The Impact of Privatization: Evidence from the Hospital Sector*

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October 2022

PRELIMINARY, PLEASE DO NOT CIRCULATE

Abstract

Privatization has been shown to improve the efficiency and growth of public firms. However, the effects for consumers are understudied. We study potential trade-offs in the case of US hospitals, where public control of capacity declined by 42% over 1983–2019. Across 257 transitions, privatized hospitals downsize capacity and patient care, with Medicaid patients experiencing the greatest decline. While other patients are reallocated across facilities, Medicaid patients experience an aggregate decline in utilization at the market-level, which we interpret as a decline in access. Private control substantially decreases labor intensity and related spending, consistent with a trade-off between maintaining access and lowering costs.

*We would like to thank Reigne Dadey, Emma Hou, and Megan Olomu for outstanding research assistance. We received helpful comments and suggestions from Diane Alexander, David Card, Janet Currie, Jetson Leder-Luis, Boris Vabson, and participants at Harvard-MIT-BU health economics, Berkeley, Wharton, National Tax Association, APPAM, ASHEcon, and the Midwest Health Economics annual conferences. All remaining errors are our own.

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1 Introduction

Should governments deliver services themselves or outsource them to private firms? Economists have long been interested in this question around the proper role of government, with views spanning the whole spectrum of possibilities (Hayek, 1944; Lerner, 1944). While large and extensive privatization drives caught the public's attention in the 1980s and 1990s, it remains an important ongoing global phenomenon, with nearly a trillion dollars raised over 2013–16 through the sale of government assets (Megginson, 2017).[1] The balance of empirical evidence suggests that privatization improves the efficiency and growth of government-owned firms (World Bank, 1995; Chong and de Silanes, 2005). However, reviews of the literature note that the effects on consumers have rarely been examined (Megginson and Netter, 2001; Estrin et al., 2009). This is a key limitation since the policy debate on privatization now centers over the delivery of social services (Mehrotra and Delamonica, 2005; Stiglitz, 2005). This paper begins to fill this gap by studying the trade-off between greater efficiency and potential harm to consumers in the case of hospital privatization in the US.

The concern for harm to consumers arises due to the incompleteness of contracts between governments and firms. Hart, Shleifer and Vishny (1997) conjecture that private firms may prioritize cutting costs at the expense of lowering quality on dimensions which are not stipulated or cannot be monitored. In the case of complex firms such as hospitals, cost-cutting could take several forms. We focus on a single channel, though with important welfare implications for consumers: whether privatized hospitals avoid admitting financially unattractive patients. Such a response would be consistent with the fact that private hospitals, specially for-profits, are less likely than public hospitals to admit Medicaid, uninsured, and other unprofitable patients (Horwitz, 2005; Horwitz and Nichols, 2022). If true, privatization *could* restrict access to hospital care for vulnerable patients, even as it makes the sector more efficient. Experts have previously noted, with concern, a tradeoff between efficiency and equity (Birdsall and Nellis, 2003).

[1] The years 2015 and 2016 saw the highest annual privatization revenues ever recorded until then. China is the global leader in privatization, followed by the UK in (distant) second place.

The hospital sector is the largest segment of US healthcare with over a trillion dollars in annual spending and employs over 6.5 million people, comparable in size to the Construction sector.[2] 1.4 million, or 22%, are employed by government owned hospitals, making hospitals the third largest sector among government employees, following education and government general administration.[3] Importantly, public hospitals have experienced significant decline over the last few decades. Since the early 1980s, the share of available acute care beds at public hospitals has declined from 36% to 21%. As Figure 1 panel (a) shows, this decline has occurred at both federal and local levels, with declines from 27% in 1983 to 17% in 2019, and from 9% to 4%, respectively. The number of public hospitals has declined through two broad channels: conversion to private ownership or managerial control, both of which we consider privatization, and closure.[4] Both types of transitions have occurred at greater rates for public hospitals than they have for their private counterparts. Privatization is the dominant mechanism by far: there are more than 6 privatizations for every public hospital closure during our sample period.

Surprisingly, this realignment of the hospital sector has remained understudied. To our knowledge, only a handful of studies – none in economics – have systematically examined the effects of hospital privatization (Needleman et al., 1999; Ramamonjiarivelo et al., 2016, 2021). In contrast, changes in public health insurance during the same period have been extensively investigated (Cutler and Gruber 1996; Currie and Gruber 1996; Finkelstein 2007; Garthwaite, Gross and Notowidigdo 2014; Miller, Johnson and Wherry 2019; among many others). State-level variation in the role of public hospitals dwarfs differences in public health insurance coverage across states.[5]

[2]Source: 2019 Quarterly Census of Employment and Wages – The Bureau of Labor Services (BLS), https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables. The Construction sector, naics code 23, in 2019 employed about 7 million individuals. https://www.bls.gov/ces/data/employment-and-earnings/2020/table1b_202001.htm

[3]Source: Current Employment Statistics – The Bureau of Labor Services (BLS), https://www.bls.gov/ces/data/employment-and-earnings/2019/table1b_201901.htm

[4]When a hospital stops providing inpatient care, we consider that to be a closure even if it continues to provide outpatient care such as maintaining an Emergency Department or physician clinics. These latter cases are sometimes called partial closures.

[5]Public health insurance coverage by state, including Medicaid and Medicare, varies between 20-48% with a standard deviation of 5% compared with public hospital share of beds with a range of 2-71% and standard deviation of 13%. Variation in public health insurance coverage is from Kaiser Family Foundation: https://www.kff.org/other/state-indicator/total-population/.

Table 1 emphasizes the considerable variation in the role that the government plays in hospital ownership in 2019, even following decades of privatization. On one end of the spectrum, 49% of hospital beds are at public hospitals in Alabama, whereas only 12% and 7% are in Illinois and Pennsylvania, respectively.[6] Furthermore, patterns of public ownership do not follow perceived preferences for the size of government; for instance, Alabama's share of public beds is about twice as large as the share in California.

We examine the effects of all privatizations of non-federal public hospitals that occurred between 2000 and 2018. Our main data source is annual hospital surveys compiled by the American Hospital Association (AHA). We identify public hospitals that experienced a change in ownership or managerial control as reported in the surveys. We manually validated each purported privatization, and confirmed 257. We also source data on our key outcomes – patient volume and hospital employment – and other hospital attributes from the AHA. We complement the AHA surveys with publicly available data sources like the Medicare cost reports and the US Census.

We employ a staggered difference-in-difference research design to estimate the effects of privatizations on the treated hospital, as well as spillovers on the market where the hospital is located. This follows the approach used by recent studies examining changes in the organization of healthcare markets (Eliason et al., 2020; Craig et al., 2021), as well as on privatization (Arnold, forthcoming). We compare outcomes at the treated hospitals (markets) following the privatization with other public hospitals (markets) that did not experience a change in ownership through the end of the sample period. While the design is standard in this literature, we recognize that privatizations are not exogenously assigned. We therefore take a number of precautions to probe the validity of our estimation strategy. We examine dynamic effects around the year of the privatization and find that the privatized hospitals do not differ from the comparison group prior to the change, but experience an immediate and persistent shift following the transition. We also subject the estimates to a number of sensitivity and robustness checks, including controlling for market-level indicators of economic activity, using a matched subset of comparison hospitals, and correcting for potential

[6]Note that examining share of hospital beds rather than hospitals accounts for differences in size and capacity across hospitals.

bias due to the staggered design. The estimates are stable and qualitatively similar in all cases.

We begin by examining the impact on the hospital's total inpatient volume (discharges) as well as on the number of patients covered by different payers. We find that total volume decreases at the privatized hospital by 8.5% and does not recover to pre-privatization levels even after five years.[7] This decline is driven by a 14% reduction in the number of Medicaid patients, while in comparison, we find only small and statistically insignificant effects on Medicare patients. A limitation of the data is that we cannot observe the number of uninsured patients directly since they are reported as part of a residual group that also contains privately insured patients. We find a decline in the volume of this composite group, however, this estimate is sensitive to the choice of specification. This instability across specifications could reflect opposing effects on the privately insured and uninsured patients that comprise this group.

Previous studies have documented spillover effects of hospital entry and exit on the profitability and patient mix of their competitors (David et al., 2014; Garthwaite et al., 2018). Given the relatively large decline in patient volume at the privatized hospital, we hypothesize the presence of spillover effects in our setting as well. If neighboring hospitals choose to compensate for this decline in patient service (particularly for Medicaid beneficiaries), we should not find an aggregate decline in patient volume at the market-level. On the other hand, since Medicaid pays below the average cost, and perhaps even below the marginal cost of care, neighboring hospitals may not accept these additional patients. Furthermore, the privatized hospital may compete more aggressively and cause a change in its competitors' patient volume and treatment intensity even absent any reallocation of patients.

We therefore turn our attention to aggregate market-level effects on patient volume, assuming that a market is treated when a public hospital is first privatized.[8] Medicaid is the only payer for

[7] We did not find a simultaneous increase in outpatient volume to suggest this reflects only a change in treatment style. The coefficient on outpatient volume is noisy, but has a negative sign, implying a decline there as well.

[8] We define hospital markets using Health Service Areas (HSAs). These are collections of contiguous counties that were delineated by the US Census to define self-contained hospital markets. There are approximately 900 HSAs in the US. We confirm they accurately reflect patient hospital choice – more than 70% of Medicare fee-for-service patients choose a hospital located in their HSA. Since there are thrice as many HSAs as HRRs, using this market definition allows us to retain more identifying variation.

which we find a negative effect on volume at the market-level. Thus, this implies that neighboring hospitals offset the downsizing of operations at the privatized hospital for patients sponsored by other payers but not for those on Medicaid. The aggregate decline in Medicaid volume is concentrated among markets with greater poverty rates. In these markets we find a statistically significant 9% decline in Medicaid volume. We interpret this result as a decline in access to hospital care for Medicaid patients due to privatization.

A key objective of privatization is to improve the hospital's profitability and financial stability. Personnel costs account for about half of total hospital operating costs according to the AHA data, with public hospitals spending slightly more than private hospitals. In the short-term therefore, private operators may aim to reduce personnel costs and improve efficiency (Boycko et al., 1996; Needleman et al., 1997). Accordingly, we test whether private operators reduce the intensity of labor inputs, which we measure using full-time equivalent (FTE) staff per 100 beds.[9] The average treated hospital in our sample employs over 500 FTE per 100 beds. Against this mean, we find a decrease of about 33 FTE, or 6%. For the average privatized hospital in our sample, this implies a reduction of approximately 30 FTE, holding bed capacity constant. There is no decline in nurses, which account for about 27% of total FTE. Instead, 90% of the decrease is concentrated within non-patient facing functions, which account for 70% of employment. For example, a third of the decline is in overhead functions.[10] We cannot test whether this reduction in labor inputs compromises quality of care with our data, though we believe this is an important area for future research. The implications of privatization have policy significance for the labor market as well. Healthcare now employs more people in the US economy than any other sector. Shifting substantial numbers of workers from public to private management may have far-reaching implications for employment, compensation, and productivity.

This paper contributes to several distinct literatures. First, and most generally, it relates to the literature examining the role of government and the effects of privatization. This literature has

[9] We normalize by the contemporaneous number of hospital beds to incorporate potential reductions in bed capacity.

[10] This includes employee benefits, administrative and general, maintenance, housekeeping, laundry, cafeteria, and miscellaneous small groups.

typically found that privatization improves the efficiency and growth of formerly public-owned firms across a wide range of countries, sectors, and modes of implementation (Megginson et al., 1994; Boycko et al., 1997; López-de Silanes et al., 1997; Shleifer, 1998; La Porta and López-de Silanes, 1999; Chong and de Silanes, 2005; Savas, 2005). However, as noted previously, there is a paucity of evidence on the corresponding effects for consumers. The evidence on hospital privatization appears to be even more scant. Ramamonjiarivelo et al. (2016, 2021) study privatizations over 1997–2013 and document improved hospital profitability and a decline in Medicaid volume. However, they do not examine employment or the market-level effects on access to care and efficiency.

We also contribute to the literature examining ownership in healthcare. Since Arrow (1963), economists have been interested in the need for and differential performance of non-profit versus for-profit firms. This literature has yet to reach a consensus since some studies have found that non-profits respond similarly to financial incentives and deliver similar quality of care, while others have found significant differences (Norton and Staiger 1994; Duggan 2000; Sloan et al. 2001; Picone et al. 2002; Malani et al. 2003; Sloan et al. 2003; Horwitz and Nichols 2009; among many others). Studies focused on public hospitals have shown that subsidies may be siphoned off by their local government owners, raising efficiency concerns (Duggan, 2000; Baicker and Staiger, 2005). Our setting allows us to provide novel evidence on the question of whether the absence of a public option affects market-level access to care and hospital employment.

Our study also contributes to an emerging literature that has linked the costs of un-insurance to the economics of care providers. Garthwaite, Gross and Notowidigdo (2018) show that hospitals – particularly non-profit hospitals – bear the cost of un-insurance in their market in the form of uncompensated care. Duggan, Gupta and Jackson (2022) find that public hospitals in California received a differentially greater boost in revenue due to the ACA mandated Medicaid expansion because of higher baseline uninsurance levels. Dunn, Knepper and Dauda (2021) confirm these findings using national data. Dranove, Garthwaite and Ody (2022) argue that supplemental payments (such as the Disproportionate Share program) are valuable in filling financial gaps for hos-

pitals with large shares of Medicaid and uninsured patients. Our study shows that without public control of hospitals, expanding Medicaid coverage may not be sufficient to maintain access to hospital care.

The paper proceeds as follows. Section 2 provides the necessary background about public hospital ownership, related trends, and privatizations. We follow with a description of the data in Section 3, and our empirical strategy in Section 4. We present the main results on the effects on hospital utilization and access in Section 5, including an examination of aggregate effects at the market level. We next examine effects on employment at the privatized hospital in Section 6. Finally, Section 7 concludes.

2 Background

2.1 Public hospital ownership

There is substantial heterogeneity in the ownership mix of hospitals across different geographies.[11] This is true not only of the share of publicly owned hospitals in a market, but also the type of privately owned hospital (non-profit or for-profit). Table 1 highlights this variation and presents the shares of four different owner types (public non-federal, public federal, private non-profit, and private for-profit) for a selected set of 6 large states with at least 100 hospitals (AL, CA, GA, IL, PA, and TX) in 2019. We also present the corresponding national means and standard deviations in column 7. We selected these states to highlight the range of public hospital ownership across states and its correlation with geography and other factors. The columns are ordered in descending order of non-federal public share of hospitals. For completeness, Appendix Table A.1 presents the corresponding values for all states.

[11] Related to ownership is the concept of hospital 'control.' Strictly speaking, the AHA survey reports the type of hospital control, which could be recorded as one of non-profit, for-profit, or government. Control and ownership are identical except in the small number of cases where the owner outsources managerial control or leases the property to a contractor who happens to have a different organization structure. Such contractors are invariably private firms, hence there are several cases, as we shall discuss below, where the government *owns* the hospital, but it is *controlled* by a private firm. We will use the two terms interchangeably unless specified otherwise.

We note three interesting patterns in Table 1. First, states vary tremendously in their reliance on public hospitals. Pennsylvania has only 3% of beds at such hospitals, while 27% of Washington hospital beds are at state or local government owned hospitals. Second, the share of public hospitals doesn't necessarily track perceptions of states' preferences over the size of government. For example, Texas has a higher public hospital share of beds than Massachusetts, Illinois, and Pennsylvania. Third, there are also large regional variations in the prevalence of for-profit hospitals. For-profit hospitals tend to be as important as non-profits in the South, but contribute small shares in other regions.

2.2 Public ownership versus coverage of hospital care

Figure 1 presents several national trends related to public sector involvement in hospital care over 1983–2019, all sourced from the American Hospital Association annual survey data. Panel (a) shows that the share of hospital beds at publicly owned hospitals (non-federal) declined from 27% in 1983 to 17% in 2019, a drop of nearly 40%. If we include in this calculation ownership by the federal government, the decline is more than 40%. The decline has been consistent over the entire period, though it was steeper in the 1980s and 1990s.

This pattern of declining public provision of hospital care stands in stark contrast to the expansion of public insurance coverage for hospital care over the same period. Figure 1 panel (b) plots the trend in the share of hospital patients covered by Medicaid, the means-tested public insurance program. It shows that Medicaid *doubled* its share of hospital patients from 10% in 1983 to 21% in 2019. This is not surprising since Medicaid coverage has been expanded through several federal and state policy initiatives over this period, extending eligibility to an ever increasing share of the population. There has also been a large increase in the share of Medicare – the public insurance program for the elderly – from 30% to 44%, or by nearly 50%.[12] Unlike Medicaid, eligibility for this program has been relatively stable and a large part of the increase is likely due to the ageing of the population over this period. By the end of the sample period, the two public insurance plans

[12]The trend here includes patients on Traditional Medicare (TM) and Medicare Advantage (MA) in the numerator.

collectively sponsored care for about two-thirds of all hospital patients, an increase of more than 60% relative to 1983.

The dramatic decline in government provision of hospitals is not part of a wider trend where they are similarly shrinking their role in the provision of other services considered to be important for social welfare. For example, government provision of education services – a sector with similar market failures and policy considerations as healthcare – have remained remarkably stable over this same time frame. In contemporaneous time series for the share of high school and higher education (associate degree or higher) in public institutions, the share of students at public high schools has actually *increased* slightly, while the share of students at public degree granting institutions has decreased by 5%. Hence, the decline in public hospital control is likely due to factors specific to the hospital sector.

Historically, a key justification for public ownership of hospitals has been to provide last-resort access to necessary care to vulnerable segments of the population. Perhaps state and local governments viewed the expansion of Medicaid coverage as an alternate means to ensuring access to care, making it easier to justify the privatization or divestiture of public hospitals. While the national time series are clearly negatively correlated, we formally tested whether this correlation also exists at the state-level. Specifically, we estimated the association between state-level changes in Medicaid's share of hospital patients (ΔM_{st}) and the corresponding changes in the public share of hospital bed capacity (ΔP_{st}) over three periods – 1983–94, 1995–2006, 2007–18 – using the following stacked model:

$$\Delta P_{st} = \alpha_t + \beta \Delta M_{st} + \xi_{st}. \tag{1}$$

β is the coefficient of interest in this model and captures the within-state correlation between changes in Medicaid coverage and public hospital capacity. We obtained a statistically significant estimate of -0.28 (0.13) for β, implying that an increase in Medicaid share of 10 percentage points (pp) is associated with a decline in public share of bed capacity of nearly 3 pp, about 30% of the

observed reduction in the public hospital share over this period. We emphasize that this is just a correlation and does not imply causality. However, it is consistent with the hypothesis that local government officials may view the expanded eligibility for Medicaid as an acceptable substitute for maintaining public hospitals.

2.3 Privatization

The previous section documented the significant decline in public control of hospitals in the US. The reduction in the number of hospitals under government control occurred through two channels. More than 85% of the decline during the period we study was due to privatization – local governments relinquished operational control of the hospital. The remainder occurred through outright closures of public hospitals or their conversion to solely providing outpatient care. During our sample period, we identified 257 and 41 cases of each, respectively.

In addition to manually validating all purported privatization deals, we also spent considerable time reviewing the key features of the deal so we could classify them. We did not have access to the contracts between the governments and the private parties for this exercise and relied on press releases and independent reporting from the time around the transaction. Appendix Table A.2 presents the distribution of the different types of deals represented in our sample, and whether the new operator is a for-profit or non-profit. As the table shows, privatization can manifest in several different forms and one could argue that every deal has some unique features. We find hospitals were brought under both non-profit and for-profit control, with the latter accounting for about a quarter of the deals.

From the perspective of how much control the government retains over the hospital after the transition, there are broadly two types of deals. In the first type – which accounts for about two-thirds of the privatizations in our sample – the government retains ownership of the land and buildings, but outsources operational and managerial control to a private firm. This structure was preferred to outright sales in some states (eg., Florida) because certain types of sales require legislative approval, a lengthy and uncertain process (Needleman et al., 1997). Within the cases

belonging to this set, the most common approach in our sample was for the government to find a hospital management firm that would run the hospital in return for a monthly fee. We refer to this as 'contract management.' The next most common approach was to award a long lease (usually more than 15 years) to a private operator, giving them more autonomy to make changes to the buildings and other assets. A related approach that also involves a long-term transfer of control along with autonomy over the assets is to enter in a joint venture with a private partner. Finally, the government may transfer operational control to a private firm incorporated specially for the purpose of operating the hospital. The government agency that owned the hospital usually maintains considerable oversight over the new entity.

It is unclear how much incentive private operators have to improve the hospital's profitability under these arrangements and whether they have the autonomy to make the necessary changes (eg., focus on more profitable patients and services, downsize staff). In general, we did not find language suggesting the operators were constrained in their ability to make any sort of changes, including payer and service mix. The private operators were typically responsible for staffing the hospital anew, but it is possible they were obligated to retain some share of, or give preference to the original employees of the hospital when doing so. Appendix Section B.1 provides more details on the different ways in which governments transfer managerial control.

In the remaining one-third of deals, the government entity sold off the land, buildings and other assets to a private firm and fully divested itself of any control over the hospital. We assume that in these cases the new owners operate the hospital to maximize their own objectives, as they would any of their existing hospitals.

3 Data and descriptive evidence

3.1 Data sources and sample construction

Our main data source comprises annual surveys of hospitals from the American Hospital Association (AHA). Our primary analysis relies on AHA files for the years 1995–2019. We use

the AHA files to source both our key outcomes variables (patient volume and staffing), information on hospital attributes such as ownership (public or private), and size (in beds). We exclude federal-owned hospitals (mostly the Veterans Affairs and Indian health services facilities) from our analyses entirely since these are not funded by state or local governments and typically cater to targeted patients (such as veterans) rather than the local community at large. Our focus is on hospitals owned by a state, county, city, or by a hospital district. A non-trivial number of government owned hospitals specialize in psychiatric or rehabilitation care. In addition to being highly specialized, they are often reimbursed in a distinct way from general community hospitals. We exclude these from our analysis sample and focus on general acute care hospitals.[13]

Since the treatment of interest is the privatization of publicly owned hospitals, we took several steps to minimize measurement error in identifying hospital ownership transitions. We started by inferring changes in owner type if the value reported on the AHA survey changes from one year to the next. This naive approach yielded a total of 353 privatizations of public hospitals over 2000–18. We manually validated these implied changes in ownership by examining the annual summary of change files from the AHA, news articles, press releases, hospital websites, and confirming the changes against proprietary databases such as the American Hospital Directory (AHD) which tracks hospital ownership over time. If we were not able to confirm a privatization, we assumed the hospital continued under public ownership in that instance. In several cases, the external data also helped us correct the year of privatization. Using this approach, we validated 257 privatizations, about 73% of the number implied by the raw data. Our analysis focuses on these transitions. Our final analysis sample contains public hospitals that were either treated (privatized) or that did not experience a change in ownership.[14]

[13] We identify general acute care hospitals using AHA's primary service code of 10, which are "general medical and surgical" hospitals. While it is rare for hospitals to switch service codes over the course of our sample period, we include all hospitals whose most common service code is general medical and surgical. The predominant service code among excluded public hospitals is psychiatric.

[14] We cannot rule out the possibility of false negatives – public hospitals that were privatized but this transition was not reported to the AHA. We believe this is very unlikely since it would mean the change is not reported over multiple years, not just a one-time event. We conducted random checks and did not find any. This measurement error, if it exists, will tend to bias effects toward zero. We also validated 46 transitions of privately owned hospitals to public ownership during this period. We excluded these hospitals from the sample.

The key outcomes are measures of patient volume and hospital employment. We study patient volume by payer and in aggregate. Specifically, we observe volume for three payers: Medicare, Medicaid, and a residual group ('Others') that is largely composed of privately insured and uninsured patients. A limitation of the AHA data is that we cannot separately observe volume for uninsured and privately insured patients.[15] We similarly examine total full-time equivalent (FTE) employed staff and the effects on different components (physicians, nurses, administrative). We also rely on the Medicare cost reports to examine labor inputs since they provide more granular information than the AHA on this aspect. For example, we can observe the number of FTE contract staff at the hospital as well, allowing us to test whether the new management outsources staff. To circumvent potential bias due to the substantial skew in hospital volume and labor inputs, we transform the variables, either by taking logs or normalizing by the hospital's number of beds. In the latter case we use contemporaneous beds to account for potential capacity adjustments over time. In the case of labor inputs, we also normalize by adjusted admissions in sensitivity analyses.[16]

Our final analysis sample is an unbalanced panel at the hospital-year level. Figure A.1 presents a frequency distribution of the number of years we observe hospitals in the sample. About 90% of the hospitals are observed for the maximum possible 25 years. The patterns are nearly identical for the privatized and comparison hospitals.

We supplement the AHA data with information on market-level attributes, such as county-level population, poverty, unemployment, and uninsurance rates from publicly available data sources like the US Census and the Bureau of Labor Services (BLS).

3.2 Descriptive evidence

Table 2 describes the hospital-level analysis sample. Across all columns, we present values from 1999, a year prior to the first privatization in our sample. Column 1 presents values for the

[15] To our knowledge, there is no national data that can do better. It is possible to use uncompensated care costs reported in the Medicare cost reports to *impute* the share of uninsured patients, but this approach is feasible only after 2010.

[16] Adjusted admissions are sometimes preferred over just using inpatient volume since they also account for outpatient care which has rapidly grown over time. The AHA reports adjusted admissions. These are computed by scaling outpatient volume by the ratio of outpatient charges to inpatient charges (Schmitt, 2017).

257 hospitals that would be privatized (treated) during the sample period. Column 2 describes the 766 remaining public hospitals that did not experience a change in ownership during this period and are located at least 15 miles away from any privatized hospital. This group comprises our primary comparison group. We imposed this distance requirement to mitigate the potential for spillover contamination.[17] Comparing values in these two columns reveals that privatized hospitals had about 20% fewer beds, but were otherwise very similar: both types treated about 35 patients per bed per year, were largely reliant on public payers (about 65%), and had similar labor input intensity (about 400 FTE per 100 beds). Column 3 presents the corresponding statistics on the 4,392 privately owned hospitals observed in the data during this period. On almost all measures, private hospitals were noticeably different than their public counterparts. For example, they operated at much greater scale with twice the number of beds as the treated hospitals and discharged more patients per bed (39 versus 35). Public payers accounted for a lower share of their patients (58%). Hence, private hospitals differ substantially from public hospitals on important operational dimensions and are unlikely to offer a suitable counterfactual to the privatized hospitals. Column 4 presents the corresponding statistics for all 5,415 hospitals in the sample. Since 80% of the hospitals are privately owned and they serve more patients, the aggregate statistics lean towards those for private hospitals.

Figure 2 describes the phenomenon of hospital privatization in the US over 2000–18. Panel (a) presents a heat map of the US based on the number of privatizations in the state. Privatization was widespread across the country with more than 40 states having at least one. States in the South and Midwest experienced the most number of privatization events during this period. Texas, Georgia, Louisiana, Indiana, and Minnesota are the five states with the most privatizations. Relative to the extant number of public hospitals, Louisiana and Indiana privatized a much greater share of their public hospitals than any other state. Panel (b) presents the number of privatizations in each year. There were at least 10 privatizations in each year from 2002 through 2017, suggesting that the

[17] The choice of 15 miles is somewhat arbitrary and trades off the need to isolate comparison hospitals from treated facilities against the desire to retain a larger share of potential comparison hospitals in the sample. We found that about 75% of Medicare patients over 2000–16 were treated at a hospital located within 15 miles of their home zip code, suggesting this is an appropriate threshold.

estimated treatment effects will not be dominated by a specific sub-period. Similarly, no single year accounts for more than 8% of the total number of privatizations. The trend of privatization accelerated following the great recession – there were about 16 conversions per year in 2009–18 versus 12 per year over 2000–09.

4 Empirical Strategy

Our goal is to quantify the causal effects of privatization on public hospitals and the markets they are located in. Our baseline models implement a staggered difference-in-differences (D-D) research design, following the recent literature on hospital ownership (Dafny et al., 2019; Craig et al., 2021). Since our data spans 1995–2019, we study privatizations executed over 2000–2018 so we observe each treated hospital for 5 years before and at least 1 year following the privatization. Public hospitals that did not experience a change in ownership constitute the comparison group, and they offer an intuitive counterfactual for privatized hospitals.[18] Their performance trends are not contaminated by previous treatments, a complication with using already privatized (treated) hospitals as controls.

Equation 2 below presents our baseline model. Y_{ht} denotes the outcome of interest for hospital h in year t. We model the outcome as a function of hospital and year fixed effects, α_h and α_t, respectively. Recent studies of hospital closures have noted that markets experiencing closures had weak economic trends prior to the closures (Alexander and Richards, 2021; Chatterjee et al., 2022). Hence, we test sensitivity to including covariates X_{mt}, a vector of time-varying market attributes including population level, unemployment, poverty, and uninsurance rates for the county in which the treated hospital is located. We do not include time-varying hospital-level covariates (eg. bed capacity, services offered) in the models since most such attributes would plausibly be affected by the privatization. The key regressor of interest, D_{ht}, is a time-varying indicator variable that is equal to one starting in the year the hospital is privatized and zero otherwise. Finally, ϵ_{ht} denotes unobserved time varying factors. We cluster standard errors by hospital to account for the potential

[18] Hospitals that exit are retained in the comparison group since this is a valid counterfactual to privatization.

correlation of outcomes over time at the same hospital, which is the unit of treatment.

$$Y_{ht} = \alpha_h + \alpha_t + \beta\, D_{ht}\, [+X'_{mt}\, \delta] + \epsilon_{ht}. \tag{2}$$

While our approach is standard in this literature, we note that privatizations are not randomly assigned, nor are we aware of credible quasi-experimental instruments for changes in hospital ownership. Hence, one should interpret the coefficient of interest, β, with caution. However, our specifications control for the most important potential confounders. For example, hospital fixed effects eliminate persistent unobserved differences between hospitals, an important source of selection. Under the assumption that the privatized and comparison hospitals would have evolved on parallel trends in the absence of the transaction, β recovers the average treatment effect on the treated hospitals. We assess dynamic effects on treated hospital outcomes around the year of the privatization by estimating the event study model in Equation 3 for each outcome.

$$Y_{ht} = \alpha_h + \alpha_t + \sum_{s \neq -1} \beta_s\, D_{h,t+s}\, + \epsilon_{ht}. \tag{3}$$

A lack of differential trends in the years prior to the acquisition is consistent with the identifying assumption. Reassuringly, the evidence suggests relatively large changes in trends following privatization that cannot be explained by pre-trends, if any. We truncate the sample to 5 years before and after the year of privatization to focus on immediate changes in trajectory following the change in ownership. We also exclude the year of privatization (year zero) since it represents partial treatment. In our primary specifications, we estimate unweighted models, thus giving equal importance to all hospitals. Section 5.3 presents results from multiple checks where we assess robustness to using alternate modeling assumptions (including weighting) and specifications.

5 Effects on hospital utilization

5.1 Hospital-level effects

We begin by presenting the estimated effects on patient volume at the privatized hospitals following the privatization. Table 3 presents the D-D coefficients obtained by estimating Equation 2 without including the covariate vector X (Panel A) and including controls at the county-year level for population, percent in poverty, percent unemployed, and percent uninsured (Panel B), respectively. We present the effects on total patient admissions as well as on the components by payer, to highlight potential heterogeneity in effects for patients accessing care through different payers. Columns 2–4 present results for patients covered by Medicaid, Medicare, and Other payers, which include private and uninsured patients.[19] Since the outcome in these models is log patient volume, we interpret the coefficients as approximately estimating the percent change in volume.

As the table shows, the estimates are very similar whether we include market-level covariates or not. This is reassuring since it mitigates the concern of model mis-specification and omitted variables like the prevailing economic environment. We prefer to focus on the estimates obtained without including additional covariates as our primary results, hence throughout the text we will primarily discuss these estimates. Total patient admissions at the privatized hospital decline by about 8.5% following privatization. This estimate is statistically significant at the 1% level and suggests a substantial contraction of the hospital's patient care services. More importantly, the decline is not evenly felt by all patient groups. While Medicaid admissions decline by about 14.5%, Medicare admissions only decline by 5%, and are marginally significant. Finally, we find a 13.4% decrease in Other admissions, which includes uninsured admissions. Taken together, we infer that hospital privatization primarily affects non-Medicare patients.

Figure 3 presents the corresponding event study plots obtained by estimating Equation 3. The

[19] Medicaid and Medicare include those on managed care plans, e.g., Medicare Advantage. The 'Other' group is mostly composed of privately insured and self-pay patients. It also includes patients covered by small payers like government employee plans and workers' compensation. Unfortunately, the AHA survey does not provide a breakdown of Others.

figures show that, relative to the non-treated hospitals, the privatized hospitals were not trending differentially on these outcomes prior to the year of the transition. This is reassuring and supports the parallel trends identifying assumption. Further, the patterns are consistent with the coefficient magnitudes presented in Table 3. For example, there is a noticeable, discrete drop in Medicaid and Other volume in the year after the transition (panels b and d). As indicated by the dynamic coefficients, the magnitude of the drop in admissions persists for at least the 5 years we follow. This pattern suggests the decline is not a transient phenomenon due to a one-off disruption in management. In contrast, there is little change in Medicare volume at privatized hospitals following the change (panel c).

We conducted an additional check to probe the marginal change in Medicare admissions using patient-level claims data on hospital utilization by Traditional Medicare (TM) patients, obtained from the Centers for Medicaid and Medicare Services (CMS). There are two noteworthy differences in this sample relative to our main sample drawn from the AHA. First, the volume observed in claims differs from the Medicare volume we observe in the AHA since it does not include utilization by Medicare beneficiaries on managed care, known as Medicare Advantage (MA). Second, the claims data spans 2000–2017 and we can therefore include slightly fewer privatizations in this analysis. We implement the same research design and present the results in Appendix Table A.3. We find a decline in TM admissions (Panel A row 1) that is not robust to using a matched sample (Panel B), nor to correcting for the staggered nature of the D-D, thus bolstering the interpretation that Medicare patient utilization is unaffected by privatization.[20]

The results above imply that hospitals scale down patient care following privatization. A partial explanation for this decline could be a change in treatment style so that the hospital treats more patients in the outpatient department following privatization. We tested this conjecture and find there is no parallel increase in outpatient care at the privatized hospitals. Appendix Table xx presents the corresponding effects on total outpatient and Emergency Department (ED) volumes,

[20]We also examine the effects separately for dual eligible and non-dual eligible TM patients and find a slightly larger decline among dual eligible patients in the baseline specification. However, the effects for both groups tend to be non-robust and are statistically indistinguishable.

respectively. In both cases we find statistically insignificant and negative coefficients, implying a decline, if anything. Appendix Figure xx presents the corresponding event study plots.

In supplementary analyses, we tested whether the new management reduces bed occupancy or executes a broader decline in operational capacity. The former implies a reduction in operating efficiency – a surprising outcome of privatization – while the latter could reflect a strategic decision to improve finances. To investigate this, we consider the effect on total volume per bed, where beds are updated contemporaneously to account for changes in capacity. Appendix Figure A.2 presents the dynamic effects on total patient volume per bed, obtained by estimating Equation 3. The figure shows a flat trend in total volume per bed following privatization, supporting the latter explanation. The corresponding D-D estimate is small and statistically insignificant: -0.3 patients per bed against a mean of 35, with a standard error of 0.73.

5.2 Market-level effects

The results in the previous section showed that public hospitals persistently admit fewer patients following privatization, and the decline is uneven across patients covered by different payers. This naturally leads to the question whether privatization leads to an aggregate decline in utilization at the market-level or are the patients reallocated to neighboring hospitals? Medicaid patients appear to be one of the negatively affected groups. If these patients are perceived as unprofitable or undesirable, then neighboring hospitals may be reluctant to step in as well. The implications for policymakers turn on the answer to this question. A reallocation to a different hospital could potentially be harmful if the new hospital is further away or of worse quality than the privatized hospital, but at the same time it may also be an improvement if the public hospital was low quality. However, a reduction in access to care implies Medicaid (and perhaps other) patients are unambiguously worse off following a privatization.

To shed light on this concern, we adapt our research design and implement it at the market-level, which we define using Health Service Areas (HSAs). These were originally delineated by the US Census in a similar fashion and for the same purpose as the more commonly used Hospital

Referral Regions (HRRs), developed by the Dartmouth Atlas group. We prefer to use HSAs for two reasons. First, they are smaller in size – there are about 930 HSAs against 306 HRRs. The average HSA has about 6 hospitals (including both public and private owned), while the average HRR contains about 18. Hence, we will have greater statistical power to detect the market-level effects of a single hospital's privatization when we use a more granular market definition. At the same time, HSAs adequately capture patient hospital choice decisions.[21] Second, their borders follow county boundaries, while those of HRRs do not. This allows us to directly map the time-varying county-level characteristics to HSAs.

To implement our analysis at the market-level, we tag the 203 markets in which privatized hospitals are located as treated, while the 730 remaining markets form the comparison group.[22] We then estimate an unweighted market-year level model equivalent to that presented in Equation 2. A market is considered treated when it first experiences a privatization during our sample period, and is then considered treated through the end of the sample. 42 of the 203 markets experienced more than one privatization event. Table 4 describes the market-level analysis sample. Columns 1 and 2 are equivalent to the corresponding columns in Table 2 and should be interpreted in the same way. We also present some market-level economic characteristics, such as poverty and unemployment. The average treated market has 6 hospitals, out of which 1.3 or 21% are treated during the period. Privatized hospitals account for 15% of the total beds in the median market, a more conservative assessment of their contribution. Market-level bed counts, payer mix, and economic indicators are as one would expect based on the hospital-level averages. Comparison markets are slightly smaller in size and have slightly better economic indicators on average (eg., lower poverty and unemployment).

Table 5 presents the estimated effects on market-level patient volume, with log of volume as the outcome. The columns present effects on total volume and by payer, respectively. Panels A and B

[21] Using Medicare claims data, we confirm that more than 70% of TM patients choose a hospital located in the same HSA as their residence zipcode. The corresponding number for HRRs is about 80%.

[22] We considered imposing a non-neighbor rule for comparison markets to mitigate the potential for spillovers. But such a rule would nearly eliminate all potential untreated markets in the same states as the treated markets. It was unappealing to have the comparison group be restricted to an almost disjoint set of states.

present the estimates from specifications without and with the time-varying controls, respectively. Including market controls tends to magnify the point estimates but leads to similar interpretations, hence we focus on the estimates without controls. Column 1 presents estimates on total volume and suggests a 0.7 percentage point (pp) decline in admissions across all hospitals in the market. Our direct effect at the treated hospitals was an 8.4% decline in total admissions. If there was no increase in admissions at neighboring hospitals and we assumed that treated hospitals account for 20% of beds, then we would expect a 1.7 pp decrease in total admissions at the market level (20% of 8.4 pp). Hence, the point estimate we obtain suggests the presence of some offsetting responses by other hospitals in the same market. We are under-powered to statistically detect an effect of this magnitude at conventional levels of significance, nor can we reject the hypothesis that our estimate differs from 1.7 pp.

The most interesting finding is that Medicaid is the only payer for which we estimate a negative effect on volume at the market-level. While the point estimates for Medicare and Others are positive and close to zero, the effect on Medicaid is -3 pp – approximately what we would predict based on the privatized hospital's decline alone (20% of -14 pp, or -2.8pp). Hence, the point estimate suggests no offsetting responses by neighboring hospitals for Medicaid patients. The coefficient is noisily estimated so we cannot reject the null hypothesis of no decline in Medicaid volume, although it is larger and significant at the 10% level when we include controls. Figure 4 presents the corresponding event study plots for these outcomes. The estimated dynamic effects are consistent with the coefficients discussed above. Medicaid is the only payer for which the trend appears to be consistently negative following privatization.

Heterogeneity

The average effect across all markets may mask heterogeneity in treatment effects across different types of markets, and the possibility that some markets may experience larger effects. This has implications for policy since we may want to avoid privatization in certain types of markets if they are likely to have significant undesirable effects for consumers. We draw on the institu-

tional setting of healthcare markets and predictions from the privatization literature to guide our investigation of heterogeneous effects.

We first explore potential heterogeneity across markets with greater poverty since hospitals in markets with greater poverty levels are likely to have fewer resources to offset the decline in patient volume at the privatized hospital. Disparities in payer mix and profitability are evident between hospitals in markets with low versus high poverty rates. Medicaid contributed 18% of patients for hospitals in 1999 in markets with poverty greater than median, while the corresponding figure was 13% at hospitals in markets with poverty lower than the median. The average hospital operating margin in markets with above median poverty rate was 0.4%, less than half that in markets with poverty below the median (1%). We hypothesize that the aggregate decline in patient volume will therefore be larger in markets with greater poverty rates. In fact, since the competing hospitals may be losing much-needed privately insured patients to the newly privatized hospital, they may reduce their own Medicaid admissions in response. Hence, the aggregate impact on Medicaid volume at the market-level may even exceed what one would predict based on the direct effect of privatization. To test whether the impacts differ in markets with greater poverty, we estimate a triple difference specification including an additional term interacting the privatization indicator with an indicator for being above the median poverty rate.

Table 5 Panel C presents the estimated coefficients of interest from the triple difference model without including covariates. The results clarify that privatizations barely register in markets with below-median poverty rates. All D-D coefficients, which estimate the effects for low poverty markets, are positive, small, and statistically insignificant. In contrast, markets with greater poverty rates experience an aggregate decline in patient volume of 2.3 pp (0.9 - 3.2 = -2.3), driven mostly by a large and statistically significant decline in Medicaid volume of 9.4 pp (3.3 - 12.7 = -9.4). We confirmed in results not presented here that privatized hospitals downsize in both types of markets. The point estimate for the effect on hospital-level volume is not statistically distinguishable in the two types of markets. The contrasting effects on Medicaid volume in these two groups of markets suggests that neighboring hospitals in wealthier markets are able to offset the decline of hospital

operations following privatization. However, not only does this offsetting mechanism not operate in lower income markets, but also the neighboring hospitals appear to reduce their own intake of Medicaid patients.

Shleifer (1998) discusses the factors that reduce the potential benefits of privatization or exacerbate the likelihood that the new management may hurt consumers by reducing quality. He hypothesizes that privatization will have less beneficial effects in more concentrated markets since consumers have fewer outside options and therefore market forces cannot discipline the new managers. This is a highly pertinent issue in the case of hospitals since local hospital markets are concentrated on average – the mean Herfindahl Hirschman Index (HHI) in 2000 was nearly 3,000, well over the federal government's threshold for being "highly concentrated" (DOJ, 2010). The mean HHI further increased to about 4,000 by 2020.[23] We test this hypothesis in our setting by examining if the negative effect on utilization is greater in more concentrated markets. We estimate triple difference models where we include an interaction term between treatment and a concentration level greater than the median in 1999. We note that highly concentrated markets do partially overlap with high poverty markets (54 markets are above-median on both dimensions), but overall, the two groups appear quite different. Concentrated markets are not as economically disadvantaged, having similar poverty, Medicaid, and uninsurance levels as the average treated market. Concentrated markets are also smaller and have half the number of hospitals as the average treated market. Hence, the remaining hospitals are more 'exposed' to privatization than in markets with greater poverty. We therefore expect greater aggregate effects in concentrated markets.

Table 5 Panel D presents the corresponding results from the triple difference model. The results imply that the effects of privatization are diametrically opposed in markets with low versus high concentration. Utilization does not decline in competitive markets, and even increases a bit, though even in this case there is no increase for Medicaid patients. There is a sharp decline in utilization in concentrated markets, with a 6 pp decline in aggregate volume (4.5-10.5=-6), nearly three times

[23] We computed these HHI values using hospital bed shares recorded in the AHA and hospital referral regions to define hospital markets. Since HSAs are smaller and have fewer hospitals, the mean HHI would be greater if we used HSAs to define hospital markets.

that in high-poverty markets. However, in this case, the decline in utilization appears to be more widespread and affects all patients regardless of payer.

5.3 Robustness

We test the robustness of the main results to different modeling assumptions and important validity concerns. Table 6 presents the corresponding results for both hospital- and market-level volume in columns 1–4 and 5–8, respectively. Panel A presents the baseline estimates, without including time-varying covariates, for ease of comparison to the main estimates. Across all checks, the models do not include market-level covariates.

Panel B presents the coefficients obtained from regressions incorporating hospital bed capacity as weights.[24] This approach gives more weight to the changes at larger privatized hospitals. The estimates remain very similar in magnitude and statistical significance in the case of the hospital-level effects. At the market-level, giving more importance to larger markets results in a positive overall effect. This implies that the decline in Medicaid is greater in smaller markets.

Panel C tests whether the estimates are robust to allowing the privatized hospitals (markets) to progress on a differential linear trend. We estimate models including a linear trend interacted with an indicator for the treated units. Both sets of estimates remain qualitatively similar. The hospital-level results suggest that the estimated decline in Other patients is not robust to this change.

The recent econometric literature on differences-in-differences has shown that estimates obtained from staggered treatment designs may suffer from biases due to the use of treated groups as controls for future treated units. To assess the importance of this potential threat, we report coefficients from the estimator proposed by Callaway and Sant'Anna (2020) which corrects for staggered designs and computes the weighted average treatment on the treated. Panel D presents the corresponding coefficients which are remarkably similar to the baseline estimates.

The last two panels present results from the baseline specification estimated on two different

[24]For this exercise, we hold bed capacity fixed. For treated hospitals we use the mean of pre-period beds, i.e., the mean of beds in the five years prior to privatization. For control hospitals we use the number of beds in 1999 or if the hospital was not in the sample in 1999 (rare), the first year we observe that hospital.

sub-samples. Our main analysis sample allows an unbalanced panel in treatment time for the privatized hospitals. That is, while we are able to follow some hospitals for 5 years following privatization, we can follow others for as little as 1 year. We assess the importance of this imbalance by imposing the restriction that we should be able to follow all privatized units for 5 years. The results remain qualitatively similar. The only noteworthy point is that market-level effects on Medicare and Other volume become more positive.

Finally, we implement propensity score matching to identify a subset of the comparison hospital group that resembles the privatized hospitals on key attributes like bed capacity and patient volume in the years prior to the transition. We use matching to identify a single unique comparison hospital for each treated hospital, and then estimate our baseline D-D specification without market covariates. We don't implement matching at the market-level since imposing a minimum distance threshold eliminates candidate HSAs in the same states as the treated markets. Appendix C.2 describes the matching exercise in more detail. Panel F presents the corresponding coefficients, which suggest slightly smaller effects on patient volume. Appendix Figure A.3 presents the corresponding event studies on patient volume. Reassuringly, the patterns are qualitatively very similar to those obtained using the full sample.

6 Effects on labor intensity

6.1 Direct effects

So far we have focused on the impact of privatization for patients (consumers) by examining hospital volume, a proxy for access to care. However, privatization is likely to affect hospital operations along multiple dimensions. Studies have documented across a wide range of settings that the new private management usually reduces operating costs, and specifically reduces labor inputs and associated spending (La Porta and López-de Silanes, 1999; Megginson and Netter, 2001). Hence, privatization is likely to make the targeted hospital leaner. Our results in the previous section have established that patient volume declines at the privatized hospital, and in some types

of markets, at the aggregate level as well. Hence, we expect an accompanying decline in the level of hospital employment appropriate for the diminished patient volume and bed capacity. We test whether the new management is also able to reduce labor *intensity* by quantifying the effect on FTE normalized by contemporaneous beds or adjusted admissions.

Table 7 presents the estimated effects on employed and contracted full-time equivalent (FTE) staff per 100 beds, approximately the size of the average privatized hospital. We find an economically meaningful reduction in total employed staff following privatization. Total staff declines by about 33 FTE per 100 beds (Col. 1). Compared to the pre-privatization mean, this implies a decrease of 6% in labor intensity. Although nurses account for 27% of total staff, we do not detect any reduction in nurse intensity. The reduction is driven mainly by the residual group, referred to as 'Others.'[25] This group is disproportionately affected since it accounts for 70% of total FTE but contributes 90% of the total reduction in intensity. This is a diverse group and includes patient care (eg., technicians), back office or overhead (eg., accounting), and managerial functions (eg., administrators). While a smaller component of the aggregate effect, the estimate on physicians suggests an economically meaningful reduction of 25% compared with the pre-privatization mean.

To open the black box of the 'Other' group, we also examined labor input data reported in the Medicare cost reports. Specifically, we study the effect on FTE employed purely in overhead functions such as accounting, maintenance, IT, and so on. This group alone accounts for about 40% of the average hospital's total employed staff.[26] Table 7 column 5 presents the corresponding estimate. We find a reduction of about 10 FTE. Hence, at least a third of the total decline in labor intensity is at the expense of overhead functions. This estimate is significant at the 10% level. Finally, we test whether the decline in employed staff is partially offset by an increase in the use of contract labor following privatization. This is crucial since it affects how we interpret the decline in employment discussed above. If the decline in employment is partly or fully offset by an increase in contract labor, it implies that patient care is likely not affected, and the new management is just

[25] Hospitals typically do not employ physicians directly and this explains the small share of physicians of total FTE. The figures here only account for employed physicians, such as hospitalists.

[26] Note that some back office functions may also lie outside the overhead category as defined by the cost reports. Unfortunately, it is not possible to pinpoint the specific functions that comprise this leftover set.

changing how it contracts with staff. However, the result in column 6 is near zero and statistically insignificant. We can rule out an increase in contract staff of more than 2.5 FTE per 100 beds, which would offset less than 10% of the decline in employed staff. Hence, the results imply a real decline in labor intensity.

Figure 5 presents the event study plots corresponding to each of these labor variables. The dynamic coefficients are consistent with the D-D estimates presented in Table 7. There is a noticeable decline in physician, others, and overhead FTEs per bed in the year following privatization, and it persists or in some cases increases over the next 5 years. Appendix Table A.4 presents the corresponding estimates obtained using FTE normalized by adjusted admissions instead of beds. The benefit of using adjusted admissions instead of beds is that they incorporate changes in outpatient volume at the hospital. The results are qualitatively similar, largely driven by the other group, and suggest a slightly greater decline in labor intensity than the estimates discussed above (8% vs. 6%). Appendix Figure A.4 presents the corresponding event study plots, which are consistent with the point estimates.

6.2 Market-level effects

Previous studies on privatization have found spillover effects of privatization on market-level wages. Arnold (forthcoming) studies privatization in Brazil and finds substantial spillover effects on mean wages at exposed firms in the market. The aggregate decline in wages is nearly three times what would be predicted based on the effect on the privatized firm alone. In our setting, however, public hospitals did not pay higher wages than their private counterparts at baseline, and hence there appears less room for a decline in wages following privatization. Public hospitals did have higher labor intensity, as described above, and hence we test whether there are spillover effects on labor intensity at competing hospitals. Employment spillovers are possible in theory for at least two reasons. First, other hospitals in the market competing for the same insurer business may respond to restructuring by the privatized hospital with changes of their own to reduce costs. Second, the public hospital may have informally provided a benchmark of labor input intensity

prior to privatization that competing private hospitals felt pressured to aspire to. Once the privatized hospital decreased labor intensity, competing hospitals may feel at liberty to do the same without loss of reputation.

Table 8 presents the corresponding effects on market-level hospital labor intensity obtained by applying our research design. Panels A and B present the estimates without and with including market covariates, respectively. The columns present effects on total FTE as well as on the same components studied in Table 7. In this case, including covariates does reduce the magnitude of the coefficients, so we discuss these to be conservative. We find a reduction of 14 FTE per 100 beds following privatization, which represents approximately a 3% decline relative to the baseline mean of 492 FTE. As with the direct effect, this decline is driven mainly by a reduction in occupations except physicians and nurses.

Recall we found a 6% decline in labor intensity at the privatized hospital itself. Since privatized hospitals are about 20% of the average market, we would expect a direct effect of a 1.2% decline at the market level in the absence of spillover effects. Hence, the aggregate effect is about 2.5 times what the direct effect would predict, suggesting that more than half the effect is due to responses by competing hospitals. Policymakers concerned about the effects of privatization on labor should therefore consider effects on the entire industry rather than the privatized firm alone.

7 Conclusion

This paper studies the privatizations of public hospitals that occurred in the US over 2000–2018. Our main finding is that hospitals downsize and reduce patient volume after transferring to private control. However, the decline in utilization is not evenly spread across all types of patients. The decrease in the number of Medicaid patients is nearly twice as large as the total decline in patients. This raises the question whether patients experience a decline in access to care following privatizations, or are reallocated to other hospitals in the market. We find a decline in aggregate Medicaid volume at the market-level which is accentuated in markets with higher poverty rates or

greater concentration. In contrast, aggregate patient volume for other payers remains unaffected, implying a decline in access to care only for Medicaid patients. The new private hospital operators also reduce the intensity of labor inputs, particularly in administrative and support functions, suggesting greater efficiency. The aggregate decline in hospital employment is nearly 2.5 times what we would expect given the direct effect, suggesting large spillover effects to employment by competing hospitals.

While this paper shines the light on the privatization of an important sector of the US economy, there are several avenues for future research. Due to data limitations, we cannot describe whether hospital utilization declined to a greater extent for certain services (eg., unprofitable services like psychiatric care). Researchers with access to patient-level data on utilization and health can study whether the changes in service led to adverse effects on public health. Understanding these aspects will be key to comprehensively quantify the welfare effects of privatization and inform policy interventions.

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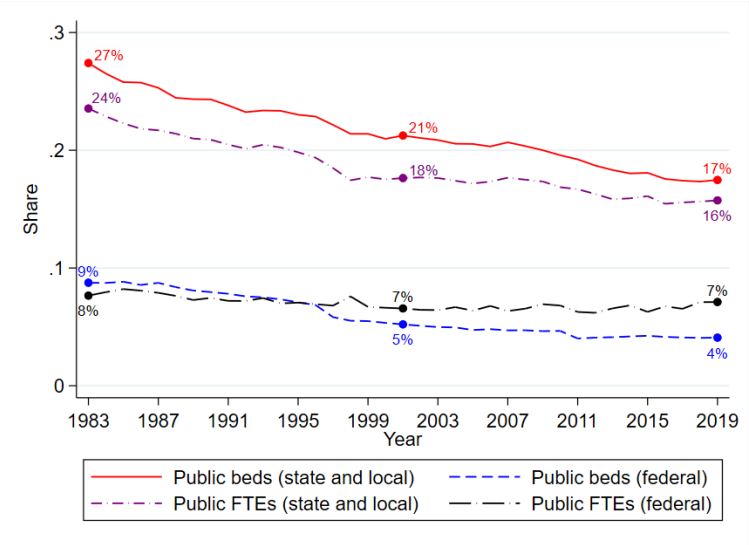
(a) As provider



(b) As payer

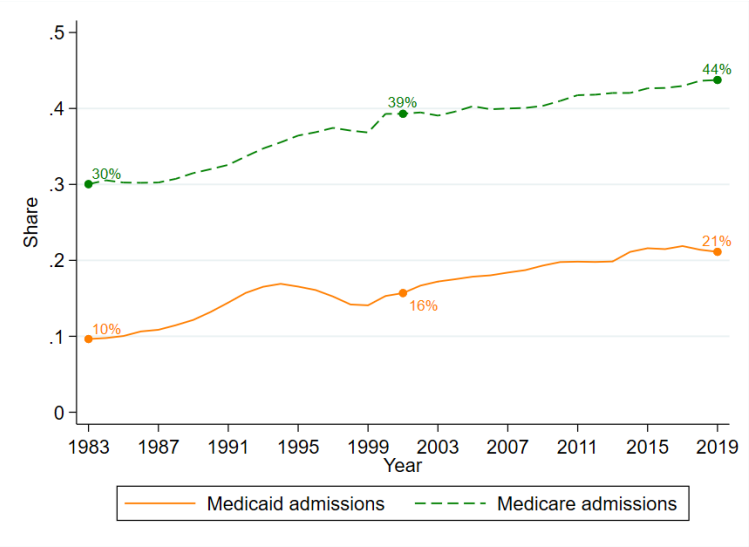
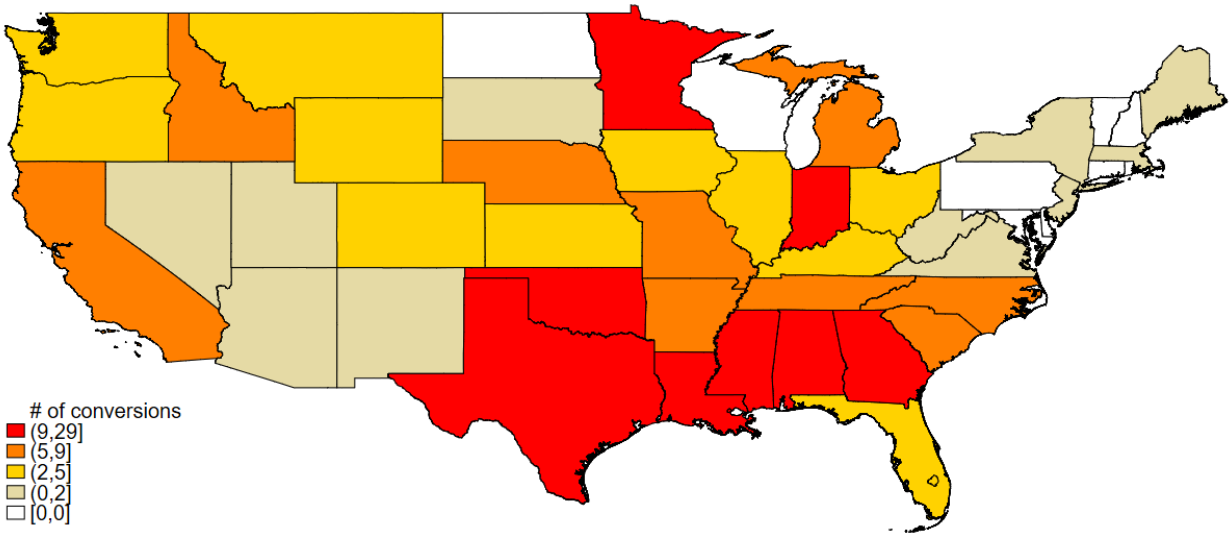


Figure 1: Government role in hospital care

Note: The figure presents overall shares in the US from 1983 through 2019 using American Hospital Association (AHA) survey data. In Panel A we plot the share of total beds contributed by public, non-federal hospitals with a red, solid line and the share of public, federal hospitals with a blue, dashed line. In Panel B, the share of Medicaid admissions is given by the orange, solid line; the share of Medicare admissions is given by the green, dashed line. The denominator comprises all hospitals present in the survey in each year.

(a) By state



(b) By year

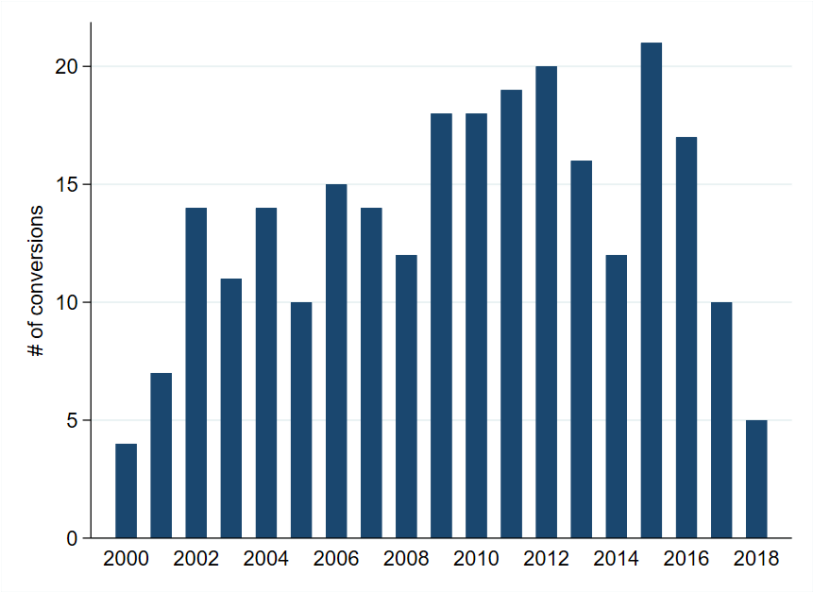


Figure 2: Privatizations

Note: The figure presents the distribution of non-federal public hospital privatizations during our sample period (2000–18). Panels (a) and (b) present the distribution by state and by year, respectively. Hawaii and Alaska are not pictured and include 4 and 1 conversions, respectively. We manually validated each conversion.

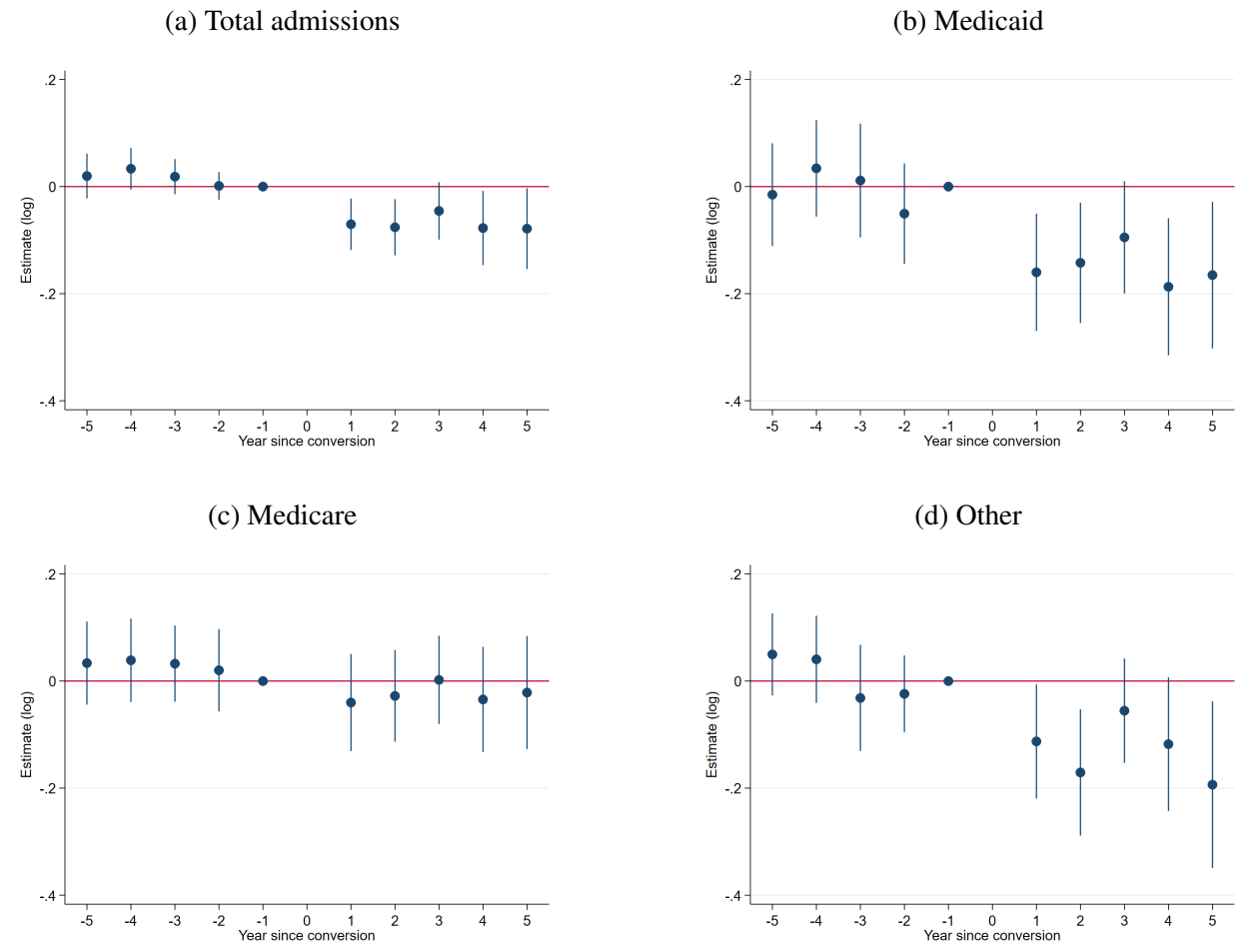


Figure 3: Effects on patient volume

Note: The figure presents event study plots obtained by estimating Equation 3 on hospital-year level data. The comparison group is comprised of hospitals that remain public throughout our sample period and are not located within 15 miles of any treated hospital. The outcomes are logged total patient volume, Medicaid, Medicare, and other volume in panels (a), (b), (c), and (d), respectively. Year zero is the year of privatization and is excluded for the treated hospitals since it represents partial treatment. The error bars present 95% confidence intervals. Standard errors are clustered by hospital.

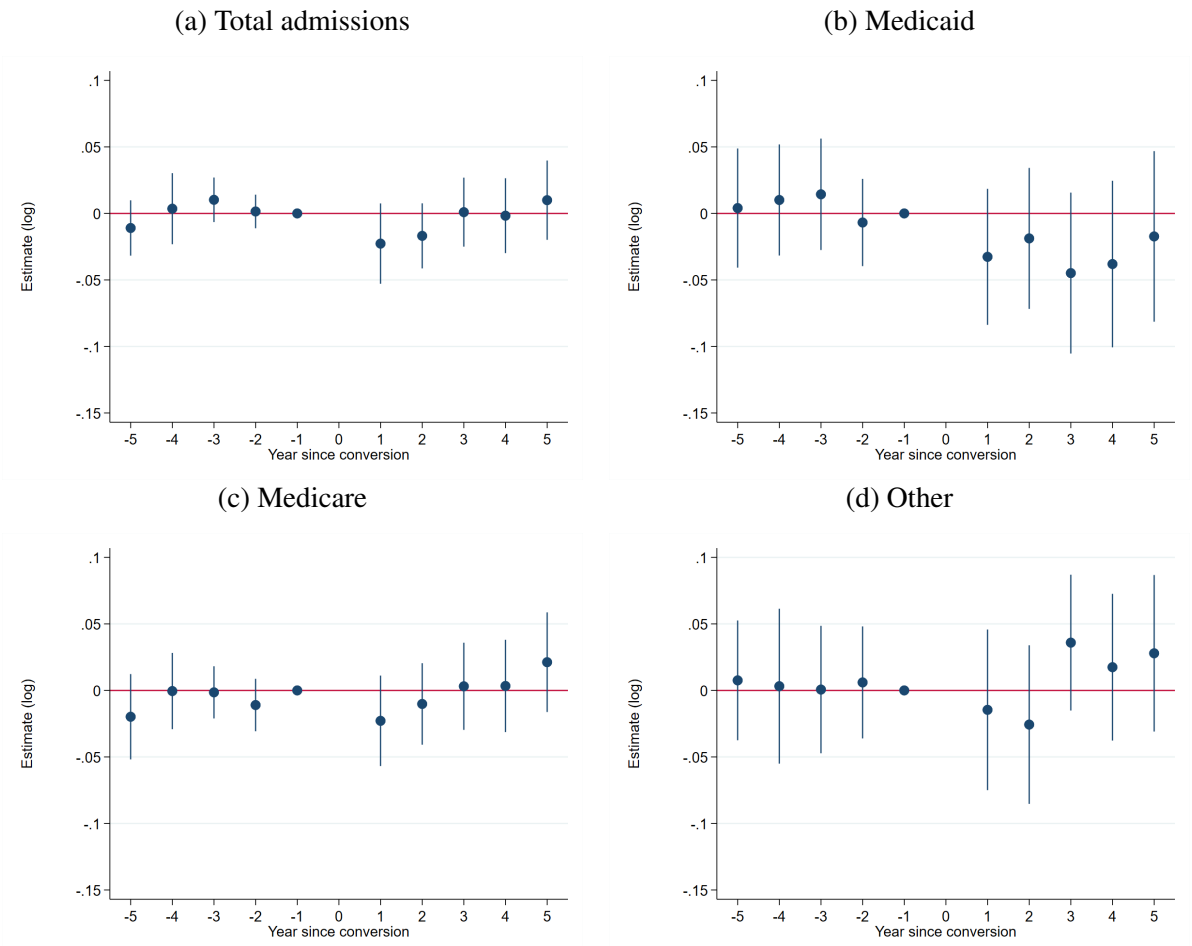


Figure 4: Effects on market volume

Note: The figure presents event study plots obtained by estimating the market-level equivalent of Equation 3 on market-year level data. We define hospital markets using Health Service Areas (HSAs), as described in Section 5.2. The outcomes are as indicated in the figure and are logged. Year zero is the year a market first experiences a privatization and is excluded from the data for treated markets since it represents partial treatment. The error bars present 95% confidence intervals. Standard errors are clustered by HSA.

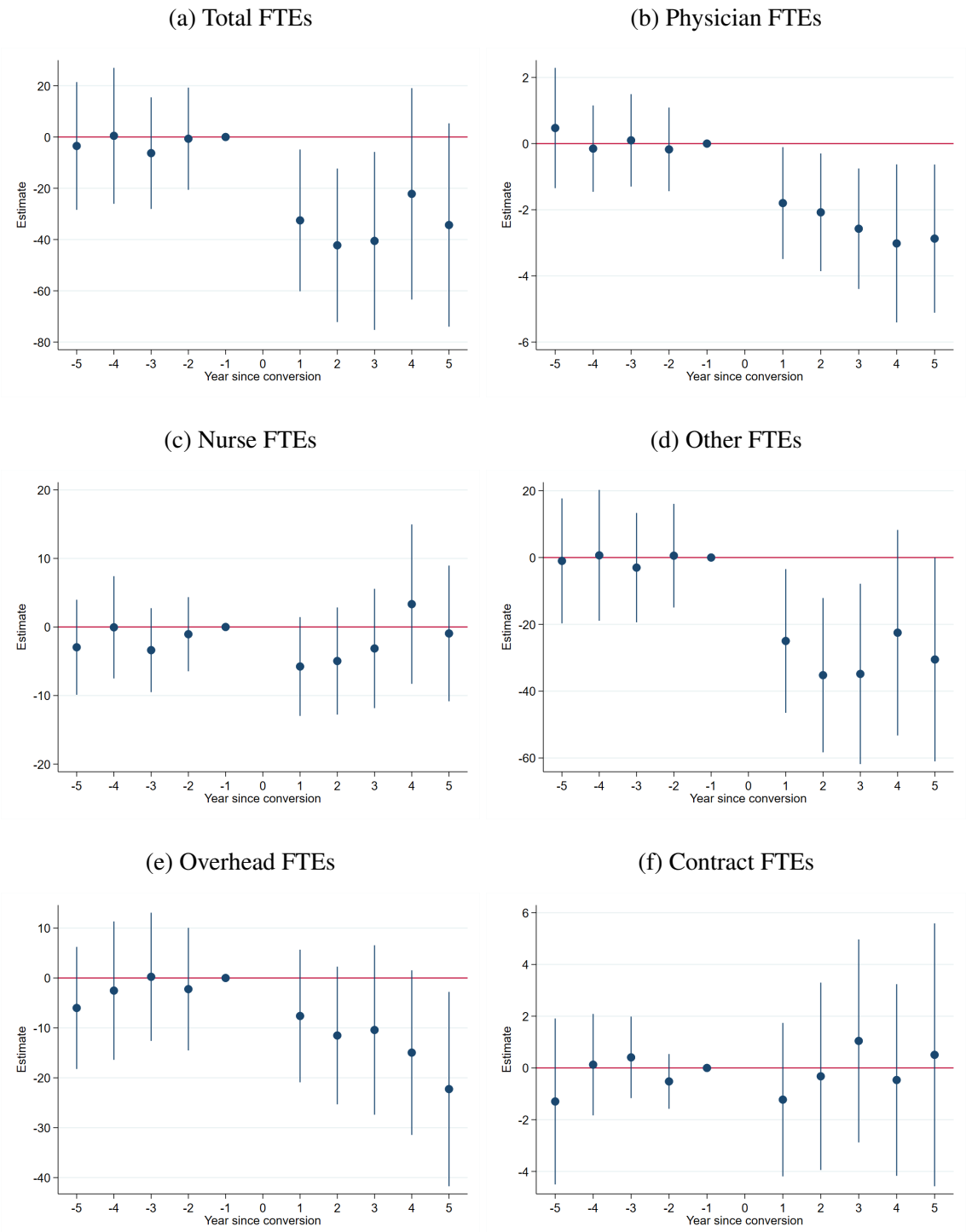


Figure 5: Effects on staff (per 100 beds)

Note: The figure presents event study plots obtained by estimating Equation 3 on hospital-year level data. The comparison group is comprised of hospitals that remain public throughout our sample period and are not located within 15 miles of any treated hospital. Outcomes from the AHA are total full-time equivalent employees (FTEs), physician FTEs, nurse FTEs, and other FTEs in panels (a), (b), (c), and (d), respectively. Outcomes from HCRIS are overhead FTEs and contract FTEs in panels (e) and (f), respectively. All outcomes are normalized by the contemporaneous number of hospital beds and presented per 100 beds. Year zero is the year of privatization and is excluded for the treated hospitals since it represents partial treatment. The error bars present 95% confidence intervals. Standard errors are clustered by hospital.

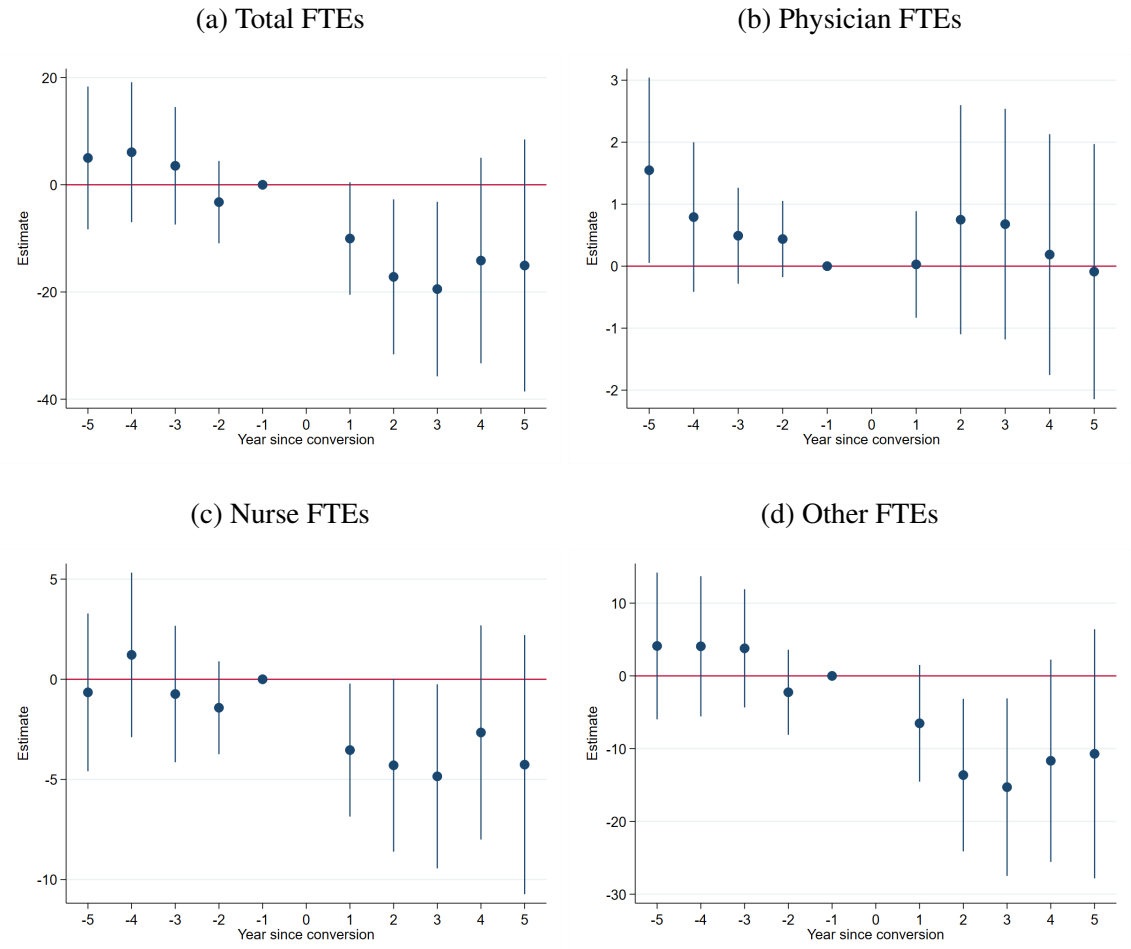


Figure 6: Effects on market staff (per 100 beds)

Note: The figure presents event study plots obtained by estimating the market-level equivalent of Equation 3 on market-year level data. We define hospital markets using Health Service Areas (HSAs), as described in Section 5.2. The outcomes are as indicated in the figure and are normalized by 100 beds. Year zero is the year a market first experiences a privatization and is excluded from the data for treated markets since it represents partial treatment. The error bars present 95% confidence intervals. Standard errors are clustered by HSA.

Table 1: Shares of hospital beds by ownership type for select states in 2019

	(1) AL	(2) CA	(3) TX	(4) GA	(5) IL	(6) PA	(7) US Overall
Public (non-federal)	44.4	22.9	15.8	11.7	8.0	3.8	17.3
							(12.5)
Public (federal)	4.4	3.6	5.8	3.4	3.7	3.6	4.2
							(2.1)
Non-profit	23.4	56.8	37.1	71.5	80.8	79.3	62.9
							(19.2)
For-profit	27.8	16.8	41.3	13.4	7.5	13.3	15.6
							(12.4)
# hospitals	116	419	588	172	208	235	6,090

Notes: The table presents shares of hospital beds by ownership type for select states using American Hospital Association survey data from 2019. Appendix A.1 lists public (non-federal) hospital bed shares for all states. Column 7 shows mean shares for the overall US; standard deviations are shown in parentheses.

Table 2: Descriptive statistics

	(1) Privatized	(2) Remaining Public	(3) Private	(4) All
% public	100.0	100.0	0.0	18.9
% for-profit	0.0	0.0	21.5	17.4
% non-profit	0.0	0.0	78.5	63.7
Admissions	3,104	3,934	7,130	6,486
	(4,411)	(6,601)	(7,472)	(7,359)
Beds	93	114	182	168
	(105)	(158)	(179)	(175)
% Medicaid adm	15.5	16.3	13.2	13.7
	(8.6)	(12.2)	(8.9)	(9.5)
% Medicare adm	49.1	47.9	44.9	45.5
	(15.6)	(16.7)	(13.3)	(14.0)
% other adm	35.5	35.7	41.9	40.7
	(14.4)	(13.8)	(14.0)	(14.2)
Total FTEs/100 beds	379	393	444	434
	(162)	(202)	(224)	(220)
Overhead FTEs/100 beds	199	179	202	198
	(95)	(103)	(130)	(124)
# hospitals	257	766	4,392	5,415

Notes: The table presents descriptive statistics on a cross-section of hospitals in the analysis sample. We use values from 1999 for most hospitals. In rare instances in which we do not observe a hospital in 1999, we use values from that hospital's first year in the data. Appendix C.1 describes the sample construction restrictions in detail. Column 1 describes the public hospitals privatized during the sample period. These comprise the treated units. Column 2 describes the primary comparison group: public hospitals that did not experience a change in ownership during this period and are more than 15 miles away from all treated hospitals. Column 3 describes all privately owned non-profit and for-profit hospitals that were not converted to public ownership during this period. Column 4 presents the corresponding values on the full sample. 'Other' admissions refers to hospital admissions not covered by Medicaid or Medicare and mostly comprises privately insured and uninsured patients. Standard deviations are shown in parentheses.

Table 3: Effects on patient (log) volume

	(1) Total	(2) Medicaid	(3) Medicare	(4) Other
A: No controls				
DD	-.084	-.144	-.050	-.134
	(.028)	(.042)	(.030)	(.043)
Obs	20,718			
B: Market controls				
DD	-.090	-.153	-.058	-.139
	(.028)	(.042)	(.030)	(.043)
Obs	19,159			
Mean outcome (t-1)	3,024	619	1,356	1,049

Notes: The table presents estimated effects on patient volume at the privatized hospitals obtained by estimating Equation 2 on hospital-year level data. Columns 1, 2, 3, and 4 present the effects on total, Medicaid, Medicare, and the remaining ('Other') admissions, respectively. In all cases outcomes are logged. Panel A reports coefficients from a two-way fixed effects specification with no covariates. Panel B reports coefficients from a two-way fixed effects specification including time-varying county-level controls as described in Section 4. Panel B has fewer observations since the market-level covariates are not available for 1995 and 1996. The mean values pertain to patient volume at privatized hospitals in the year prior to privatization. Standard errors are clustered by hospital and are presented in parentheses.

Table 4: Descriptive statistics (market-level)

	(1) Treated HSAs	(2) Control HSAs	(3) Total
# treated hospitals	1.3	0.0	0.3
	(0.6)	(0.0)	(0.6)
Total hospitals	6.1	4.6	4.9
	(5.6)	(6.6)	(6.4)
Total admissions	36,927	31,596	32,756
	(57,525)	(81,216)	(76,691)
Total beds	963	807	841
	(1,420)	(1,971)	(1,866)
% Medicaid adm	15.6	14.1	14.4
	(6.2)	(6.7)	(6.6)
% Medicare adm	44.9	47.2	46.7
	(9.8)	(9.3)	(9.5)
% other adm	39.5	38.7	38.9
	(11.0)	(9.8)	(10.0)
Total FTEs/100 beds	408	415	414
	(122)	(137)	(134)
% in poverty	14.1	13.0	13.3
	(5.0)	(4.8)	(4.9)
% unemployment	4.9	4.7	4.8
	(2.3)	(2.4)	(2.4)
% uninsurance	20.6	19.1	19.4
	(6.0)	(5.7)	(5.8)
HHI (admissions)	4,643	5,516	5,326
	(2,496)	(2,804)	(2,762)
# HSAs	203	730	933

Notes: The table presents descriptive statistics for the market-level sample, where markets are defined by Health Service Areas (HSAs). Treated HSAs have at least one hospital that undergoes public to private conversion during 2000–18. Control HSAs do not have any conversions during our sample period. All rows present means and standard deviations (in parentheses).

Table 5: Effects on aggregate patient (log) volume

	(1) Total	(2) Medicaid	(3) Medicare	(4) Other
A: No controls				
DD	-.007	-.031	.005	.002
	(.014)	(.023)	(.015)	(.021)
Obs	20,051			
B: Market controls				
DD	-.020	-.043	-.010	-.011
	(.014)	(.023)	(.015)	(.021)
Obs	18,582			
C: Heterogeneity by market poverty				
DD	.009	.033	.021	.001
	(.019)	(.029)	(.020)	(.027)
x 1(> med. poverty)	-.032	-.127	-.031	.002
	(.026)	(.043)	(.029)	(.040)
D: Heterogeneity by market HHI				
DD	.045	.037	.047	.068
	(.016)	(.022)	(.017)	(.018)
x 1(> med. HHI)	-.105	-.136	-.083	-.132
	(.025)	(.043)	(.028)	(.038)
Mean outcome (t-1)	39,425	7,474	16,509	15,442

Notes: The table presents estimated effects on patient volume at the market-level obtained by estimating the market-level equivalent of Equation 2 on market-year data. We define markets using Health Service Areas (HSAs), as described in Section 5.2. Columns 1, 2, 3, and 4 present the effects on total, Medicaid, Medicare, and the remaining ('Other') admissions, respectively. In all cases outcomes are logged. Panel A reports coefficients from a two-way fixed effects specification with no covariates. Panel B reports coefficients from a two-way fixed effects specification including time-varying HSA-level controls: population, unemployment, uninsurance, and poverty rates. Panel B has fewer observations since the covariates are not available for 1995 and 1996. Panel C presents the corresponding results from a triple difference specification including an interaction term with an indicator for the market having a poverty rate in 1999 greater than the median among treated markets. Panel D is analogous to panel C but instead includes an interaction term with an indicator for the market having a Herfindahl-Hirschman Index (based on admission shares) in 1999 greater than the median. The mean values pertain to patient volume in the treated markets in the year prior to privatization. Standard errors are clustered by HSA and are presented in parentheses.

Table 6: Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Hospital				Market		
	Total	Medicaid	Medicare	Other	Total	Medicaid	Medicare	Other
A. Baseline	-.084	-.144	-.050	-.134	-.007	-.031	.005	.002
	(.028)	(.042)	(.030)	(.043)	(.014)	(.023)	(.015)	(.021)
B. Weighted by beds	-.089	-.162	-.078	-.107	.026	-.002	.030	.048
	(.029)	(.044)	(.034)	(.048)	(.010)	(.018)	(.012)	(.014)
C. Treated group trend	-.058	-.115	-.032	-.059	-.034	-.024	-.031	-.029
	(.030)	(.058)	(.047)	(.066)	(.015)	(.030)	(.019)	(.033)
D. CS estimator	-.063	-.144	-.017	-.118	-.003	-.025	.004	.009
	(.026)	(.053)	(.044)	(.047)	(.011)	(.024)	(.015)	(.022)
Obs (panels A-D)	20,718	20,717	20,717	20,717	20,050	20,050	20,050	20,050
E. Balanced panel	-.058	-.141	-.028	-.091	.001	-.030	.014	.012
	(.031)	(.046)	(.034)	(.048)	(.014)	(.025)	(.016)	(.020)
Obs	20,242	20,241	20,241	20,241	19,769	19,769	19,769	19,769
F. Matched sample	-.061	-.116	-.025	-.110				
	(.028)	(.045)	(.032)	(.044)				
Obs	8,512	8,511	8,511	8,511				

Notes: The table shows the results of robustness checks for the effects on patient volume estimated for the privatized hospitals and treated markets, given in Tables 3 and 5, respectively. For each outcome we present the baseline estimates in row A. Row B includes static hospital beds to weight hospitals or markets. Panel C uses the baseline specification including a linear trend interacted with an indicator for privatized hospitals or treated markets. Panel D presents coefficients from the Callaway and Sant'Anna (2020) estimator. Panel E drops treated hospitals privatized after 2014 (or markets treated after 2014) to ensure we observe each privatized hospital for 5 years before and after the transition. Panel F presents results estimated using a matched subsample identified using propensity score matching. Both Panels E and F estimate the baseline specification. Standard errors are clustered by hospital or market.

Table 7: Effects on staff (FTE per 100 beds)

	(1) Total	(2) MD	(3) Nurse	(4) Other	(5) Overhead	(6) Contract
A: No controls						
DD	-32.7	-2.5	-1.1	-29.1	-10.4	0.05
	(13.0)	(0.8)	(3.3)	(9.9)	(6.2)	(1.26)
Obs	20,718				11,534	10,005
B: Market controls						
DD	-32.6	-2.6	-1.3	-28.7	-10.2	-0.01
	(13.1)	(0.8)	(3.4)	(9.9)	(6.2)	(1.27)
Obs	19,159				11,520	9,997
Mean outcome (t-1)	512.7	10.2	138.5	364.0	203.4	14.7

Notes: The table presents effects on full-time equivalent (FTE) employed staff per 100 beds at the privatized hospitals, obtained by estimating Equation 2 on hospital-year level data. Column 1 presents results for total FTEs, which comprises of physician, nurse, and all others, presented in columns 2, 3, and 4, respectively. Outcomes for columns 5 and 6 are overhead and contract FTEs, respectively, which come from HCRIS. We normalize the staff levels in each column by the contemporaneous number of hospitals beds to account for the possibility that privatized hospitals downsize following privatization. The staff inputs are presented per 100 beds, which is approximately the size of a public hospital in our sample. Panel A reports coefficients from a two-way fixed effects specification with no covariates. Panel B reports coefficients from a two-way fixed effects specification including time-varying county-level controls as described in Section 4. Panel B has fewer observations since the market-level covariates are not available for 1995 and 1996. The mean values pertain to patient volume at privatized hospitals in the year prior to privatization. Standard errors are clustered by hospital and are presented in parentheses.

Table 8: Effects on aggregate staff (FTE per 100 beds)

	(1) Total	(2) MD	(3) Nurse	(4) Other
A: No controls				
DD	-17.3	-0.3	-3.6	-13.4
	(7.0)	(0.7)	(2.0)	(5.1)
Obs	20,051			
B: Market controls				
DD	-13.5	-0.2	-3.3	-10.0
	(7.0)	(0.7)	(1.9)	(5.1)
Obs	18,582			
Mean outcome (t-1)	492.2	10.2	145.2	336.9

Notes: The table presents estimated effects on full-time equivalent (FTE) employed staff per 100 beds at the market-level obtained by estimating the market-level equivalent of Equation 2 on market-year data. We define markets using Health Service Areas (HSAs), as described in Section 5.2. Column 1 presents results for total FTEs, which comprises of physician, nurse, and all others, presented in columns 2, 3, and 4, respectively. Panel A reports coefficients from a two-way fixed effects specification with no covariates. Panel B reports coefficients from a two-way fixed effects specification including time-varying HSA-level controls: population, unemployment, uninsurance, and poverty rates. Panel B has fewer observations since the covariates are not available for 1995 and 1996. The mean values pertain to patient volume in the treated markets in the year prior to privatization. Standard errors are clustered by HSA and are presented in parentheses.

A Additional figures and tables

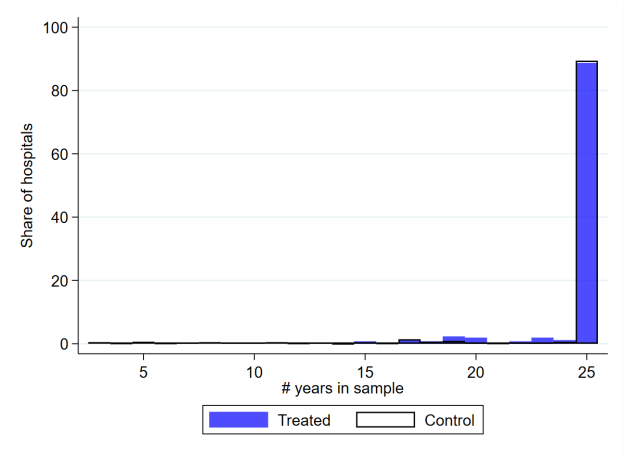


Figure A.1: Balance of hospital panel

Note: The figure presents a frequency distribution of the number of years a hospital is observed in the sample, separately for privatized (treated) and control hospitals. The maximum number of years possible is 25 (1995–2019).

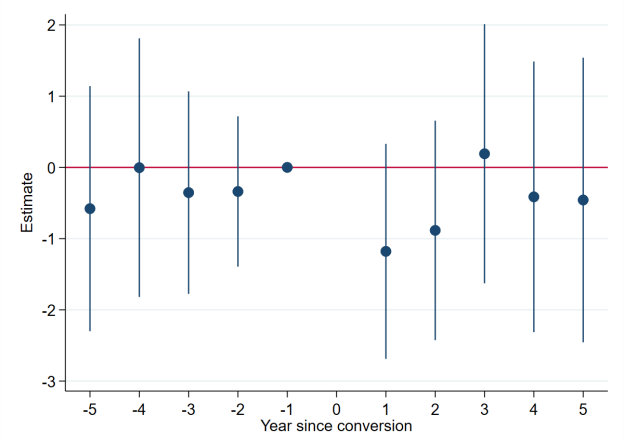


Figure A.2: Effects on patient volume per bed

Note: The figure presents dynamic effects on total volume per bed obtained by estimating Equation 3 on the analysis sample. Total patient volume is normalized by contemporaneous hospital beds. The error bars denote 95% confidence intervals. Standard errors are clustered by hospital.

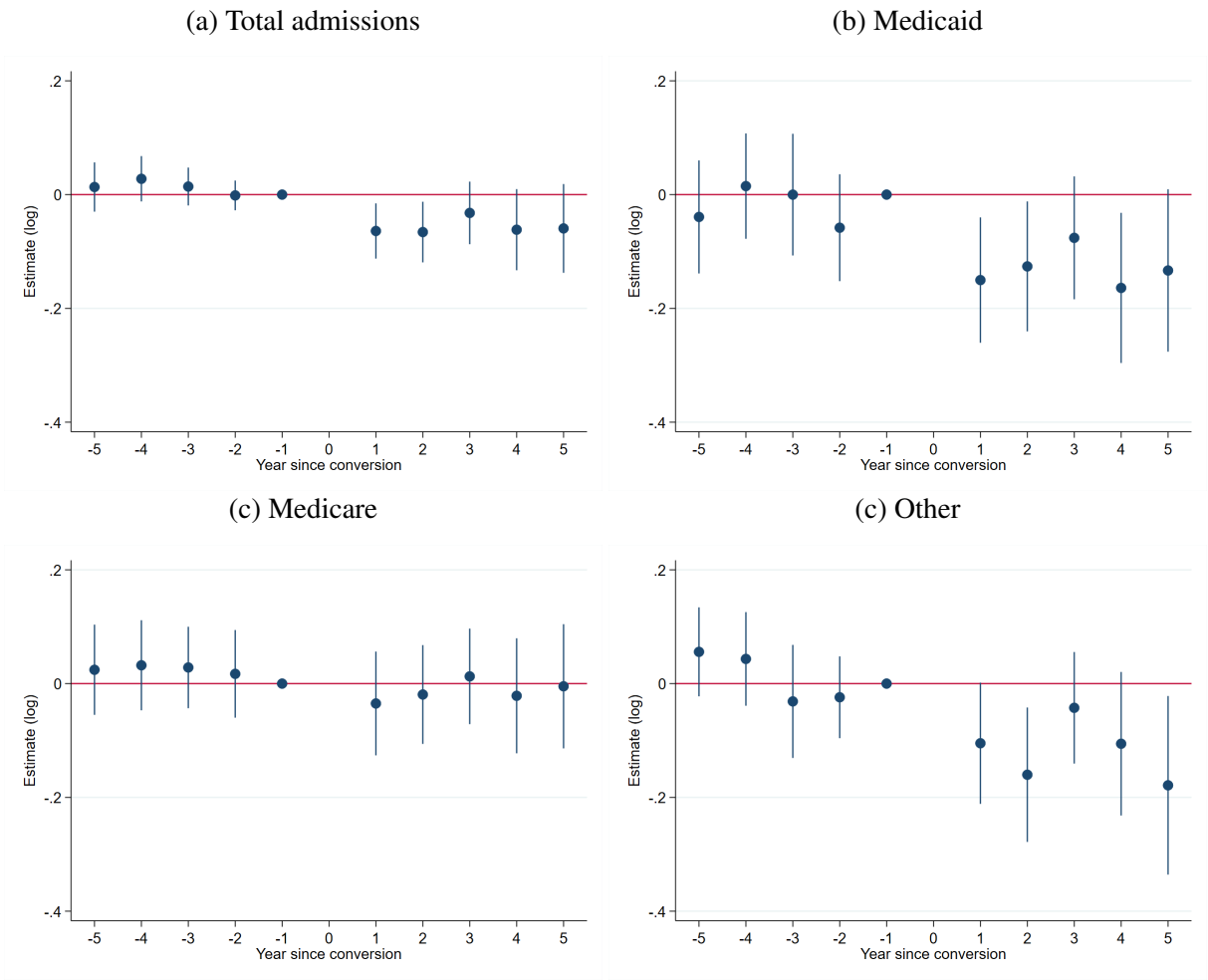


Figure A.3: Effects on patient volume using the matched sample

Note: The figure presents event study plots obtained by estimating Equation 3 on a matched subsample, where suitable matched comparison hospitals were identified using propensity score matching. We matched each privatized hospital to a single control hospital without replacement based on bed capacity, total volume, and market attributes 2 years prior to the privatization. The outcomes are total, Medicaid, Medicare, and Other patient volume, respectively. The error bars denote 95% confidence intervals. Standard errors are clustered by hospital.

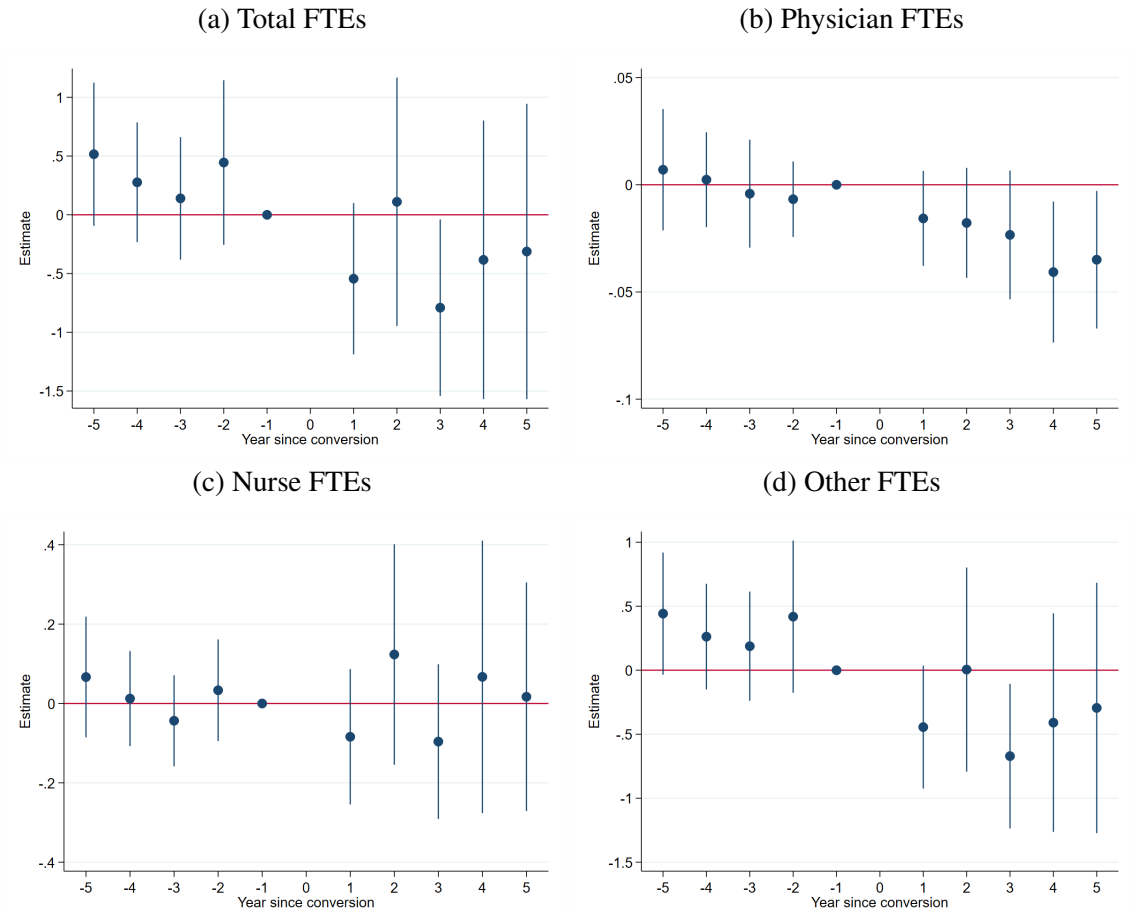


Figure A.4: Effects on staffing (FTE per 100 adjusted admissions)

Note: The figure presents event study plots obtained by estimating Equation 3 on hospital-year level data. The comparison group is comprised of hospitals that remain public throughout our sample period and are not located within 15 miles of any treated hospital. Outcomes from the AHA are total full-time equivalent employees (FTEs), physician FTEs, nurse FTEs, and other FTEs in panels (a), (b), (c), and (d), respectively. All outcomes are normalized by contemporaneous, adjusted admissions, which scales admissions by the ratio of outpatient to inpatient revenue. Year zero is the year of privatization and is excluded for the treated hospitals since it represents partial treatment. The error bars present 95% confidence intervals. Standard errors are clustered by hospital.

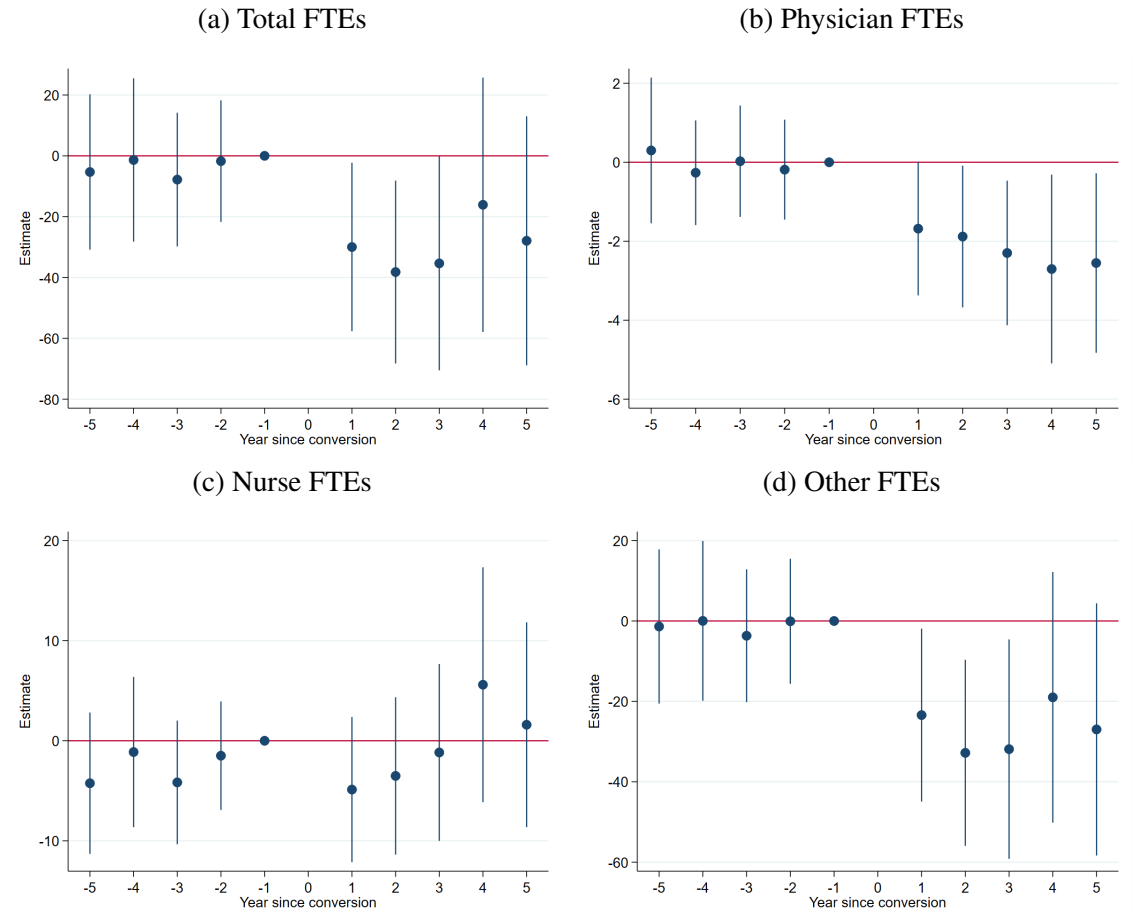


Figure A.5: Effects on staffing (per 100 beds) using the matched sample

Note: The figure presents event study plots obtained by estimating Equation 3 on a matched subsample, where suitable matched comparison hospitals were identified using propensity score matching. We matched each privatized hospital to a single control hospital without replacement based on bed capacity, total volume, and market attributes one to three years prior to the privatization (see C.2 for additional details). The outcomes are total full-time equivalent employees (FTEs), physician FTEs, nurse FTEs, and other FTEs in panels (a), (b), (c), and (d), respectively. All outcomes are normalized by the contemporaneous number of hospital beds and presented per 100 beds. The error bars denote 95% confidence intervals. Standard errors are clustered by hospital.

Table A.1: Public (non-federal) hospital share of beds by state in 2019

State	Share	# Hospitals	State	Share	# Hospitals
Wyoming	70.8	32	Nevada	14.1	58
Alabama	44.4	116	Kentucky	13.7	121
Mississippi	40.7	112	Nebraska	13.5	99
Kansas	36.8	152	New Jersey	12.9	99
South Carolina	32.9	88	Georgia	11.7	172
North Carolina	31.8	135	Ohio	11.3	224
Iowa	29.8	123	Arkansas	10.4	102
Washington	27.0	107	Rhode Island	10.3	15
Louisiana	26.1	200	Montana	10.1	66
Idaho	25.2	52	Connecticut	9.9	42
New York	23.6	210	West Virginia	9.3	61
Colorado	23.5	106	Maryland	8.5	62
California	22.9	419	Massachusetts	8.2	102
New Mexico	22.2	55	Illinois	8.0	208
Hawaii	22.1	28	District Of Columbia	7.4	14
Virginia	20.1	123	Delaware	6.3	13
Oregon	19.8	65	Wisconsin	6.3	149
Oklahoma	19.4	146	Arizona	6.2	110
Tennessee	19.0	132	Michigan	6.2	165
Utah	18.6	59	New Hampshire	5.5	31
Missouri	18.2	143	Maine	5.4	39
Indiana	17.5	161	South Dakota	4.4	64
Florida	16.8	253	Pennsylvania	3.8	235
Texas	15.8	588	North Dakota	2.6	50
Alaska	14.6	26	Vermont	1.7	17
Minnesota	14.4	141			

Table A.2: Types of privatization deals

	(1) Non-profit	(2) For-profit	(3) Total
Non-transfer of ownership	137	36	173
- Contract Management	57	10	67
- Lease/Joint venture	30	14	44
- Miscellaneous	50	12	62
Transfer of ownership	54	30	84
Total	191	66	257

Notes: This table presents a breakdown of the privatization deals in our main analysis sample. These occur between 2000-2018. Columns 1 and 2 present the number of hospitals converted to private non-profit and for-profit, respectively. Non-transfer of ownership implies the government continued to own the real estate and buildings, but transferred operational control to the new private firm. This could be implemented in multiple ways as listed. Miscellaneous includes cases where a new private firm was incorporated subject to oversight by the previous government owners specifically to operate the hospital, and cases where the modality could not be identified. Transfer of ownership implies the government sold all hospital assets to the new private owner. Appendix B.1 describes these categories in more detail with examples.

Table A.3: Effects on Traditional Medicare patient volume

	(1) All	(2) Duals	(3) Non duals
A: Full sample			
1: Baseline	-0.083	-0.077	-0.091
	(0.030)	(0.035)	(0.029)
2: C-S	-0.042	-0.056	-0.038
	(0.031)	(0.034)	(0.033)
Mean	6.09	4.82	5.69
Observations	13,824	13,824	13,824
B: Matched sample			
1: Baseline	-0.023	-0.028	-0.028
	(0.038)	(0.044)	(0.037)
2: C-S	-0.002	-0.023	0.004
	(0.035)	(0.039)	(0.037)
Mean	6.20	4.96	5.79
Observations	3,893	3,893	3,893

Notes: This table presents effects on Traditional Medicare (TM) patient volume at the privatized hospitals, estimated using 100% Medicare fee-for-service inpatient claims data over 2000–17. The outcomes are logs of total TM volume, dual eligibles, and non-duals, respectively. Panels A and B present results on the full and matched samples, respectively. In each panel, rows 1 and 2 present results from the baseline two-way fixed effects and Callaway-Santanna models, respectively. These models have fewer observations since the claims data spans a shorter period than the AHA sample used in the main analysis. To ensure we have 2 years before and after every privatization, we limit treated units to hospitals privatized during 2002–15. Hence, these models include 215 privatized hospitals instead of the 257 used in the main analysis.

Table A.4: Effects on staff (FTEs per 100 adjusted admissions)

	(1) Total	(2) MD	(3) Nurse	(4) Other
A: No controls				
DD	-.66	-.03	-.01	-.62
	(.38)	(.01)	(.10)	(.29)
Obs	20,718			
B: Market controls				
DD	-.58	-.02	.004	-.56
	(.38)	(.01)	(.097)	(.29)
Obs	19,159			
Mean outcome (t-1)	7.40	0.13	1.94	5.33

Notes: The table presents effects on full-time equivalent (FTE) employed staff per 100 adjusted admissions at the privatized hospitals, obtained by estimating Equation 2 on hospital-year level data. Column 1 presents results for total FTEs, which comprises of physician, nurse, and all others, presented in columns 2, 3, and 4, respectively. We normalize the staff levels in each column by contemporaneous, adjusted admissions, which scales admissions by the ratio of outpatient to inpatient revenue. Panel A reports coefficients from a two-way fixed effects specification with no covariates. Panel B reports coefficients from a two-way fixed effects specification including time-varying county-level controls as described in Section 4. Panel B has fewer observations since the market-level covariates are not available for 1995 and 1996. The mean values pertain to patient volume at privatized hospitals in the year prior to privatization. Standard errors are clustered by hospital and are presented in parentheses.

B Data Appendix

B.1 Privatization taxonomy

We first identify cases of public hospitals that were converted to private control or that closed during our study period of 2000–18. There is no official source of such events and thus we utilized the AHA annual survey of hospitals files over this period. We infer a conversion when we observe a change in management control type from public (state, county, or city) to private (for-profit or non-profit). We infer a closure when a hospital disappears from the survey in the middle of the sample. We validate both conversions and closures using information recorded in the annual AHA Summary of Changes files, which explain each change in the AHA survey from the previous year. A criticism of the AHA is that small, rural hospitals sometimes do not feature in its surveys. To overcome this limitation, we also inferred closures using the Medicare Place of Service (POS) files that do not appear in the AHA. This process yields 381 conversions and 127 closures over 2001–16.

Further, we have devoted hundreds of hours to manually verify each conversion and closure by combing through hospital websites, news articles, and third-party sites such as the American Hospital Directory (AHD). Manual validation help us identify non-trivial numbers of false positive (160) and false negative (34) conversions. Our final tally of conversions is accordingly 257 (381 – 160 + 34).

Through these detailed reviews we have divided conversions into five categories. Four categories involve only a change in management and account for about 65% of all conversions, while the fifth is an outright sale of all assets. To the best of our knowledge, these aspects of hospital conversions have not been studied previously.

This appendix attempts to provide a flavor of the heterogeneous nature of public hospital conversions. We briefly describe some case studies to illustrate our categorization of conversions.

- **Sale:** Occurs when there is a permanent transfer in the ownership and control of the property, assets, and debts of a hospital, from government to a private corporation or hospital.

  Example: Glenwood Regional Medical Center (West Monroe, La) recorded a conversion in the AHA in 2006 from "hospital district or authority" to "other not-for-profit." Article in 2006 states that IASIS Healthcare(R) LLC announced the signing of a definitive agreement to acquire Glenwood Regional Medical Center from the Hospital Service District for approximately $82.5 million. Source: https://www.businesswire.com/news/home/20060721005223/en/IASIS-Healthcare-LLC-Announces-Agreement-Acquire-Northeast.

- **Contract management:** Occurs when a private (corporation or health system) authority takes over the day-to-day management of a hospital. Government maintains control over the hospital's property, assets, and debts. We consider this to be a management change only.

  Example: Mercy Hospital Lincoln (Troy, Mo) recorded a conversion in the AHA in 2015 from "County" to "other not-for-profit." Article in January 2015 states that "Under an agreement executed by both parties, Mercy will lease and manage 25-bed Lincoln County Medical Center beginning March 1." Source: https://www.beckershospitalreview.co

m/hospital-transactions-and-valuation/lincoln-county-medical-center-joins-mercy-health.html

- **Long-term lease:** Occurs when a private (corporation or health system) authority takes control over day-to-day management of a hospital for an extended period of time (more than 15 years). The government entity maintains control over the hospital's property, assets, and debts. We consider this to be a management change only. Example: Mercy McCune-Brooks Hospital (Joplin, Mo) recorded a conversion in the AHA in 2012 from "city" to "church operated." Article published in 2012 states that "Mercy's 50-year lease of the city-owned hospital was approved by the Carthage City Council." Source: https://www.joplinglobe.com/news/local_news/new-year-brings-mccune-brooks-into-sisters-of-mercy-health-system/article_2aca1cb3-7a97-5538-b98e-b434fd2ef056.html.

- **Joint venture or merger:** Occurs when two private (corporations or health systems) authorities agree to merge or sign a joint venture, which results in a newly formed private authority to take over management of the hospital. We consider this to be a management change only.

  Example: Rice Memorial Hospital (Willmar, Mn) recorded a conversion in the AHA in 2018 from "city" to "other not-for-profit." Article published in 2017 states that "Rice Memorial Hospital, ACMC Health and CentraCare Health signed the final agreement to establish Carris Health, a subsidiary of CentraCare Health, which is a not-for-profit health care system. Carris Health will make a capital investment of $32 million in Rice Memorial Hospital over the next 10 years. Rice Memorial Hospital assets will continue to be owned by the City of Willmar." Source: https://www.centracare.com/blog/2017/december/carris-health-agreement-finalized/

- **Public hospital incorporating:** Occurs when a public health system files for 501c3 nonprofit status ("incorporating"). We consider this to be a management change only.

  Example: Hutchinson Area Health Care (Hutchinson, Mn) recorded a conversion in 2008 from "city" to "other not-for-profit." In an article detailing the history of the Hutchinson's hospital and clinic, the article notes that in "January 2008: Hutchinson Area Health Care becomes its own private, nonprofit corporation and is no longer a part of the city of Hutchinson. Source: https://www.crowrivermedia.com/hutchinsonleader/news/local/hutchinson-health-and-healthpartners-become-one/article_7357cfee-04c4-5c62-b4c4-7b9dc22cd13b.html

C Methodology

C.1 Sample selection

To construct our analytic sample of control hospitals, we start with American Hospital Association (AHA) survey data for the years 1995 to 2019 (∼6,200 hospitals per year) and then make the following restrictions:

- Drop hospitals that on average report fewer than 10 beds (75 hospitals)

- Drop hospitals that are ever classified as federal government by the AHA (343 hospitals). These include military, Veterans Affairs, Indian Health Service, and Department of Justice hospitals
- Drop hospitals that convert from private to public (64 hospitals)[27]
- Drop (control) hospitals that are classified as public (state and local) in only some years of our sample period and/or are located within 15 miles of at least one treated hospital (487 hospitals). This is a conservative restriction to ensure that our comparison group is comprised of non-converting, public hospitals
- Drop hospitals whose most common AHA primary service code across our sample period is not "general medical and surgical" (2,065 hospitals). This is our mechanism for identifying general acute care hospitals
- Drop any remaining private hospitals (4,392 hospitals)

Our final, analytic sample consists of 766 control hospitals.

As discussed in Section 3.1, we created our list of public to private conversions by starting with conversions implied by changes in the AHA's control variable and then manually validating each conversion. From this process we identified 269 total conversions. Two treated hospitals experience a second conversion in which they convert back from private to public. For these two hospitals we drop observations on or after the second conversion. From our manual validation, we found that two treated hospitals experience more than two conversions (i.e. public to private or private to public) over our sample period; we dropped these hospitals. Finally, we dropped 10 treated hospitals whose most common AHA primary service code was not "general medical and surgical." Our final set of treated hospitals consists of 257 public to private conversions.

C.2 Propensity score matching

In one of our robustness checks reported in Table 6, we apply propensity score matching (PSM) to our analytic sample to identify treated and control hospitals that are similar on pre-period observables. Specifically, we conduct one-to-one, nearest neighbor matching without replacement and estimate logit models to predict privatization with the following explanatory variables from t-1 to t-3 (where t denotes the year of privatization for a given treated hospital):

- # hospital beds
- Total admissions
- Medicaid admissions
- Total expenses

[27] This number differs from the 46 private to public conversions reported in the main text. The discrepancy is the result of two additional restrictions: 1) limiting conversions to those with a primary service code of "general medical and surgical" and 2) dropping conversions which do not have observations in AHA data in the post years.

- % in poverty (measured at the county-year level)
- % unemployment (measured at the county-year level)
- Health Service Area population (only t-1; calculated by aggregating county-year population estimates)

We impose the restriction that propensity scores of matched pairs be in the same decile of the propensity score distribution. We apply PSM sequentially by first searching for similar control hospitals for hospitals that privatize in 2000, the first year of conversions in our data. Control hospitals that match to these privatizing hospitals are removed from the donor (control hospital) pool prior to searching for matches for hospitals that privatize in 2001. We continue this process for all 19 years of privatizations (2000–2018) and are able to match all 257 treated hospitals.