,003.8**	1,018.8**	1,056.4***	993.9**	995.6**	1,034.1***
	(368.5)	(320.8)	(313.7)	(365.1)	(321.5)	(313.5)
Economic controls		✓	✓		✓	✓
Health controls		✓	✓		✓	✓
Demographic controls			✓			✓
Observations	1,190	1,190	1,190	1,190	1,190	1,190

Note: This table reports aggregated treatment effect parameters for the estimated impact of LTAC-CON repeal on long-term care beds per one million population ages 65 and older. The sample period spans 1984–2018. Columns (1) through (6) apply the estimators proposed by Callaway and Sant'Anna (2021). The row labeled "ATT" in columns (1) through (6) represents the simple weighted average of all available group-time average treatment effects. The row "ATT: Group" aggregates the average treatment effects by the timing of the CON repeals, while the row "ATT: Calendar" aggregates them by year. Control groups in columns (1) through (3) consist of never-treated states, while columns (4) through (6) use not-yet-treated states. Column (2) adjusts for the state's unemployment rate and diabetes diagnosis rate, while column (3) controls for the unemployment rate, diabetes diagnosis rate, and share of the population ages 65 and older. Column (5) includes not-yet-treated states with controls for unemployment and diabetes diagnosis rates, and column (6) additionally controls for the share of the population ages 65 and older. Sources include the Provider of Services files from the Centers for Medicare and Medicaid Services, unemployment rates from the Bureau of Labor Statistics, diabetes diagnoses from the Centers for Disease Control and Prevention, and population data from the National Cancer Institute's SEER Program. Standard errors are clustered at the state level and shown in parentheses.

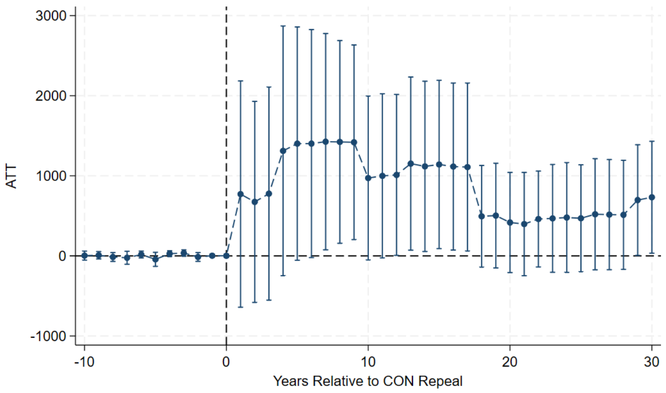
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

FIGURE C.3. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care beds, never-treated observations included in control group

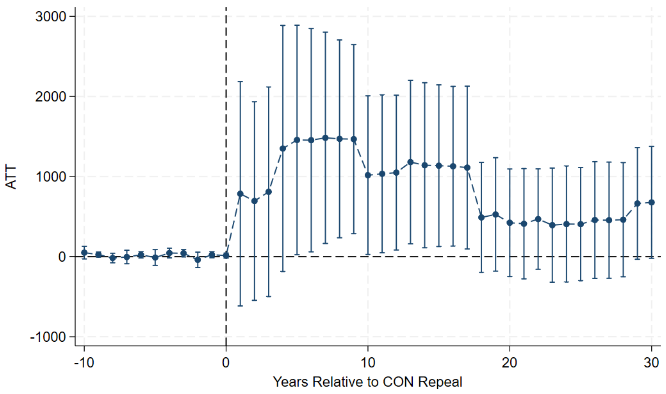
(1) No controls



(2) Health and economic controls

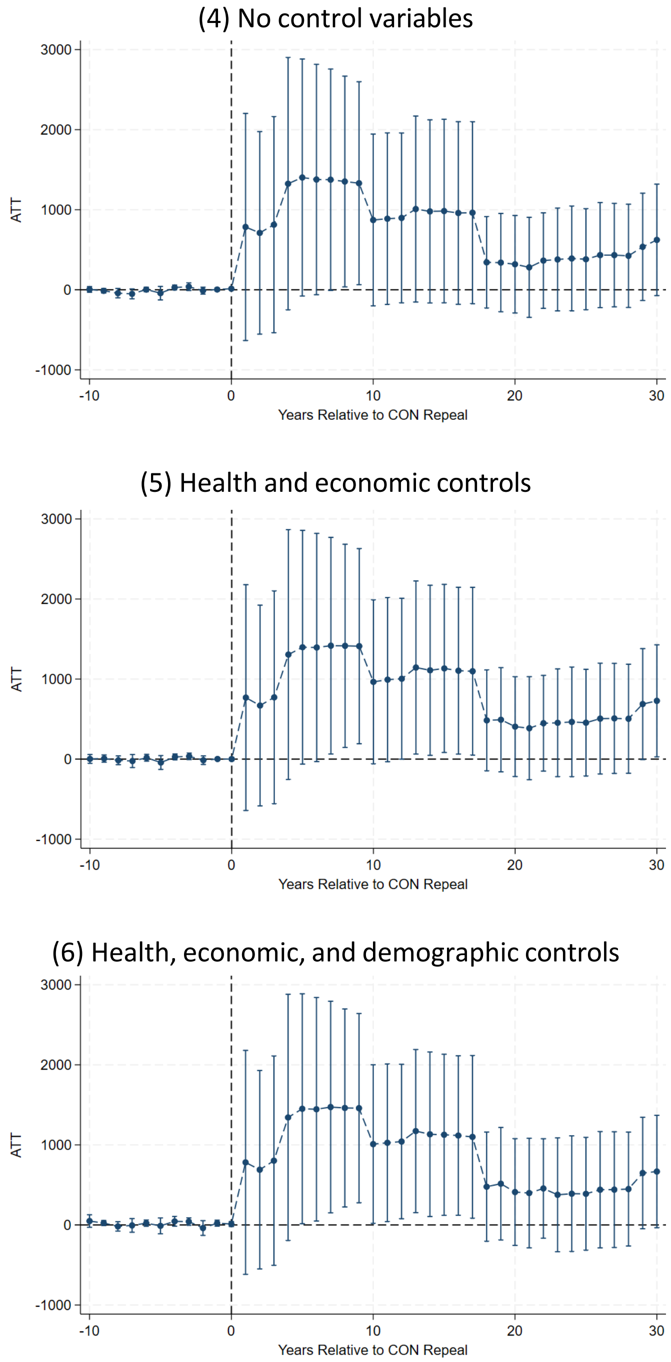


(3) Health, economic, and demographic controls



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on LTAC beds per million elderly, estimated using the Callaway and Sant'Anna difference-in-difference estimator including only never-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table C.2. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

FIGURE C.4. Event studies: Estimated effects of LTAC-CON repeal impact on long-term care beds, not-yet-treated observations included in control group



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on LTAC beds per million elderly, estimated using the Callaway and Sant'Anna difference-in-difference estimator including not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table C.2. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the state level across all models.

Appendix D: Nursing home outcomes

TABLE D.1. Effect of LTAC entry on bedsores in nursing homes

	2005–10		2011–18	
	Never treated	Not yet treated	Never treated	Not yet treated
ATT	–0.016	–0.017	–0.093	–0.093
	(0.276)	(0.278)	(0.102)	(0.102)
Observations	148,125	148,125	215,060	215,060

Note: The measure for bedsores captures the percentage of PAC residents with new or worsening stage II–IV pressure ulcers. This measure is adjusted for patient characteristics including mobility, diabetes diagnoses, and body mass index. The measure for pain captures the percentage of PAC residents with one or more episodes of moderate to severe pain or any horrible or excruciating pain during the past five days. This measure is not adjusted for patient characteristics. The measure for bedsores was updated as part of an overhaul to Nursing Home Compare in 2010. We therefore conduct our analyses over two time periods: 2005–10 and 2011–18.

TABLE D.2. Effect of LTAC entry on pain in nursing homes

	Never treated	Not yet treated
ATT	0.638	0.650
	(0.483)	(0.482)
Observations	414,074	414,074

Source: Nursing Home Compare dataset provided by the Centers for Medicare and Medicaid Services for the years 2005–18. These measures are available quarterly starting in 2005 for the universe of nursing homes certified to operate in the United States through the Nursing Home Compare website, https://www.medicare.gov/care-compare/?redirect=true&providerType=NursingHome.

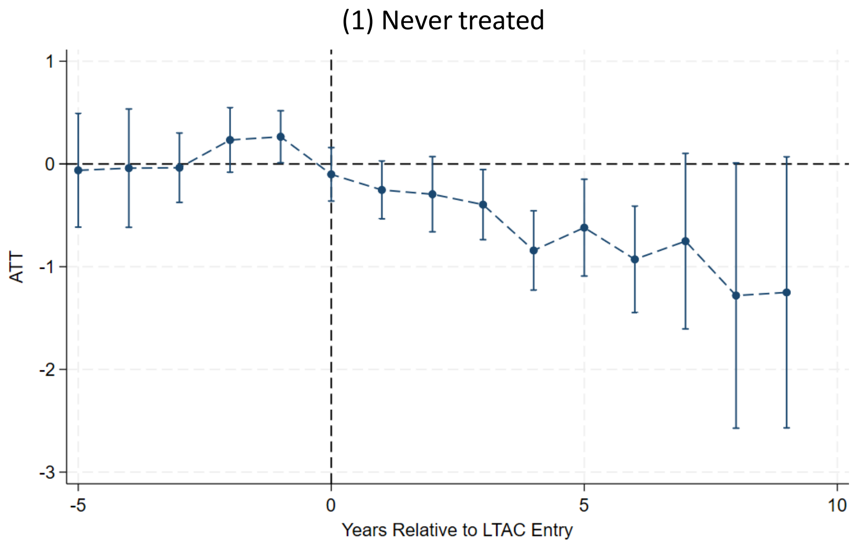
TABLE D.3. Effect of entry of LTACs into market on nursing home outcomes, 2000–10

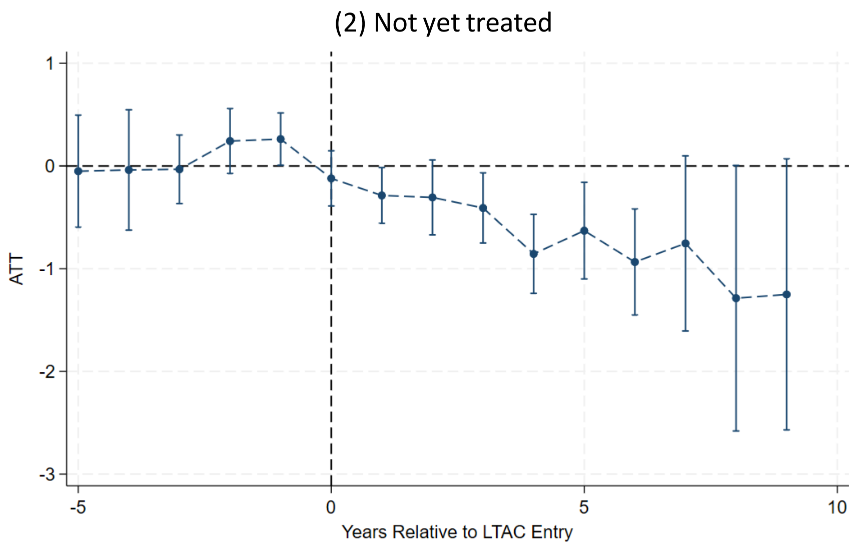
	(1)	(2)	(3)	(4)	(5)	(6)
Rehospitalization rate	–0.423***	–0.426***	–0.393***	–0.462***	–0.455***	–0.425**
	(0.128)	(0.129)	(0.129)	(0.128)	(0.129)	(0.130)
N	66,101	66,101	66,101	66,101	66,101	66,101
Falls	–0.143	–0.158	–0.182	–0.131	–0.148	–0.167
	(0.134)	(0.136)	(0.136)	(0.135)	(0.137)	(0.137)
N	45,071	45,071	45,071	45,071	45,071	45,071
Restraints	–0.077	0.164	0.356+	–0.112	–0.112	0.316
	(0.190)	(0.193)	(0.192)	(0.190)	(0.193)	(0.193)
N	120,705	120,705	120,705	120,705	120,705	120,705
Economic controls		✓	✓		✓	✓
Health controls		✓	✓		✓	✓
Demographic controls			✓			✓

Note: This table reports aggregated treatment effect of entry of LTACs into market on nursing home outcomes. The sample period spans 2000–10. Columns (1) through (6) apply the estimators proposed by Callaway and Sant'Anna (2021). The row labeled "Rehospitalization rate" in columns (1) through (6) represents the simple weighted average of all available group-time average treatment effects for patients who were hospitalized 30 days after being discharged. The row "Restraints" represents the simple weighted average of the admitted residents who had to be restrained while in care. The row "Falls" represents the simple weighted average of the admitted residents who fell in the past 30 days while in care. Control groups in columns (1) through (3) consist of never-treated states, while columns (4) through (6) use not-yet-treated states. Column (2) adjusts for the state's unemployment rate and diabetes diagnosis rate, while column (3) controls for the unemployment rate, diabetes diagnosis rate, and share of the population ages 65 and older. Column (5) includes not-yet-treated states with controls for unemployment and diabetes diagnosis rates, and column (6) additionally controls for the share of the population ages 65 and older. Sources include the Provider of Services files from the Centers for Medicare and Medicaid Services, unemployment rates from the Bureau of Labor Statistics, diabetes diagnoses from the Centers for Disease Control and Prevention, and population data from the National Cancer Institute's SEER Program. Falls, 30-day rehospitalization, and restraints data are from the LTCFocus database at the Brown University Center for Gerontology and Healthcare Research. Standard errors are clustered at the nursing home level and shown in parentheses.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

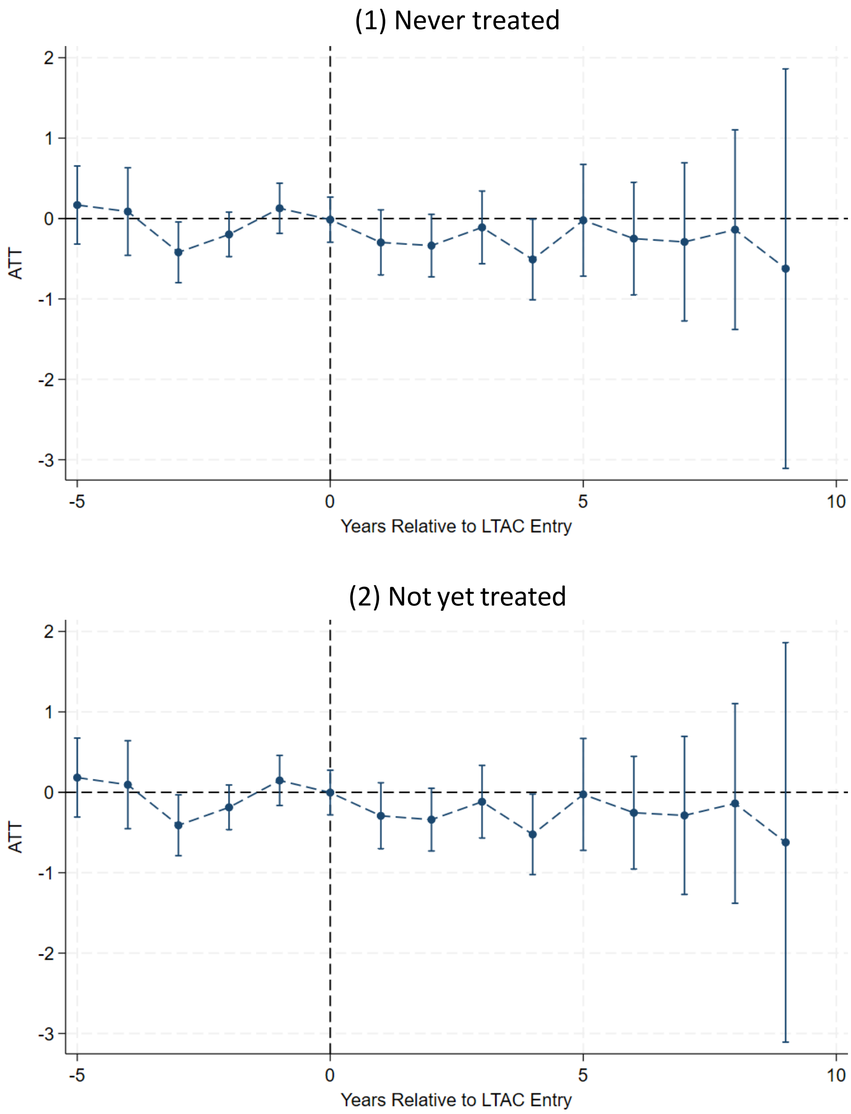
FIGURE D.1. Event studies: Estimated effects of LTAC-CON Repeal impact on rehospitalization rates, 2000–10





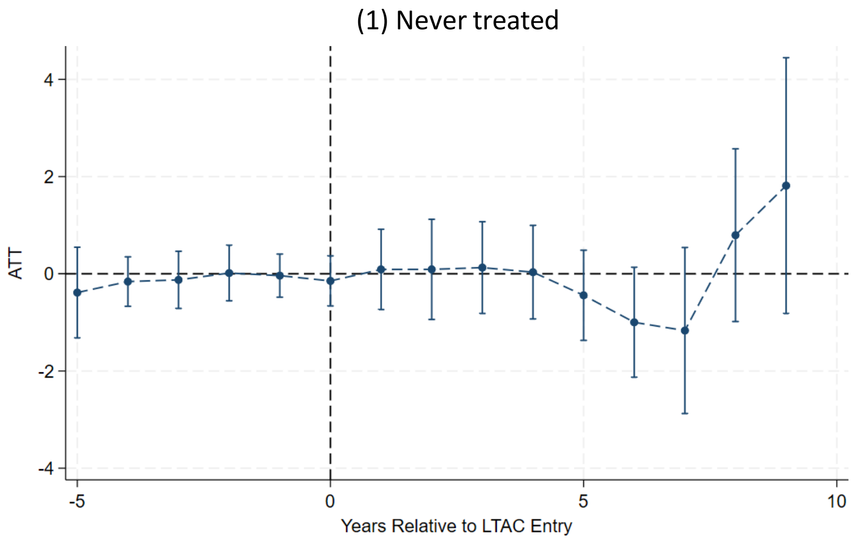
Note: These figures display the dynamic treatment effects of LTAC-CON repeal on 30-day rehospitalization rates, estimated using the Callaway and Sant'Anna difference-in-difference estimator including never-treated and not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table D.3. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the nursing home level across all models.

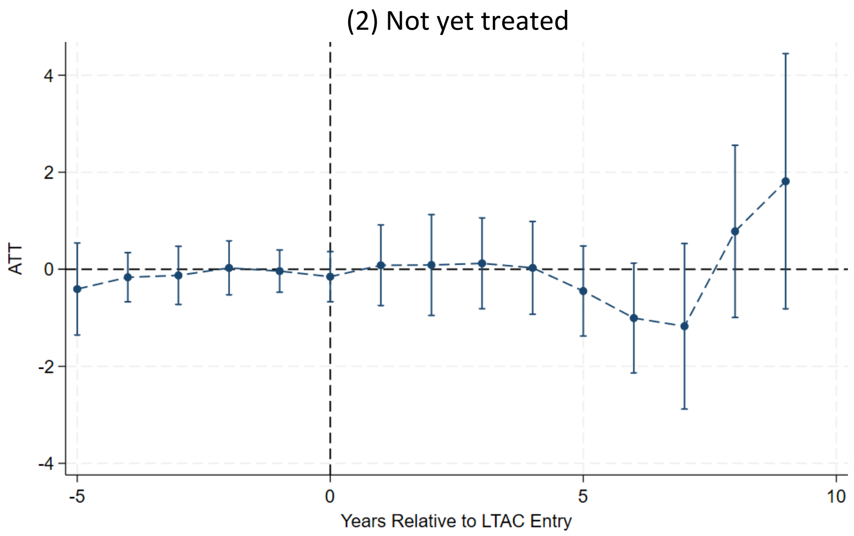
FIGURE D.2. Event studies: Estimated effects of LTAC-CON repeal impact on falls, 2000–10



Note: These figures display the dynamic treatment effects of LTAC-CON repeal on fall rates, estimated using the Callaway and Sant'Anna difference-in-difference estimator including never-treated and not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table D.3. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the nursing home level across all models.

FIGURE D.3. Event studies: Estimated effects of LTAC-CON repeal impact on restraints used, 2000–10





Note: These figures display the dynamic treatment effects of LTAC-CON repeal on restraints used rates, estimated using the Callaway and Sant'Anna difference-in-difference estimator including never-treated and not-yet-treated states in the control group. The panel number on each plot corresponds to the ATT columns in table D.3. Each plot shows the estimated ATT values with 95 percent confidence intervals, where each mark represents the ATT estimate for each year relative to the repeal events. Standard errors are clustered at the nursing home level across all models.

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