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RESEARCH ARTICLE

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The economic effects of rural hospital closures

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Abstract

Objective: To provide an updated analysis of the economic effects of rural hospital closures.

Study Setting: Our study sample was national in scope and consisted of nonmetro counties from 2001 to 2018.

Study Design: We used a difference-in-differences study design to estimate the effect of a hospital closure on county income, population, unemployment, and size of the labor force. Specifically, we compared economic changes over time in nonmetro counties experiencing a hospital closure to changes in a control group of nonmetro counties over the same time period. We also leveraged insight from recent research to control for estimation bias due to heterogeneity in the closure effect over time or across groups defined by when closure was experienced.

Data Extraction: Data on (adjusted gross) annual income (in real dollars), annual population size, and monthly unemployment rate and labor force size were sourced from the Internal Revenue Service, Census Bureau, and Bureau of Labor Statistics, respectively. We used data from the North Carolina Rural Health Research Program to identify counties that experienced a hospital closure.

Principal Findings: Of the 1759 nonmetro counties in our study sample, 109 experienced a hospital closure during the study period. Relative to the nonclosure counterfactual, closures significantly decreased labor force size, on average, by 1.4% (95% CI: [−2.1%, −0.8%]). Results also suggest that Prospective Payment System (PPS) hospital closures significantly decreased population size, on average, by 1.1% (95% CI: [−1.7%, −0.5%]), relative to the nonclosure counterfactual.

Conclusions: Our analysis suggests that rural hospital closures often have adverse effects on local economic outcomes. Importantly, the negative economic effects of closure appear to be strongest following Prospective Payment System hospital closures and attenuated when the closed hospital is converted to another type of health care facility, allowing for the continued provision of services other than inpatient care.

KEYWORDS
health economics, hospitals, rural health

What is known on this topic

- The rate of rural hospital closures is increasing.
- There is a lack of updated research that rigorously quantifies the effects of rural hospital closures on the economic health of local communities.

- Recent growth in health care-related employment could indicate that the economic consequences of hospital closures are greater than previous data and research estimates would suggest.

What this study adds

- Rural hospital closures have significant negative effects on the local labor force and population size.
- The economic effects of closures appear to be strongest following Prospective Payment System hospital closures.
- The economic effects of closures are attenuated when the closed hospital is converted to another type of health care facility.

1 | INTRODUCTION

1.1 | The economic importance of rural hospitals

Hospitals are cornerstones of many rural communities. In addition to medical care, rural hospitals often provide boosts to local employment,[1] income,[1,2] and population growth.[3] The typical rural hospital is estimated to supply approximately 5% of total county employment, which includes a mixture of hospital-based professions (e.g., physicians, nurses) and professions outside of health care (e.g., construction).[1] Hospital-based professions in particular often offer higher wages relative to those in other industries,[1] indicating that a local hospital can have a positive effect on community income. In addition to providing jobs, hospitals boost community income through the purchase of local goods and services.[2] By supporting other local businesses, hospitals also further increase local tax revenue, which has additional positive downstream effects on community infrastructure (e.g., increased funding for public schools, emergency services, maintenance).[3] Lastly, hospitals and their positive effects on local economic conditions and infrastructure help attract new residents to the community, thus leading to increased population size and economic development.[4]

1.2 | Previous research on rural hospital closures and their economic effects

The importance of rural hospitals suggests that hospital closures could adversely affect local economic indicators, including income, employment, and population size (among others). Since the turn of the century, efforts to quantify the economic effects of rural hospital closures include early work by Stensland et al.,[5] which examined the economic effects of hospital closures in rural Appalachia that occurred between 1986 and 1997. Follow-up research by Pearson and Tajalli,[6] Holmes et al.,[7] and Ona et al.[8] assessed the economic effects of closures among additional rural communities, including closures in rural Texas from the late 1980s,[6] closures among a national sample of rural counties from 1990 to 2000,[7] and closures in rural Georgia, Tennessee, and Texas from 1998 to 2000.[8] Over the last 15 years, the scope of research has continued to expand through consideration of additional outcomes, study samples, and analytic techniques.[9–16]

However, despite the research progress detailed above, there is still a critical need for updated analyses of rural hospital closures and their economic effects. Only a handful of previous studies have used data from the last 5 years,[14–16] and these studies have largely focused on health workforce supply outcomes. Recent growth in health care-related employment[17,18] could indicate that the economic consequences of hospital closures are greater than previous data and research estimates would suggest. In addition, recent advances in statistical modeling techniques have highlighted the challenges of accurately measuring the causal effects of economic shocks (e.g., hospital closures).[19–24] By leveraging insight from these methodological advances, new research can provide updated estimates that more accurately describe the economic effects of rural hospital closures.

1.3 | The objective of the current research

The economic importance of hospitals is well established, but relatively few studies have specifically analyzed the economic effects of rural hospital closures. Of the rural hospital closure studies that *do* exist, many of them use data from the year 2000 or earlier or focus solely on health workforce outcomes. Given the broad economic significance of rural hospitals and the limited amount of recently published research in the field, the objective of this research was to provide an updated analysis of the economic effects of rural hospital closures.

2 | METHODS

2.1 | Sample, data, and measures

Our study sample was national in scope and consisted of rural counties with available data on annual total income, annual population size, monthly unemployment rate, and monthly labor force size from 2001 to 2018. We defined rural hospitals as hospitals located in nonmetro counties, following the definition used by the Office of

Management and Budget.[25] Furthermore, we required counties in our sample to retain their nonmetro status throughout the study period. Data on (adjusted gross) annual income (in real dollars), annual population size, and monthly unemployment rate and labor force size were sourced from the Internal Revenue Service,[26] Census Bureau,[27] and Bureau of Labor Statistics (unemployment and labor force),[28] respectively. We selected a mixture of annual and monthly outcomes to explore different temporal dynamics of closure effects. Furthermore, we selected 2018 as the last year of our study period because this was the most recent year with available county-level data across all of our economic outcomes.

We used data provided by the North Carolina Rural Health Research Program[29] to identify nonmetro counties that experienced a hospital closure during our study period. We excluded counties that experienced multiple closures during our study period in order to better isolate the effect of a single hospital closure. Furthermore, we considered nonmetro counties that had *not* experienced a closure to be our control group. We excluded counties from our control group that experienced a closure before our study period (i.e., before 2001) under the rationale that these counties could have experienced lingering effects due to a hospital closure.

2.2 | Statistical methods

We used difference-in-differences regression methods to estimate the effect of a hospital closure on each of our economic outcomes. Difference-in-differences models compare outcome changes in a "treatment" group over time (i.e., difference #1) to outcome changes in a control group over the same time period (i.e., difference #2), hence a difference-in-differences. The control group outcomes are generally assumed to represent the counterfactual outcomes that the treatment group would have experienced if the event of interest (e.g., hospital closure) would not have occurred. Thus, the difference-in-differences estimate generally represents the effect of the event of interest on the relevant outcome(s).

Although difference-in-differences regression is a powerful tool, a swell of recent econometrics research[19–24] has shown that estimates can be biased if treatment effects vary over time or across groups defined by when treatment was experienced (i.e., cohort effects). Thus, we used difference-in-differences methods recently proposed by Callaway and Sant'Anna[20] that specifically account for possible treatment effect heterogeneity by time or group. Callaway and Santa'Anna provide a complete description of these methods in their article.[20] For brevity, we summarize key points below.

The Callaway and Sant'Anna estimator begins by calculating a complete set of "group-time average treatment effects" across all possible combinations of group and time point. The group-time average treatment effect on the treated, ATT(g, t), is defined as the average treatment effect for group g at time t. By creating a separate effect estimate for each group-time combination, the Callaway and Sant'Anna estimator flexibly allows for effect heterogeneity by group and time. The first step in calculating the group-time average treatment effects includes both outcome regression and inverse probability weighting. The outcome regression methods focus on linearly modeling the expected evolution of outcomes, conditional on covariates. In comparison, the inverse probability weighting methods focus on modeling the probability of being in group g, conditional on covariates. These auxiliary models are then plugged into identifying functions for the group-time average treatment effects that were derived by Callaway and Sant'Anna as extensions of previous research.[30–33] Specifically, the identifying functions established by Callaway and Sant'Anna extend previous work on the difference-in-differences identification of treatment effects to study settings with multiple time periods and multiple groups.

Post-estimation, the group-time average treatment effects can be aggregated together to create additional measures that summarize the treatment effect. For our research, we focused on two summary measures. The first summary measure aggregates the group-time average treatment effects based on length of exposure to the treatment and represents the average effect of treatment across groups for a given point in time (relative to treatment initiation). This dynamic or "event-study" aggregation scheme allowed us to analyze the immediate, short-term, and long-term economic effects of hospital closures. The second summary measure aggregates the group-time average treatment effects based on group, and then further aggregates the group-specific effects to create an overall summary measure of the treatment effect. This overall summary measure represents the average effect of treatment that was experienced across all units (e.g., counties) that experienced treatment and is proposed by Callaway and Sant'Anna as the best single overall measure of the treatment effect.[20]

We used the Callaway and Sant'Anna estimator to estimate the effect of hospital closure on each economic outcome of interest, (logged[7] and inflation-adjusted[34]) income, (logged) population size, unemployment rate, and (logged) labor force size. Standard errors were clustered by county. For each outcome, we also performed stratified analyses that compared complete versus converted hospital closures. Following the definitions used by the North Carolina Rural Health Research Program,[29] complete closures describe hospitals that stop providing all health services, whereas converted closures describe hospitals that stop providing inpatient services but continue to provide other health services (e.g., emergency, rehabilitation, outpatient services). We hypothesized that converted closures would have weaker economic effects than complete closures under the assumption that converted hospitals would retain economic value within the community. Furthermore, using data on hospital payment classification collected from inpatient Provider Specific Files,[35] we performed stratified analyses that compared Critical Access Hospital (CAH)[36] closures versus Prospective Payment System (PPS)[37] hospital closures. Among other criteria, rural hospitals designated as CAHs generally have 25 or fewer acute care inpatient beds and are located more than 35 miles from the nearest other hospital (with exceptions).[36] Given that CAHs typically serve smaller, more isolated rural communities, CAHs might employ a larger percentage of local workers (compared to PPS hospitals). However, given the CAH 25-bed maximum, PPS hospitals might employ more local workers in total. Thus, there is difficulty in hypothesizing a priori whether CAH or PPS hospital closures lead to stronger economic effects.

In addition to the main analyses, we completed sensitivity analyses to assess the robustness of our findings. The first sensitivity analysis restricted the post-closure time period to 5 years; we reasoned that the control group might not always accurately represent the counterfactual outcomes of the closure group over a very long time period. The second sensitivity analysis restricted the control group to counties with a hospital[38]; we reasoned that economic trends in nonclosure counties with a hospital might better represent the counterfactual outcomes of closure counties given that closure counties had a hospital in pre-closure years.

All analyses were performed using R Version 4.0.3[39] and the "did" R package created by Callaway and Sant'Anna.[40] The "did" package implements the Callaway and Sant'Anna methods described above. Additional details regarding implementation of the Callaway and Sant'Anna estimator are provided in Appendix S1. The study was exempted from review by our Institutional Review Board due to the fact that the data were aggregated at the county level and publicly available.

3 | RESULTS

Our study sample included 1759 nonmetro counties. In the year 2000 (i.e., before any of the observed hospital closures), the counties in our sample had an average annual personal income of $437.7 million, average population of 21,539, average unemployment rate of 4.7%, and average labor force of 10,300 (additional demographics are provided in Table S1). Of the 1759 counties in our study sample, 109 experienced a hospital closure between 2001 and 2018, and 1650 did not experience a closure. Of the 109 hospital closures, 59 were complete closures and 50 were converted closures. In addition, of the 109 hospital closures, 44 were CAH closures and 65 were PPS hospital closures (see Table S2 for the number of hospital closures in our study sample by year).

3.1 | Effect of hospital closure on annual income

Figure 1 shows the estimated effect of hospital closure on (logged and inflation-adjusted) gross annual county income using the

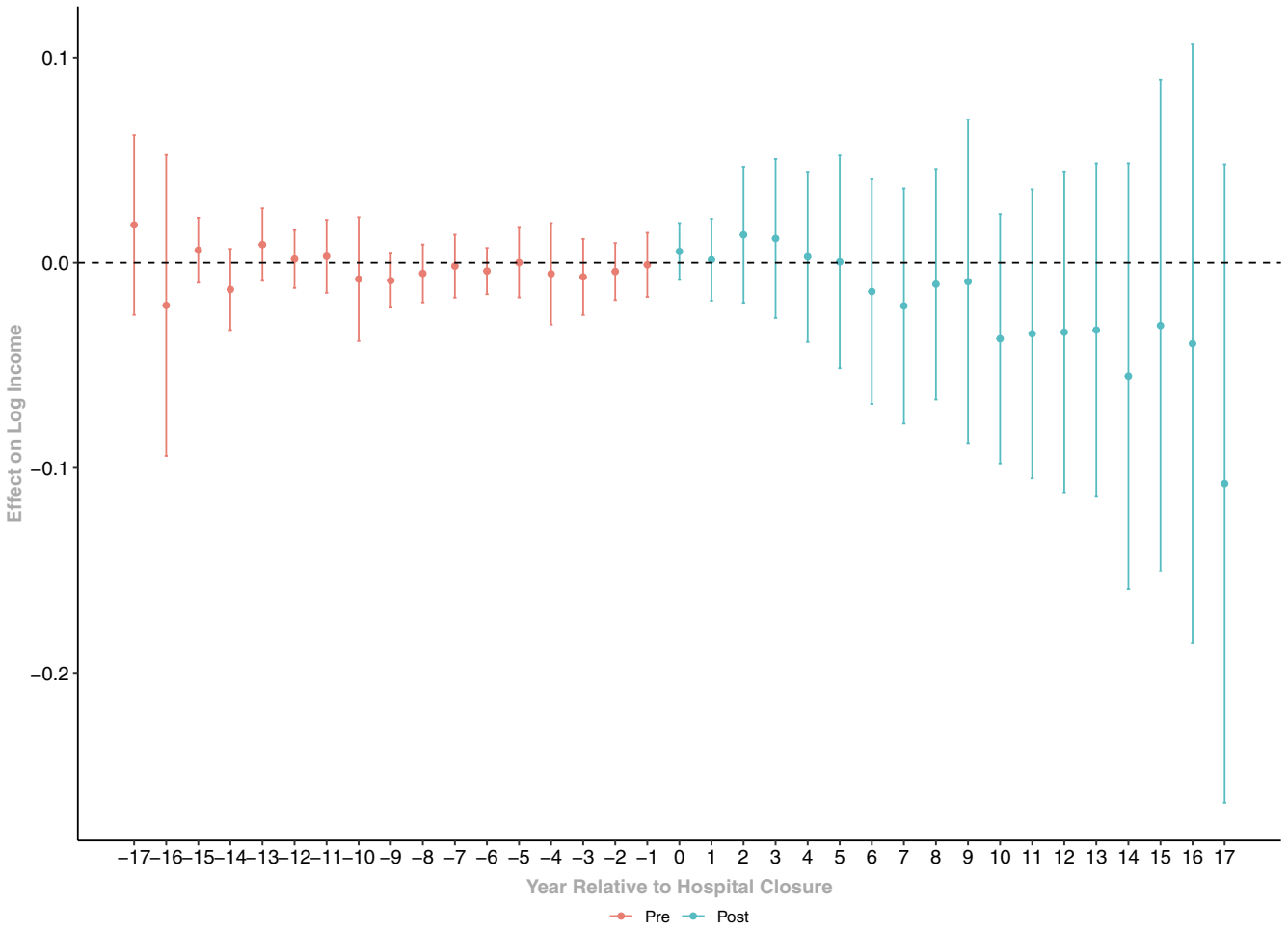

FIGURE 1 Average effect of rural hospital closure on logged and inflation-adjusted gross annual county income by year relative to closure. This figure was created by aggregating group-time average treatment effects based on length of time since hospital closure. This figure presents point estimates and simultaneous 95% confidence bands that (1) account for multiple-testing and (2) cover all closure effects with a probability of at least 95%. Post, post-closure; Pre, pre-closure [Color figure can be viewed at wileyonlinelibrary.com]

difference-in-differences model. Figure 1 uses the event-study aggregation of group-time average treatment effects to show how the average effect of closure changes over relative time to the closure date. As shown in Figure 1, annual county income is largely unaffected during the first several years post-closure, but then appears to steadily decrease thereafter (relative to the nonclosure counterfactual). However, the simultaneous 95% confidence bands indicate that each individual post-closure point estimate is statistically nonsignificant, despite the apparent decreasing trend in annual income point estimates (the simultaneous 95% confidence bands (1) account for multiple-testing and (2) cover all closure effects with a probability of at least 95%).[20] Aggregation of the group-time average treatment effects by group (i.e., group defined by year of closure) indicates substantial heterogeneity in the effect of closure on annual county income (see Figure S1). Further aggregation of the group-specific effects provides an overall summary measure of the closure effect equal to −0.002 (expressed in log units). Thus, averaged across all closure counties and post-closure time periods, closures changed annual income by $100[e^{-0.002} - 1] = -0.2\%$ from the estimated income if no closures had occurred. Table 1 shows how the overall measure of the closure effect changes when comparing complete versus converted closures or CAH closures versus PPS hospital closures. Relative to the nonclosure counterfactual, complete closures changed annual income, on average, by −0.8%, converted closures changed annual income, on average, by 0.3%, CAH closures changed annual income, on average, by 1.1%, and PPS hospital closures changed annual income, on average, by −1.0%. However, each of these overall measures was statistically nonsignificant.

TABLE 1 Average effect of rural hospital closure on economic outcomes, stratified by closure type

Outcome by closure type	Point estimate	95% confidence interval
All closures		
Income[a,b]	−0.002	[−0.019, 0.015]
Population size[b]	−0.004	[−0.012, 0.005]
Unemployment rate	−0.006	[−0.147, 0.135]
Labor force size[b]	−0.014*	[−0.021, −0.008]
Complete closures[c]		
Income[a,b]	−0.008	[−0.024, 0.008]
Population size[b]	−0.006	[−0.017, 0.004]
Unemployment rate	−0.047	[−0.212, 0.117]
Labor force size[b]	−0.019*	[−0.027, −0.011]
Converted closures[d]		
Income[a,b]	0.003	[−0.025, 0.031]
Population size[b]	−0.002	[−0.014, 0.009]
Unemployment rate	0.006	[−0.055, 0.067]
Labor force size[b]	−0.009*	[−0.013, −0.005]
CAH closures		
Income[a,b]	0.011	[−0.018, 0.039]
Population size[b]	0.006	[−0.009, 0.021]
Unemployment rate	−0.047	[−0.141, 0.048]
Labor force size[b]	−0.013*	[−0.021, −0.004]
PPS hospital closures		
Income[a,b]	−0.010	[−0.026, 0.006]
Population size[b]	−0.011*	[−0.017, −0.005]
Unemployment rate	0.004	[−0.138, 0.146]
Labor force size[b]	−0.015*	[−0.021, −0.009]

Note: Effects shown in this table represent aggregations of group-specific closure effects to create an overall summary measure of closure (groups defined by year of closure). For each economic outcome and set of counties, this summary measure represents the average effect of closure that was experienced across all closure counties and post-closure time periods.

Abbreviations: CAH, Critical Access Hospital; PPS, Prospective Payment System.

[a]Annual income, adjusted for inflation.

[b]Logged.

[c]Complete closures refer to hospitals that stop providing all health services.

[d]Converted closures refer to hospitals that stop providing inpatient services but continue to provide other health services (e.g., emergency, rehabilitation, outpatient services).

*Statistically significant ($p < 0.05$).

3.2 | Effect of hospital closure on population size

Figure 2 shows the average effect of hospital closure on (logged) county population size over time. As with annual income, county population size begins to steadily decrease several years post-closure (relative to the nonclosure counterfactual), although each individual post-closure point estimate is again statistically nonsignificant. Aggregation of the group-time average treatment effects by group also indicates heterogeneity in the effect of closure on annual population size (see Figure S2), but the direction of effect on population size is more consistently negative across closure-year groups compared with effects on annual income. Averaged across all closure counties and post-closure time periods, closures were estimated to change population size by −0.4%, relative to the nonclosure counterfactual. Stratified by type of closure and relative to the nonclosure counterfactual, complete closures changed population size, on average, by −0.6%, converted closures changed population size, on average, by −0.2%, CAH closures changed population size, on average, by 0.6%, and PPS hospital closures changed population size, on average, by −1.1%. The overall measure of effect for PPS hospital closures was statistically significant ($p < 0.05$).

3.3 | Effect of hospital closure on unemployment rate

Figure 3 shows the average effect of hospital closure on county unemployment rate over time. Unlike with income and population size, the effect of closure on unemployment rate does not appear to follow a consistent trend. Specifically, closures appear to have minimal effect on unemployment rate over the first 60–72 months post-closure. From there, the effect size cyclically increases and decreases over much of the remaining time periods. Many of the individual point estimates are statistically nonsignificant, but several of the later period point estimates suggest statistically

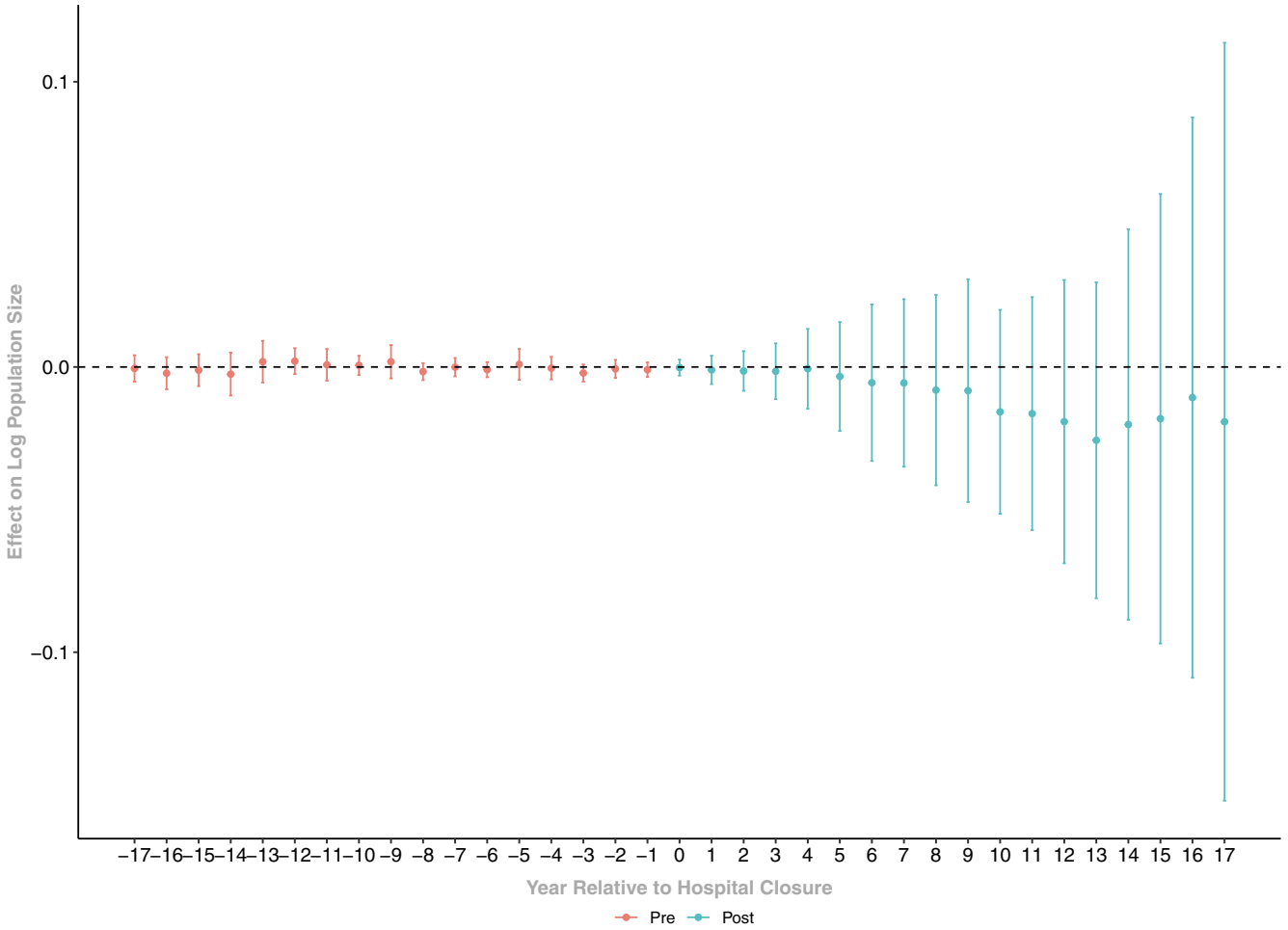

FIGURE 2 Average effect of rural hospital closure on logged county population size by year relative to closure. This figure was created by aggregating group-time average treatment effects based on length of time since hospital closure. This figure presents point estimates and simultaneous 95% confidence bands that (1) account for multiple testing and (2) cover all closure effects with a probability of at least 95%. Post, post-closure; Pre, pre-closure [Color figure can be viewed at wileyonlinelibrary.com]

significant ($p < 0.05$) effects on unemployment rate (relative to the nonclosure counterfactual). However, aggregation of the group-time average treatment effects by group again indicates substantial heterogeneity in the effect of closure (see Figure S3). For instance, many closures were estimated to increase the unemployment rate (relative to the nonclosure counterfactual), whereas others had a neutral or negative effect. Furthermore, after further aggregation of the group-specific effects, the magnitude of the overall closure effect was less than 0.01 percentage points. The estimated overall effects of complete, converted, CAH, and PPS hospital closures, respectively, on unemployment rate were similarly negligible and statistically nonsignificant.

3.4 | Effect of hospital closure on labor force size

Figure 4 shows the average effect of hospital closure on (logged) county labor force size over time. Unlike the aforementioned economic outcomes, labor force size appears to be quickly affected by hospital closure. Specifically, closure appears to significantly decrease labor force size (relative to the nonclosure counterfactual), with the magnitude of effect generally increasing over time. Aggregation of the group-time average treatment effects by group indicates heterogeneity in the closure effect (see Figure S4), but the direction of effect on labor force size is negative across most groups. Averaged across all closure counties and post-closure time periods, closures were estimated to change labor force size by −1.4% (i.e., approximately 84 fewer labor force participants; $p < 0.05$), relative to the nonclosure counterfactual. Stratified by type of closure and relative to the nonclosure counterfactual, complete closures changed labor force size, on average, by −1.9% ($p < 0.05$), converted closures changed labor force size, on average, by −0.9% ($p < 0.05$), CAH closures changed labor force size, on average, by −1.3% ($p < 0.05$), and PPS hospital closures changed labor force size, on average, by −1.5% ($p < 0.05$).

3.5 | Sensitivity analyses

The results of the sensitivity analyses largely mirrored those of the main analyses and are provided in Table S3. After restricting the

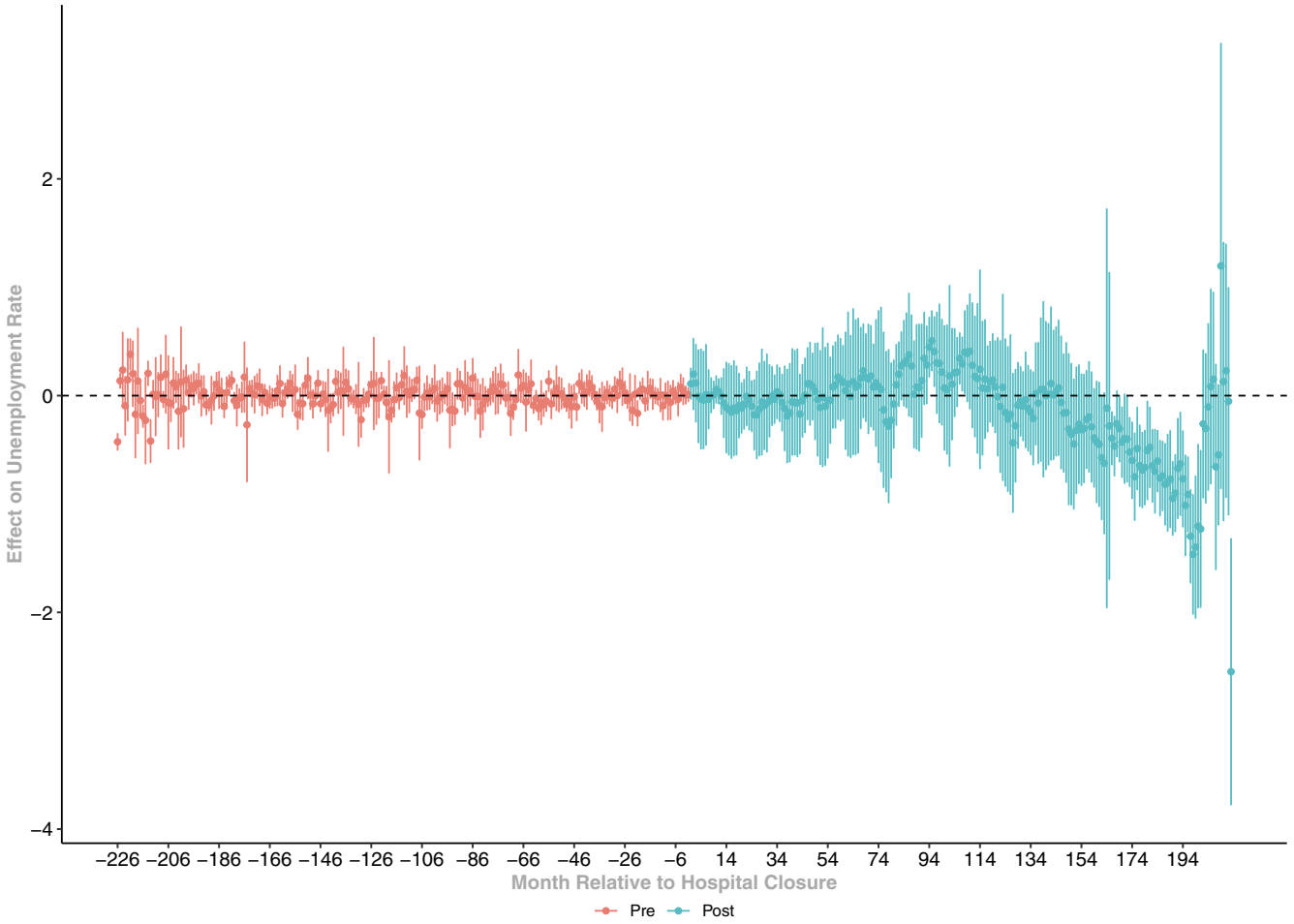

FIGURE 3 Average effect of rural hospital closure on county unemployment rate by month relative to closure. This figure was created by aggregating group-time average treatment effects based on length of time since hospital closure. This figure presents point estimates and simultaneous 95% confidence bands that (1) account for multiple testing and (2) cover all closure effects with a probability of at least 95%. Post, post-closure; Pre, pre-closure [Color figure can be viewed at wileyonlinelibrary.com]

post-closure time period to 5 years, we found that closures had statistically nonsignificant effects on income, population size, and unemployment rate and a statistically significant and negative effect on labor force size ($p < 0.05$). However, compared with the effect measured in the main analysis, the sensitivity analysis' measured effect on labor force size was smaller in magnitude (−1.4% vs. −0.8%). In addition, after restricting the sample to nonmetro counties with (1) available data on the number of hospitals within the county ($n = 1469$) and (2) at least one hospital ($n = 1452$; mean number of hospitals = 1.4), we again found that closures had statistically nonsignificant effects on income, population size, and unemployment rate and a statistically significant and negative effect on labor force size ($p < 0.05$). The sensitivity analysis' measured effect on labor force size (−1.0%) was again slightly smaller in magnitude than the effect measured in the main analysis.

4 | DISCUSSION

The objective of this research was to provide an updated analysis of rural hospital closures and their effects on local economies. Our results suggest that hospital closures generally have negative effects on local economic outcomes, with the strongest effects observed following complete (rather than converted) closures and PPS hospital (rather than CAH) closures. Specifically, we found that all closure types significantly decreased labor force size and that PPS hospital closures significantly decreased population size as well. Complete and PPS hospital closures also appeared to have negative effects on annual income, although these effects were imprecisely estimated. Furthermore, our findings indicate no consistent closure effect on unemployment rate.

Previous studies have often provided similar results on the economic effects of rural hospital closures. Although past research generally suggests negative effects on income,[7,8,10–12,14,41] population size,[11,41] employment,[5,7,10,11,13,14] and labor force,[11,13,41] many of these effects were statistically nonsignificant. In contrast to previous studies, we implemented newer difference-in-differences methods proposed by Callaway and Sant'Anna[20] that directly address possible sources of estimation bias (i.e., variation in closure effect over time or by closure cohort group). However, we also found negative (yet often statistically nonsignificant) results, consistent with previous research.

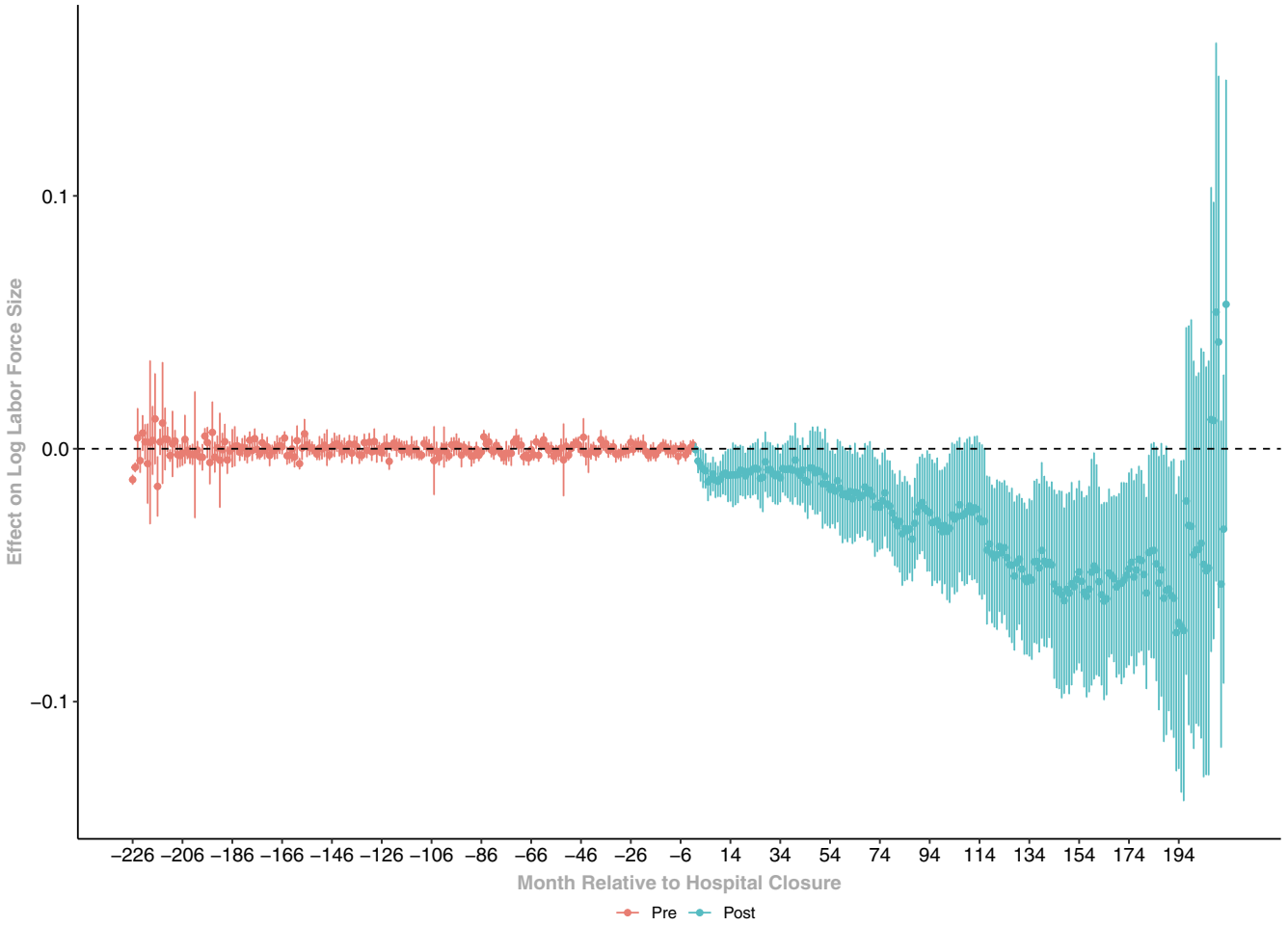

FIGURE 4 Average effect of rural hospital closure on logged county labor force size by month relative to closure. This figure was created by aggregating group-time average treatment effects based on length of time since hospital closure. This figure presents point estimates and simultaneous 95% confidence bands that (1) account for multiple testing and (2) cover all closure effects with a probability of at least 95%. Post, post-closure; Pre, pre-closure [Color figure can be viewed at wileyonlinelibrary.com]

The nonsignificance of past and current results could be a function of additional closure heterogeneity. As suggested by previous studies[5,14,15] and the current research (Table 1, Figures S1–S4), the economic effects of closure are not uniform across all closures. Thus, although previous and current results suggest that closures have adverse economic effects *on average*, these average effects do not necessarily represent the economic consequences of each individual closure. Differences by individual closure could contribute to the imprecision of aggregate closure effect estimates. Future research can explore additional possible mechanisms for closure effect heterogeneity, including possible relationships between the size or direction of effect and characteristics of the closed hospital (e.g., number of employees, proximity to the next closest hospital).

Even considering the possible influence of effect heterogeneity across different closures, the lack of a more consistent closure effect on local unemployment is notable. Interestingly, multiple previous studies have also found inconsistent closure effects on unemployment rate,[6,8,12,41] suggesting the phenomenon is not unique to the present study sample. One possible explanation for the inconsistency is that unemployed individuals migrate out of the county following hospital closure. Relatedly, the results of this study show that closures had a negative effect on local labor force (i.e., the combined total of unemployed and employed individuals in the county). This further suggests that, following a hospital closure, a substantial number of unemployed or employed individuals could leave the county (or retire and/or stop looking for employment). Thus, if the negative effect on labor force is disproportionately caused by *unemployed* individuals leaving the county, then the unemployment rate might remain stable (or possibly even decrease). For instance, unemployed individuals might interpret a local hospital closure as a signal of a poor local job market and move out of the county to find better employment prospects. Future research can further explore this possible mechanism by examining whether closures lead to different outmigration patterns among (formerly) employed and unemployed individuals.

4.1 | Limitations

One possible limitation of our research is that the latest closure effects (i.e., effects observed 15 or more years after closure) are estimated using

relatively few observations. For example, to estimate the economic effects of closure 17 years after the closure date, we could only use data from counties with closures in the year 2001 (2018 is the most recent year with available data for all economic outcomes). The smaller available sample size likely explains why the 95% confidence bands for each effect estimate generally increase in width as time relative to closure increases (see Figures 1–4). In several of the event-study figures, the effect of closure appears to stabilize or become less adverse over the last several years of observation. These later effects should be interpreted with caution, as they are based on fewer observations. However, the later effects could also reflect differences in effects between the earliest versus later closure cohorts, the opening of new hospitals within the county, or the entry of other providers to fill the market vacuum created by hospital closure. Future research should further examine the timing of hospital or provider market entry following hospital closure and the resultant effects on economic outcomes. Lastly, as with all difference-in-differences study designs, our research assumes that outcome trends in the control group represent the counterfactual outcomes that the treatment (e.g., closure) group would have experienced if the event of interest (e.g., hospital closure) would not have occurred. Empirical tests provided little evidence against this assumption (see Appendix S1 for additional details). However, violations of the assumption could potentially bias our study findings.

5 | CONCLUSION

In addition to their importance to population health, hospitals provide strong economic value to many rural communities. When these hospitals close, our research suggests that there are often adverse effects on the local labor force and population size, and possibly negative effects on local income as well. Importantly, we found that the adverse economic effects of closure appear to be strongest following PPS hospital closures and attenuated when the closed hospital is converted to another type of health care facility, allowing for the continued provision of services other than inpatient care. Hospitals, policy makers, and rural stakeholders should consider conversion as an alternative to complete closure, as it could mitigate the economic shock on the surrounding community and protect access to important health services.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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