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LOSING MEDICAID:
WHAT HAPPENS TO HOSPITALIZATIONS?

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Losing Medicaid: What happens to hospitalizations?
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ABSTRACT

There is substantial evidence on the impact of gaining insurance on healthcare service utilization and financing. Less is known about effects of losing insurance, but there are reasons to expect non-symmetric impacts of insurance losses relative to gains. The dearth of causal evidence on insurance loss is concerning in light of the current unwinding of the temporary COVID-19 pandemic era Medicaid expansions. While research on the 2023 Medicaid contraction will build over time, here we draw lessons from a previous large scale sudden Medicaid eligibility contraction that occurred in Tennessee in 2005, to understand impacts of losing Medicaid on the use and financing of hospitalizations. We find that hospital service utilization declined in Tennessee post-policy by 4.6%, and that among hospitalizations that occurred, the use of insurance generally and Medicaid specifically to pay for services fell. Patients replaced 28% of the Medicaid loss of hospitalizations with increased use of other public insurance. These findings suggest that Medicaid insurance contractions meaningfully reduce hospital use but that patients may be able to substitute with other public insurance options.

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1 Introduction

Medicaid is the largest single source of health insurance in the United States (Centers for Medicare & Medicaid Services, 2023b), covering 86M Americans in March 2023 (Centers for Medicare & Medicaid Services, 2023a). The program primarily insures lower−income, disabled, and pregnant people. Medicaid costs represented 17% of national healthcare expenditures in 2021 (Congressional Research Service, 2023) at $728B (Kaiser Family Foundation, 2023), which is more than annual expenditures on other important social programs including the Earned Income Tax Credit – $64B (IRS, 2023), Supplemental Security Income – $55.4B (Social Security Administration, 2023),[1] and Workers Compensation – $58.9B (National Academy of Social Insurance, 2022).[2] As such, Medicaid is the largest U.S. social program in terms of enrollment and expenditures (Donohue et al., 2022), and is a crucial component of the American social safety net.

There is a large literature examining the impact of gaining Medicaid coverage on healthcare, health, financial, and other social outcomes such as crime and evictions (Wen et al., 2017; Hu et al., 2018; Mazurenko et al., 2018; Allen et al., 2019; Gruber and Sommers, 2019; Guth et al., 2020; Soni et al., 2020; Miller et al., 2021; Baicker and Finkelstein, ND). While findings vary across studies to some extent, generally gaining access to Medicaid leads to increased healthcare utilization and reduces mortality risk, and provides financial protection to enrollees who would otherwise need alternative means to pay (and potentially incur debt over) medical bills. Moreover, Medicaid coverage is linked with reduced crime, evictions, and child neglect, generally without substantial negative distortions to labor markets. While Medicaid expansions are arguably some of the most well−studied healthcare policies in the U.S.,[3] much less is known about the importance of policies that contract Medicaid coverage (discussed in Section 2.2).

[1] This figure represents federal expenditures.

[2] All estimates as of 2021 with the exception of Workers Compensation, 2020 is the most recent year of data available at the time of writing.

[3] For example, Guth et al. (2020) located 404 studies of ACA Medicaid expansion impacts released between January 2014 and January 2020.

There are various reasons to suspect that gaining and losing Medicaid will not have symmetric effects on healthcare use which suggests that extrapolating from the broad body of evidence on gaining coverage to losing coverage could be mis-guided. A Medicaid enrollee can accumulate 'patient education,' which may persist following the loss of coverage. Such education could include information on underlying health status, chronic condition management, and generally how to interact with the healthcare delivery system (Tello-Trillo, 2021). Even if the enrollee is able to obtain a different source of insurance post-coverage loss, due to differences in plan networks, there may be changes or discontinuity in providers and treatment received. Medicaid is an in−kind income transfer and income losses have larger impacts than (equally−sized) income gains (Kahneman et al., 1991). Charity care or heavily discounted care might offset some of the declines in healthcare use following an insurance loss (Dranove et al., 2016). In terms of policy changes that lead to gaining or losing Medicaid, policies that curtail coverage are generally unanticipated by enrollees, suggesting that those losing coverage have less time to plan for the policy-induced change in insurance coverage.[4] Finally, there may be psychic costs associated with losing coverage (for example, worries about the potential financial burden one must face without coverage) that could lead to differential impacts.

In addition to economically important reasons for studying the effect of losing insurance, there are practical reasons for such analyses as well. In response to the COVID-19 pandemic, a public health emergency (PHE) was declared by then-Secretary of Health and Human Services Alex Azar January 31 2020. As part of the PHE, the federal government provided states with incentives to maintain eligibility and continuous care provisions for Medicaid enrollees. As a result, Medicaid coverage increased by 31% (21M people) between February 2020 and January 2023 (Dague and Ukert, 2023). Beginning in March 2023, states have the authority to end PHE continuous Medicaid coverage over

[4]For example, the policy change we study, described later in the manuscript, was largely unexpected by enrollees and current curtailment of Medicaid through the unwinding of the COVID-19 continuous Medicaid coverage appears to be unexpected by many enrollees losing coverage (Tolbert, 2023).

a one-year 'unwinding' period. During the unwinding, states are required to systematically re-determine program eligibility for all current Medicaid enrollees. Estimates suggest that eight to 24M Americans will lose Medicaid coverage with the unwinding, and many of those losing coverage will be removed from Medicaid rolls for procedural rather then eligibility reasons (Burns et al., 2023; Tolbert, 2023). Those losing coverage are likely to be especially vulnerable: disabled persons, older adults, immigrants, recent migrants, and people with limited English proficiency (Tolbert, 2023). Moreover, 13 states have adopted 'work requirements' as part of Medicaid eligibility criteria with non−compliant enrollees being disenrolled (Guth and Musumeci, 2022).[5] Though unsuccessful to date, federal lawmakers have also proposed work requirements for enrollees. The Limit, Save, and Grow Act (LSGA) of April 2023 is the most recent effort developed by House Republicans. If adopted, LSGA would require all adults ages 19−55 without dependents to meet work requirements to remain eligible for Medicaid. The Congressional Budget Office predicts that, if LSGA was adopted nationally, 1.5M low-income Americans would lose Medicaid (Congressional Budget Office, 2023).

In this study, we add new, timely, and policy relevant evidence on the impact of <u>losing</u> Medicaid coverage on hospitalizations. We exploit a very large and unexpected disenrollment that occurred in the state of Tennessee in August 2005 through a contraction of Medicaid eligibility. The state disenrolled an expansion group of enrollees ('TennCare') which included 'un-insurable' non-elderly non-disabled and childless adults (Farrar et al., 2007). The disenrollment was unexpected and lead to 190,000 enrollees (14% of all enrollees and 3% of the state population) losing coverage in a matter of months (Farrar et al., 2007). We combine administrative data sources on community hospitalization use and financing with a difference-in-differences design over the period 2002−2007. Other Southern states serve as our counterfactual for Tennessee. We find

[5] As of May, 2022 13 states have an approved waiver from the Centers for Medicare and Medicaid Services to implement work requirements in the Medicaid program and nine states have a pending waiver for such requirements (Guth and Musumeci, 2022).

that, post-disenrollment, hospitalizations declined and expected payment sources shifted away from Medicaid and towards other public sources. While our coefficient estimates are imprecise, we offer suggestive evidence that some patients financed more care out of pocket post−disenrollment and some patients were able to use private coverage. Finally, in an extension, we provide suggestive evidence that all−cause mortality among non-elderly adults increased following the policy change, which is in line with the hypothesis that the hospitalizations that did not occur were not unnecessary or low−value care.

Our work contributes to at least three literatures. First, we add to the literature on the role of insurance in determining healthcare use and financing. We focus on losing coverage while much of the literature to date examines policies that lead to insurance gains. Second, we contribute methodologically by documenting the limitations of using data that not representative at the level of treatment in a difference-in-differences setting. There has been a recent surge in our understanding of difference-in-differences methods. Econometricians have highlighted the importance of using two-way fixed-effects with a staggered policy rollout, challenges with pre-trend testing, and implications of using different functional forms and including time-varying covariates (de Chaisemartin and d'Haultfoeuille, 2020; Callaway and Sant'Anna, 2021; Caetano et al., 2022; Roth and Sant'Anna, 2023; Roth et al., 2023). To the best of our knowledge, there has been less research on the underlying data used in the difference-in-differences analysis, which is our focus. More specifically, we outline a potential diagnostic tool using simulation methods and a solution. Third, we add to the literature that examines the link between insurance and mortality, focusing on public insurance and non-elderly and non-disabled adults.[6]

[6] Although, as we describe later in the manuscript, our mortality findings may be vulnerable to bias from differential pre-trends and thus we interpret these findings with a high degree of caution.

2 Institutional background and literature

2.1 The TennCare program

Medicaid has historically provided coverage only to low−income populations that the federal government mandated the program serve, such as children, pregnant people, parents, and disabled individuals. Prior to the Affordable Care Act (ACA), the federal government did not routinely share the costs of enrollees ineligible for traditional Medicaid (mostly low-income, childless adults), referred to as 'optional' or 'expansion' populations. Accordingly, most states denied Medicaid to these populations.

One of the ways in which states could extend Medicaid coverage to expansion populations prior to the ACA was through section 1115 demonstration waivers of the Social Security Act. States had to obtain authorization from the Health Care Financing Administration (HCFA). Tennessee obtained approval from HCFA for a Medicaid demonstration project, TennCare, in November 1993. TennCare was created to reduce uninsurance and contain healthcare costs. In January 1994, Tennessee placed all enrollees in managed care organization plans, aiming to control costs and use the savings generated to provide subsidized Medicaid coverage to the expansion population. Uninsured individuals who qualified for TennCare coverage included those without employer-sponsored insurance but whose income was too high to qualify for public insurance.[7] The demonstration project resulted in Tennessee achieving the highest Medicaid coverage rate of any state in the country, with 23% of the population enrolled in TennCare in 2004 (Farrar et al., 2007). TennCare covered a range of services such as preventive care, prescriptions, imaging, mental healthcare, and hospital services with low cost−sharing.

Despite these efforts, Tennessee was unable to sustain the cost-control objective for the TennCare program, and the state submitted a waiver amendment proposal to the

[7]Eligibility included beneficiaries' annual income to be less than 400% of the federal poverty level. The expansion population included non-elderly adults who (1) were 'uninsured' on March 1, 1993 and had continued to be without insurance thereafter or (2) belonged to the 'uninsurable' category – those denied insurance due to pre-existing conditions (Moreno and Hoag, 2001).

Centers for Medicare and Medicaid Services (CMS, formerly HCFA) in September 2004 to roll back the expansion. In November 2004, Governor Phil Bredesen announced that TennCare would stop covering the expansion population (Chang and Steinberg, 2016). CMS approved the proposal in March 2005, which authorized disenrollment of TennCare beneficiaries over age 19 who were not eligible for the open Medicaid categories.[8]

The disenrollment took place within a span of three months beginning late July 2005. In 2004, administrative records showed that there were 1,340,824 beneficiaries of Tennessee Medicaid, of whom 1,079,975 were in mandatory categories and 260,849 were in expansion categories. Nearly 160,000 adults belonging to the expansion population had been disenrolled from TennCare by the fourth quarter of 2005, which represented a 12% reduction in Medicaid enrollment in the state. By 2006, the total number of adult TennCare beneficiaries disenrolled reached approximately 190,000 (14% of enrollees). The disenrolled group was predominantly composed of non−disabled and non-elderly adults without dependent children in the household (Garthwaite et al., 2014). We can compare the scale of the TennCare disenrollment to recent policy changes. For example, eight to 24M people are predicted to lose Medicaid through the unwinding (Tolbert, 2023). Medicaid covered 86M people in March 2023 (Centers for Medicare & Medicaid Services, 2023a), which implies that 9.3% to 27.9% will lose coverage do to the unwinding. Thus, in percentage terms, these policies could have similar−sized effects.

Losing TennCare should increase the out-of-pocket prices of healthcare to disenrollees which, in turn, will decrease the quantity of services demanded (Grossman, 1972). However, how losing TennCare will impact hospitalizations specifically is unclear *ex ante*. The effect of losing TennCare could have a chilling effect on all healthcare as those without coverage tend to use fewer services overall (Decker et al., 2013). In addition, disenrolled people may delay or avoid preventive care or services related to chronic con-

[8]We acknowledge that coverage generosity was curtailed to some extent among continuing enrollees. Nonetheless, coverage remained relatively generous and, in line with the broader TennCare literature, we assume that the effects of insurance losses dwarfed the effects of other changes.

ditions (Tarazi et al., 2017; DeLeire, 2019), which could lead to worsening health and a need for (more intensive) hospital care. Hospitals are required to treat and stabilize all patients regardless of ability to pay through the 1986 Emergency Medical Treatment & Labor Act, suggesting that hospitals may disproportionately provide care for those losing insurance. Finally, many providers do not accept Medicaid due to low reimbursement rates, administrative burden, and so forth (Decker, 2013). Losing coverage that cannot be used to pay for services may have limited impacts on healthcare use and financing.

In terms of financing care, we expect that using Medicaid to pay for hospitalizations will decline following the disenrollment, but disenrollees may be able to (at least partially) substitute other forms of coverage. Some disenollees may be eligible for Medicare if they have disabilities and qualify through the Social Security Disability Insurance program. Disenrollees could find employment that offers employer-sponsored insurance or purchase insurance individually. Care that is not financed by these sources will likely be shouldered by patients or hospitals if patients cannot pay.

2.2 Literature

To date a relatively small literature has examined the impact of the TennCare disenrollment on coverage and healthcare utilization.[9]

The literature to date demonstrates that the TennCare disenrollment reduced overall insurance coverage and Medicaid coverage (Garthwaite et al., 2014; DeLeire, 2019; Tello-Trillo, 2021; Maclean et al., 2023). Garthwaite et al. (2014) find that, post-disenrollment, the probability of having Medicaid declined 33% among low-income, childless, and non-disabled adults using survey data. The extent to which patients substituted other coverage sources of is less clear (Garthwaite et al., 2014; DeLeire, 2019; Tello-Trillo, 2021).

In terms of healthcare utilization, previous studies use survey data to show that the disenrollment reduced reported use of healthcare (both preventive and ambulatory) and

[9]Additional studies have explored the effect of TennCare on other outcomes such as labor supply and financial well−being (Garthwaite et al., 2014; Argys et al., 2020; Ham and Ueda, 2021).

reporting a regular healthcare provider, and increased reported unmet need for care and cost barriers associated with care (Tarazi et al., 2017; DeLeire, 2019; Tello-Trillo, 2021). Using administrative data from the American Hospital Association, Garthwaite et al. (2018) find that provision of uncompensated care increased disenrollment.

In the paper arguably most similar to the current study, Maclean et al. (2023) show that hospitalizations for substance use disorders declined post-disenrollment, but changes in mental health disorder hospitalizations were unchanged. The authors only considered these two outcomes. While these outcomes are important, they capture just 6.7% of community hospital inpatient stays (Heslin et al., 2015) and such conditions are perceived as more discretionary than other forms of healthcare (Frank and McGuire, 2000), and may not provide a complete picture of how losing Medicaid impacts the use of hospital care. We extend this study by considering community hospitalizations for all causes.

3 Data and methods

3.1 Hospitalization data

We combine the universe of community hospitals in Tennessee from the Tennessee Department of Health (DOH) and a sample of such hospitalizations in other Southern states using the National Inpatient Sample (NIS) over the period 2002−2007. We begin the study period in 2002 as Tennessee implemented a major re−certification of all current Medicaid enrollees in 2002 (Farrar et al., 2007), and we close the panel in 2007 to avoid confounding from the Great Recession (Garthwaite et al., 2014). However, we show that our results are robust to including early and later years.

The NIS is an administrative database managed by the Healthcare Cost and Utilization Project (HCUP). NIS capture a 20% sample of U.S. hospitals, including five to eight million hospitalizations at over more than 1,000 hospitals per year (Barrett et al., 2010). The data are not representative at the level of the state (which is the level at which our treatment varies) and survey administrators advise against using the data for analysis of state−level treatments. As shown by Maclean et al. (2023), combining the DOH hospital data for Tennessee and the NIS for other Southern states has better properties for difference-in-differences methods that we use in this paper. We provide a comparison of trends for Tennessee in the DOH and NIS, and replicate simulation analysis conducted by Maclean et al. (2023) in Section 4. Results from this analysis support our combined use of the two data sets over relying fully on the NIS.

We focus on total inpatient hospitalizations by payer type[10] among adults 21−64 years as this is the population most likely to be directly impacted by the disenrollment (though we will use patients 65 years and older in a placebo analysis). Because we cannot isolate those patients losing coverage with the disenrollment, our coefficient estimates will have the interpretation of 'intent-to-treat.' Payer type information available is the expected payer at admission. The DOH and NIS data include up to two expected payers. We consider the following expected payer sources based on the first or second listed expected payer: Medicaid, any insurance, private, Medicare, and self-pay.[11]

We measure all outcomes at the hospital-quarter level, that is we have the number of discharges per hospital (in the DOH and NIS data) or the probability that a specific payer was the expected source of payment for the hospitalization. We have 12,048 hospital-year-quarter observations. We do not weight the DOH data as we have the universe of community hospitals, but we weight the NIS data using HCUP−provided weights.

We focus on a single healthcare service: hospitalizations. However, hospitalizations are a central component of healthcare in terms of costs and access to care. In 2021, the U.S. spent $4.3T on healthcare services, with hospital care accounting for $1,323.9B (Centers for Medicare & Medicaid Service, 2023). Attempts to contain growing healthcare expenditures must include hospital care. The cost of community hospitalizations[12]

[10] Our data use agreement with the Tennessee DOH does not allow us to separately consider types of hospitalizations, which would otherwise have lead to us exploring heterogeneity by hospitalization type.

[11] The variables in the DOH and NIS are fully comparable as the data are provided in the same format.

[12] The American Hospital Association (2023) defines a community hospital as follows: 'all non-federal,

(the focus of our study) are \$526B per year in the U.S. (American Hospital Association, 2023).[13] Each year 5% to 6% of the U.S. population experiences a community hospitalization (American Hospital Association, 2023). Patients can receive primary care, acute care services, inpatient rehabilitation, outpatient consultations, specialist referrals, child healthcare, therapy and rehabilitation services, injury and illness care, health clinic care, and health education. In many localities (in particular rural localities), the community hospital may offer the principal point of access to care for residents. Thus, from both a healthcare financing and an access to care perspective, understanding how community hospitalization use and payment varies with public policies is important.

3.2 Methods

We estimate the difference-in-differences (DID) regression outlined in Equation 1:

$$Y_{h,s,q,t} = \beta_0 + \beta_1 DID_{s,q,t} + \beta_2 Pop_{s,q,t} + \alpha_h + \alpha_q + \alpha_t + \epsilon_{h,s,q,t} \tag{1}$$

where $Y_{h,s,q,t}$ represents a hospitalization or insurance outcome for hospital h in state s and in quarter q in year t. $DID_{s,q,t}$ is an indicator taking on a value of one in Tennessee after the disenrollment and zero otherwise. $Pop_{s,q,t}$ is the quarterly state non-elderly population using data on population from the U.S. Census Bureau (University of Kentucky Center for Poverty Research, 2023) and age-shares constructed from the Current Population Survey (Flood et al., 2022). α_h is a vector of hospital fixed-effects, and α_q and α_t are vectors of quarter and year fixed-effects. $\epsilon_{h,s,q,t}$ is the error term.

Community hospitalizations in Tennessee form our treatment group. We use hospitals in other Southern states that appear in the NIS as our comparison group. In the NIS,

short-term, general, and other special hospitals including academic medical centers or other teaching hospitals.' In 2022, 84% of all hospitals were community hospitals, and 94% of total hospital admissions were to community hospitals.

[13] We construct this cost estimate by inflating the average cost per inpatient stay from \$14,101 in 2019 dollars to 2023 dollars (\$16,447) using the the Consumer Price Index and multiplying by the number of admissions to community hospitals in 2022 (31,967,073).

we observe the following states (years): Arkansas (2004−2007), Florida (2002−2007), Georgia (2002−2007), Kentucky (2002−2007), Maryland (2002−2007), North Carolina (2002−2007), Oklahoma (2005−2007), South Carolina (2002−2007), Texas (2002−2007), Virginia (2002−2004 and 2006−2007), and West Virginia (2002−2007).

We have a single treated unit (Tennessee) and a small number of clusters (18 states). Thus, we follow Garthwaite et al. (2014); Tello-Trillo (2021); and Maclean et al. (2023), and apply a modified block-bootstrap procedure to calculate standard errors.

Unadjusted trends in quarterly hospitalizations for Tennessee and other Southern States are reported in Figure 1 Panel A, and Figure 1 Panel B reports these trends for Medicaid as the expected payer. While trends are not identical, the two groups of states appear to move broadly in parallel pre−2005.

4 Combining datasets

As stated in Section 3.1, the NIS is not designed to be state representative. HCUP administrators provide the following guidance to researchers using these data: '. . . strongly advises researchers against using the NIS to estimate state-specific statistics. . . . However, these NIS samples were not designed to yield a representative sample of hospitals at the state level' (Healthcare Cost and Utilization Project, 2016). The NIS is representative at the level of the region over our study period, thus we are less concerned about the representativeness of our comparison group (Maclean et al., 2023).

Given this background, we follow Maclean et al. (2023) and combine the universe of community hospitals using administrative data from the DOH for Tennessee and the NIS for other Southern states. In this section, we compare trends in the number of community hospitals and average community hospitalizations in the NIS and DOH over our study period (2002−2007) and conduct a simulation to demonstrate the value of using the combined dataset.

Figure 2 (Panel A) reports the number of hospitals in Tennessee (DOH data which captures the universe of community hospitals in Tennessee) and the number of hospitals appearing in the NIS (which is a sample of community hospitals), and Panel B reports trends in the average number of hospitalizations for non-elderly adults in each data set in each quarter 2002−2007. DOH data provide information on all community hospitals while NIH provide information on a sample of community hospitals, and sampling over our study period is conducted based on region (not state) and other factors. Thus, the DOH offers a more complete picture of community hospitals than does the NIS. Panel A reveals a drop in the number of hospitals appearing in the NIS at precisely the time of the disenrollment: the number of hospitals declined from 148 in 2005 to 124 in 2006 (−16.2%). This trend is not apparent in the DOH data where the number of hospitals was 562 in 2005 and 563 in 2006 (+0.2%). Thus, the change in hospital coverage in the NIS is likely due to the HCUP sampling procedures, not a real decline in hospitals in Tennessee. In Panel B, we see that the hospitals appearing in the NIS are quite different from the full set of hospitals in Tennessee, and the nature of this difference varies by year. More specifically, in some years (2002−2004 and 2007), the average number of hospitalizations was lower in NIS hospitals than the average of all hospitals in Tennessee while in the year of and following the disenrollment (2005-2006) the average in the NIS was above all Tennessee hospitals. The correlation between the DOH and NIS average hospitalizations over this period was just 0.39. These trends are concerning from the perspective of evaluating the TennCare disenrollment using the NIS only.

To implement our simulation analysis, we attempt to (as much as possible) replicate the NIS sampling procedures. We utilize data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages database to determine the total number of community hospitals in each Southern state in each year 2002 to 2007. We isolate establishments with North American Industry Classification System code 622110 ('General Medical and Surgical Hospitals').[14] We construct two variables that take on values for ownership and bed size, to mimic the variables used by HCUP administrators to select hospitals for inclusion in the NIS. We simulate an outcome variable where the data generating process emulates a standard DID functional form. More specifically, we generate a variable Y that is determined by a DID variable (Tennessee interacted with a post-disenrollment period indicator), hospital fixed-effects, and year fixed-effects. We also include a random error term in the data generating progress. Only Southern states appearing in the NIS are used in the comparison group. Third, we perform various draws from the universe of community hospitals (following the HCUP sampling procedure that incorporates hospital ownership status and bed size): i) a 100% sample, ii) a 20% sample and excluding hospitalizations for non-elderly adults (which mimics using the NIS for the treatment and comparison group), and iii) a 100% sample for the treatment group and a 20% sample for the comparison group and exclude hospitalizations for non-elderly adults (which mimics our combined approach). We then estimate a DID specification in each sampling scheme across 1,000 simulated populations. We set the data−generating process so that the true effect is two.

The simulation results are reported in Figure 3, and the implications of reliance on the NIS are quickly observable. Both distributions of beta hat are centered on the true parameter value (constructed to have a value of two). However, the sampling framework employed has consequences for the likelihood that the estimated DID parameter will be significantly over- or under-estimated.

Using the 100% sample, the distribution of beta hats is tightly centered around the true value, as we would expect (in blue). The 20% sample with exclusions required to form our analysis sample produces a very wide distribution of estimates, with many estimates differing substantially from the true treatment effect (in green). Importantly for our study, our combined approach (black) reduces the variance of coefficient estimates.

[14]Please see the following website: https://www.bls.gov/oes/current/naics4_622100.htm, last accessed July 29th, 2023.

Based on this analysis and the more extensive work conducted by Maclean et al. (2023), we choose to combine the DOH and NIS data in our main analyses. We will show a robustness check using only data from the NIS for Tennessee as well. Other researchers who are evaluating single-study treatments (without access to state-representative data) could consider using these methods, documenting the potential bias and (if possible) combining datasets.

5 Results

Table 1 Row (1) reports our main DID regression results for hospitalizations. We find that following the disenrollment, total quarterly hospitalizations declined by 31.9. Comparing that coefficient estimate with the mean number of quarterly hospitalizations in Tennessee pre-treatment (680.9) implies a 4.6% reduction.

Table 1 Rows (2) to (6) report results for expected payment. Because we show that hospitalizations decline, analyses of expected payment outcomes could be biased if the composition of patients receiving hospital care changes. We interpret payment findings with some caution. With this caveat in mind, following the disenrollment the probability of listing Medicaid as the expected payer declined by 6.9 ppts, which corresponds to a 27.6% relative to the baseline proportion (25%). The use of any insurance declined by 2.4 ppts or 3.1% relative to the pre-2005 share in Tennessee (74%). Thus, some patients were able to substitute other forms of payment for lost Medicaid coverage. In particular, we observe that expected use of Medicare increased by 1.9 ppts (9.3%) post-disenrollment. Comparing the declines in Medicaid and increases in Medicare suggests that disenrollees were able to recoup 27.5% of lost Medicaid with Medicare ($=0.019/0.069 \times 100\%$). The coefficient estimate for private coverage and self-pay are imprecise, but suggest that these sources of coverage increased by 0.3 ppts (0.9%) and 0.9 ppts (18.0%) respectively, which is in line with the earlier TennCare literature (see Section 2.1).

The finding that use of Medicare increased post-policy is interesting and deserves some discussion. There is a two-year waiting period for Medicare for the majority of prospective beneficiaries, which suggests that most enrollees losing TennCare would not be able to take-up Medicare for a two-year period (i.e., until the middle of 2007). However, some patients with specific health conditions do not face a waiting period. There could be some reporting error in the expected payer data, for example Medicare being erroneously listed rather than another public payer. Individuals covered by both Medicare and Medicare ('dual eligibles') could have shifted financing fully to Medicare if they were disenrolled (Medicare is the first payer for duals, but we consider up to two expected payers in our analysis). Finally, because we show that hospitalizations declined, analyses of the conditional sample are potentially vulnerable to bias and our findings for Medicare may be attributable to the selected sample rather than capturing a true causal effect.

Event-studies are reported in Figure 4 Panel A (hospitalizations) and Panel B (expected payer). We do not observe differences in adjusted trends between Tennessee and other Southern states prior to the disenrollment in Tennesse, which is supportive of our design. Examination of policy lags largely reveal similar patterns as our DID results: hospitalizations and Medicaid and any insurance as the expected payer decline after 2005, while Medicare as the expected payer increases.

Row (7) of Table 1 reports results for a regression of the all−cause mortality rate (per 100,000) among non-elderly adults 21−64 years of age using the National Vital Statistics Data.[15] We estimate a state−level variant of Equation 1, replacing hospital fixed−effects with state fixed−effects and weighting by the state population 21−64 years.[16] We find that, post−disenrollment, the mortality rate increased by 3.0% (3.4 deaths per 100,000 non-elderly adults per quarter relative to a baseline mean of 111.7). While suggestive,

[15]We rely on the public use data. There are no suppressed data points in our data extract.

[16]Black et al. (2022) note that many studies using DID methods to study the effect of public policies on mortality outcomes may be under−powered to detect effects. Given this insight, in unreported analyses, we conducted a *post-hoc* power analysis. Results suggest that we are able to detect effect sizes of the magnitudes that we estimate with roughly 80% power.

the findings for mortality suggest that the hospitalizations that did not occur were not simply unnecessary care, that is had these hospitalizations not been deterred by the disenrollment (and potentially other healthcare), mortality rates may not have risen. However, an event-study analysis (not reported) demonstrates evidence of differential pre-trends in all-cause mortality rates in Tennessee and other Southern states pre-policy change. Further, we are not able to determine whether those that died post-policy are the same individuals who lost coverage following the disenrollment. Thus, we interpret our mortality findings with caution.

We report a series of robustness checks; for brevity we display findings for hospitalizations and Medicaid as the expected payer only. Results are reported in Figure 5 Panel A (hospitalizations) and Panel B (expected payer source). We aggregate the data to the state-year-quarter level, remove the weights, use the NIS for Tennessee, drop Georgia and Texas as these states appear to have substantially less generous Medicaid programs than Tennessee (see Maclean et al. (2023) for details), drop 2005 (the year of the disenrollment), and we use a longer study period (2000−2010). Findings are generally robust across these different specifications and samples.

Finally, we conduct a placebo analysis. To this end, we estimate the main DID regression for total hospitalizations for those 65 years and older. These hospitalizations should not be directly affected by the TennCare disenrollment. Results are reported in row 8 of Table 1 and display no change in the number of hospitalizations among older Americans in Tennessee, this pattern of results is supportive of our design.

6 Discussion

We study the effect of a large-scale Medicaid disnrollment, the largest in the 21st Century to occur in the U.S., on community hospitalization care and financing. Medicaid is the largest single insurer in the U.S. and accounts for 17% of national healthcare expenditures. Community hospitalization are an important part of the continuum of care and each year the there are nearly 32M admissions to the 5,157 community hospitals in the U.S. (American Hospital Association, 2023), and such hospitalizations contribute roughly $526B to U.S. healthcare costs each year. While changes to Medicaid policy generally reflected expansions since the program's implementation in 1965, recent state and federal policies will likely curtail eligibility. Documenting the impact of losing Medicaid on community hospitalizations is important for understanding how recent policy changes may impact patients, providers, and taxpayers.

We have several key findings. First, we show that quarterly hospitalizations among non-elderly adults declined by 4.6% in Tennessee relative to other Southern states. Second, use of Medicaid to pay for hospitalizations among non-elderly adults declined by 6.9 ppts or 27.6% in Tennessee. Third, the decline in any insurance used to pay for a hospitalization declined by a more modest amount: 2.4 ppts or 3.1%. Fourth, patients substituted public insurance (Medicare) for lost Medicaid. While not rising to the level of statistical significance, coefficient estimates for the probability of using private coverage or self-pay are positive and imply that some disenrollees may have used these alternative sources to finance hospital care post-disenrollment.[17] Finally, we provide suggestive evidence that all-cause mortality among non-elderly adults increased by 3.0%, although our findings may be subject to bias from differential pre-trends. The mortality findings, though only suggestive, hint that the lost hospitalizations due to the TennCare disenrollment were not simply low-value or unnecessary care.

We also discuss the potential limitations of relying on data that are not representative at the level of treatment when using DID methods. We propose methods to diagnose bias and, were feasible, suggest combining data sources to improve performance.

We can use our estimates for the decline in hospitalizations to probe the potential cost savings to the state Medicaid program in Tennessee, though this estimate will over-

[17] Self-pay bills often become bad debt to providers (Chappel et al., 2011) which suggests that hospitals may shoulder a larger share of care (Garthwaite et al., 2018).

state the saving to the healthcare system as we show that some patients substitute lost Medicaid with Medicare (and potentially private and self-pay), and our findings of increased mortality imply that there maybe additional costs to the policy change.[18] With those caveats in mind, our estimates imply that each community hospital in Tennessee saw 127.6 fewer admissions per year (= 31.9 per quarter × 4) and the average community hospitalization in 2023 cost $16,447. There were 544 community hospitals in Tennessee in 2004 (based on our analysis of the DOH data for this state), which implies that the annual savings associated with fewer hospitalizations post−disenrollment were $1,141,658,637 (= 127.6 × $16,447 × 544).

Overall, our findings suggest, despite reasons to suspect otherwise, the effect of gaining and losing Medicaid coverage is symmetric in terms of service use. However, for some patients, public insurance programs are substitutes, which could suggest that TennCare (and other policies, such as the unwinding, that remove enrollees from Medicaid) could shift financing to other arms of the government. That we do not see strong evidence of uptake in private coverage (coefficient estimates are positive, but imprecise) may be attributable to the fact that many TennCare enrollees were deemed 'uninsurable' at the time of the disenrollment (Farrar et al., 2007).

While we study a historical policy change, the findings are likely informative for recent policy changes in the U.S. In particular, the 'unwinding' of PHE continuous Medicaid enrollment by states. Moreover, several states have adopted 'work requirements' for Medicaid enrollees. Those not meeting these requirements are disenrolled from the program (Sommers et al., 2019; Chen and Sommers, 2020). Further, these findings suggest that the current policies that curtail access to Medicaid could lead to the federal government (and perhaps other public payers) financing additional care.

[18] Further, we focus on one modality and disenrollees could have used other modalities post-policy.

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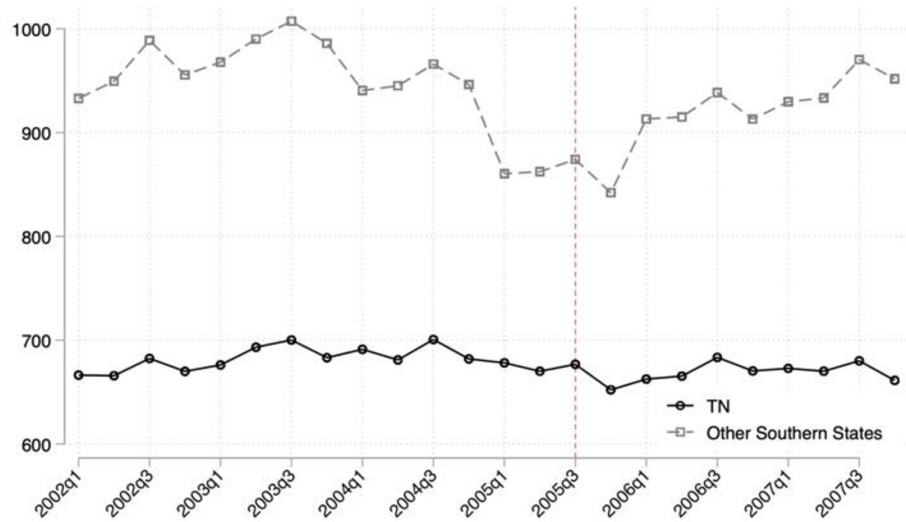
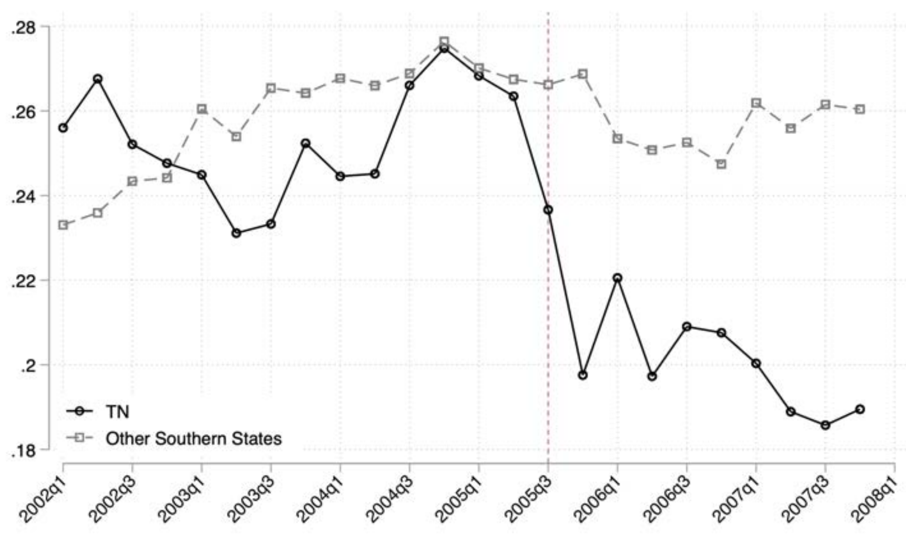
7 Figures and tables

Figure 1: Trends in hospitalizations and expected payer: 2002−2007



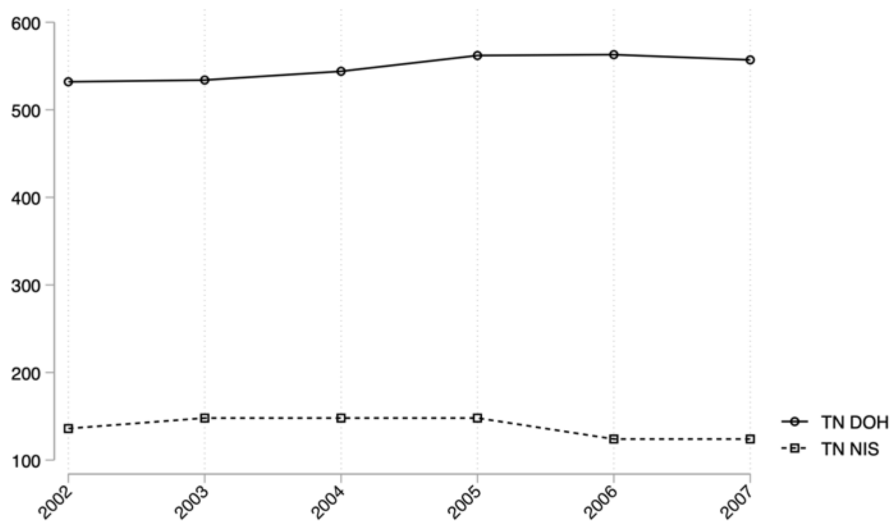
Panel A: Hospitalizations



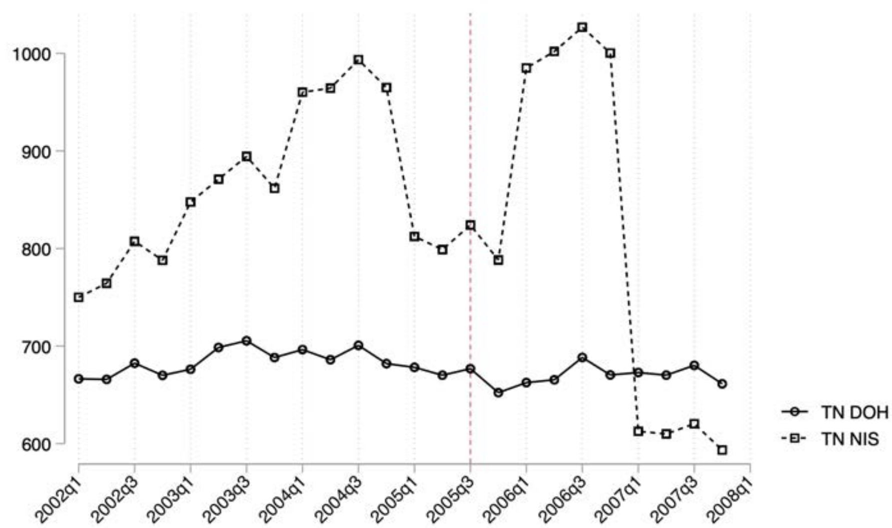
Panel B: Medicaid expected payer

Notes: The unit of observation is a quarter in a year.

Figure 2: Trends in the number of hospitals & average quarterly hospitalizations in the DOH and NIS: 2002−2007



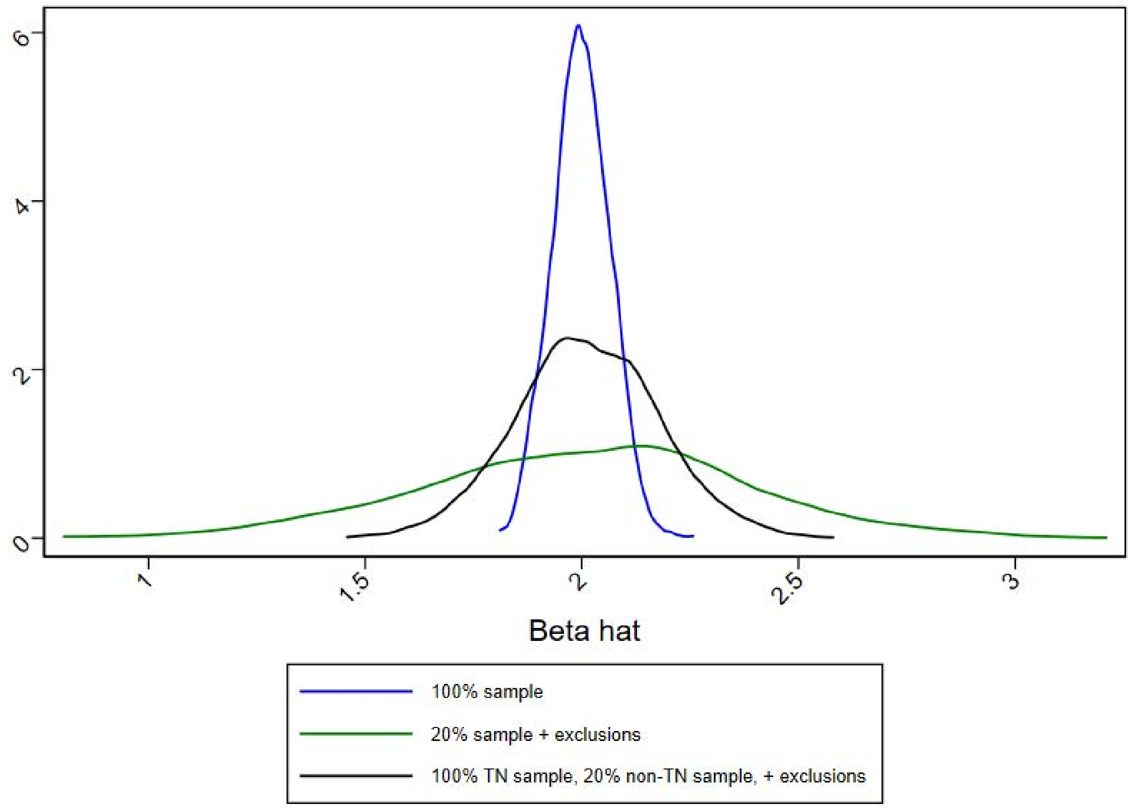
Panel A: Trends in the number hospitals



Panel B: Trends in the average quarterly hospitalizations

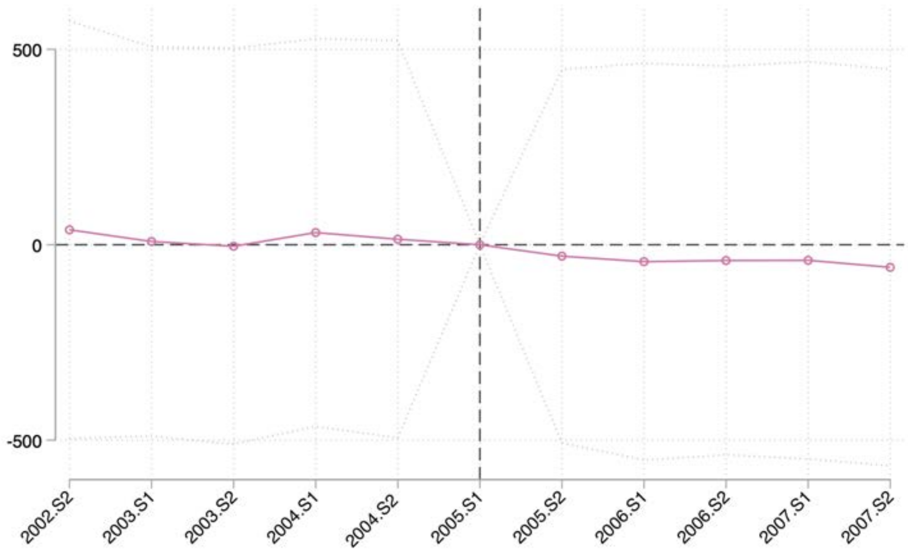
Notes: See Section 4 for details.

Figure 3: A simulation exercise: 2002−2007

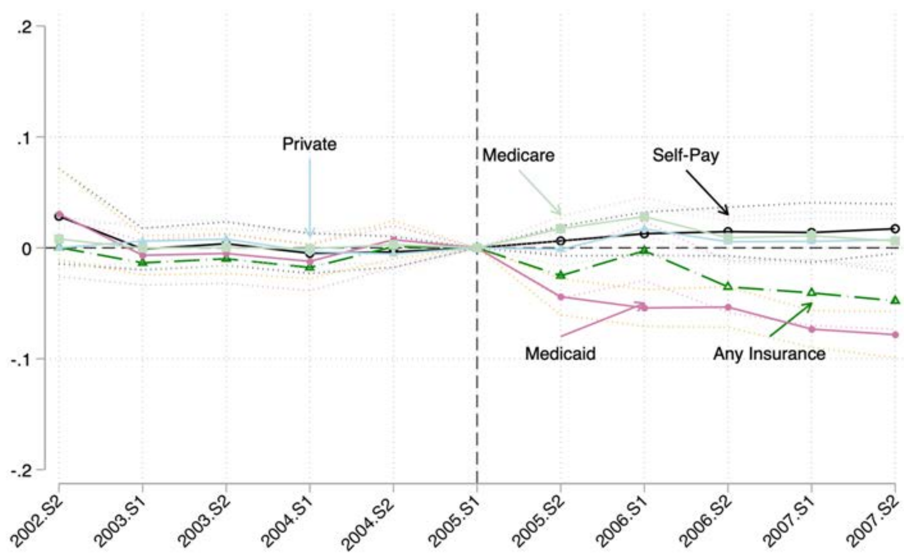


Notes: See Section 4 for details.

Figure 4: Effect of losing TennCare on hospitalizations & expected payment sources using an event−study: 2002−2007



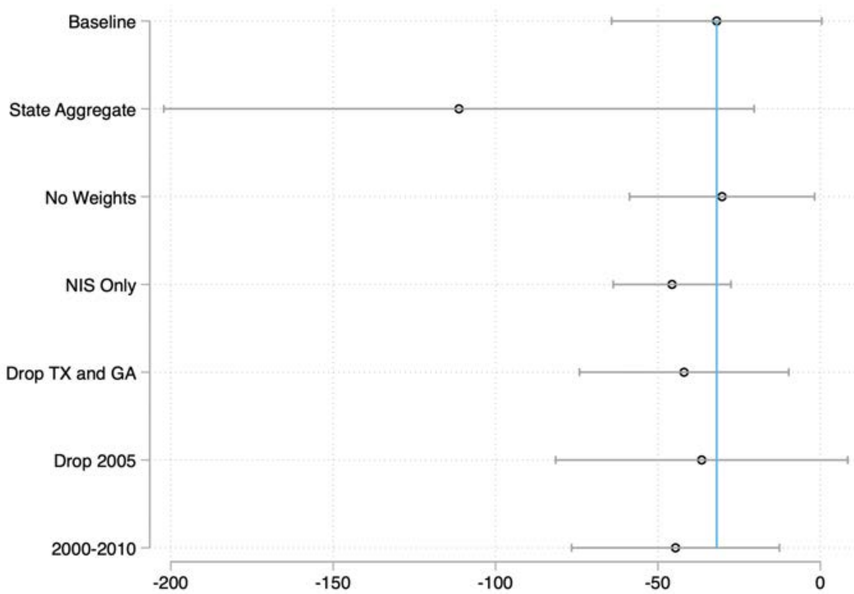
Panel A: Hospitalizations



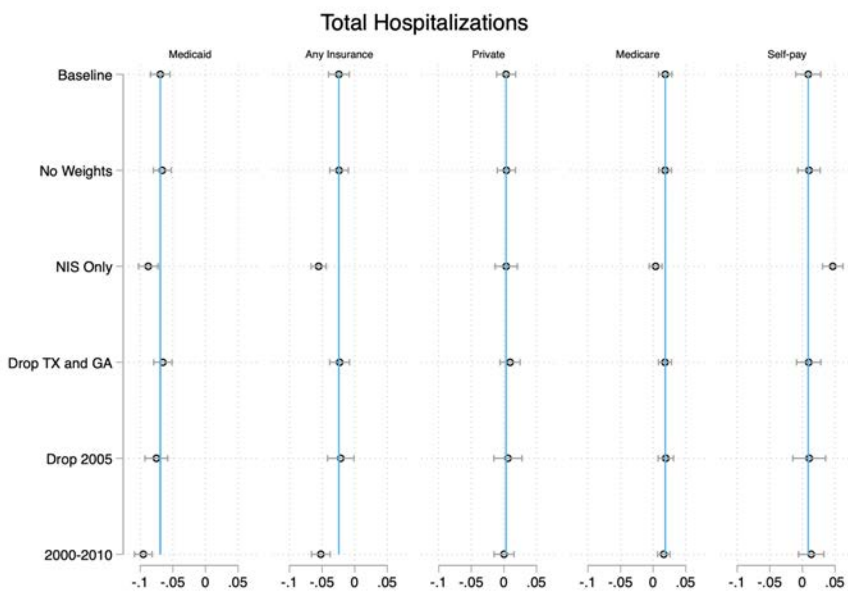
Panel B: Expected payment sources

Notes: The unit of observation is a hospital in a state in a quarter in a year. All regressions estimated with OLS and control for quarter fixed-effects, year fixed-effects, and hospital fixed-effects. Six-month intervals are used to define leads and lags. The omitted category is January 2004 to June 2004. DOH data are unweighted and NIS data are weighted by HCUP-provided weights. Standard errors are calculated using a modified block-bootstrap approach (see Section 3).

Figure 5: Effect of losing TennCare on hospitalizations & expected payment sources using alternative specifications & samples: 2002−2007



Panel A: Hospitalizations



Panel B: Expected payer

Notes: The unit of observation is a hospital in a state in a quarter in a year unless otherwise noted. All regressions estimated with OLS and control for quarter fixed-effects, year fixed-effects, and hospital fixed-effects unless otherwise noted. DOH data are unweighted and NIS data are weighted by HCUP-provided weights unless otherwise noted. Standard errors are calculated using a modified block-bootstrap approach (see Section 3).

Table 1: Effect of losing TennCare on hospitalizations, expected payment sources, all-cause mortality, & placebo: 2002−2007

Row	Outcome variable	Pre-treatment mean in TN	Coefficient. estimate	Standard error	N
(1)	Hospitalizations	680.869	-31.922**	15.951	12,048
(2)	Medicaid	0.25	-0.069***	0.0072	12,048
(3)	Any insurance	0.74	-0.024***	0.0081	12,048
(4)	Private	0.33	0.003	0.0077	12,048
(5)	Medicare	0.16	0.019***	0.0050	12,048
(6)	Self−pay	0.05	0.009	0.3727	12,048
(7)	Deaths/100,000	111.72	3.389***	1.148	256
(8)	Hospitalizations (placebo)	520.17	8.083	4.318	11,860

Notes: The unit of observation is a hospital in a state in a quarter in a year in rows 1−6 and row 8, in row 7 the unit of observation is a state in a quarter in a year. All regressions in rows 1−6 and row 8 are estimated are with OLS and control for the state non-elderly population, quarter fixed-effects, year fixed-effects, and hospital fixed-effects. In row 7, hospital fixed-effects are replaced with state fixed-effects. DOH data are unweighted and NIS data are weighted by HCUP-provided weights in rows 1−6 and row 8, and National Vital Statistics data are weighted by the state non-elderly population in row 7. Standard errors are calculated using a modified block-bootstrap approach (see Section 3).
;* = statistically different from zero at the 5%, 1% level.