Investing in Access: How Rural Hospitals Respond to Government Funding Windfalls

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Abstract

Rural hospitals receive a significant portion of their revenue from government subsidies. However, we know little about how these hospitals use government funds, as prior research has focused exclusively on urban and suburban hospitals. In this paper, I assess how rural hospitals allocate government subsidy dollars. My analysis exploits variation from a Georgia policy that sharply increased subsidies to rural hospitals. I estimate difference-in-differences models comparing the outcomes of rural Georgia hospitals with those of rural hospitals in other southern states before and after the policy change. Using financial data from Medicare cost reports, I find that rural hospitals invest subsidy dollars in physical capital. Rural hospitals allocate 75 cents of every additional subsidy dollar to fixed assets, such as medical equipment and facilities. I find that subsidization facilitates investment in capital-intensive service lines, such as diagnostic care, increasing the probability of new imaging equipment acquisition by 18 percentage points (35 percent). Finally, I show that hospitals see increased demand for inpatient services and earn higher variable profits in the years following subsidy receipt. These results suggest that rural hospitals respond to increased subsidization by making investments in physical capital that bolster profits and increase access to care in rural communities.

1 Introduction

Since the early 1900s, state and federal governments have invested in the supply of healthcare through hospital subsidies (Smith, 2023). Though they differ in size and scope, these subsidies share the common goal of increasing access to high-quality health care across the United States. Studies have shown that hospitals keep government subsidy dollars as financial reserves rather than reinvesting them in the healthcare production process, casting doubt on the efficacy of these public investments (Capps et al., 2017; Duggan, 2000; Duggan et al., 2022). However, we know little about how rural hospitals use government funds, as prior research has focused exclusively on urban and suburban hospitals. Given the well-documented financial differences between rural and urban hospitals, they may respond differently to increased government subsidization. Lower cash flows and limited access to capital markets make it difficult for rural hospitals to finance investments in new facilities and medical equipment. Consequently, rural hospitals may have a higher propensity to reinvest government subsidy dollars.

This paper explores the impact of the Rural Hospital Tax Credit (RHTC), a Georgia policy that sharply increased subsidies to rural hospitals. The RHTC was established in 2017 and distributes large lump-sum cash subsidies to rural Georgia hospitals by providing a full tax deduction for charitable donations made to those hospitals. In 2018, $59 million was donated to rural Georgia hospitals under the RHTC. To provide context for the size of this program, Panel A of Figure 1 shows average annual charitable donations distributed to rural Georgia hospitals. The year before the RHTC, these hospitals received $300 thousand in donations, but by the second year of the RHTC, average donations totaled $1.3 million and comprised 4.6% of average hospital revenue. Panel B of Figure 1 shows that after RHTC went into effect, the average profit margin earned by rural Georgia hospitals jumped from 0.004 to 0.04.[1]

Exploiting variation from this funding windfall, I assess how rural hospitals allocate government subsidy dollars as well as the impacts of increased subsidization on rural hospital profitability and access to care in rural communities. I estimate difference-in-differences models comparing the outcomes of rural Georgia hospitals with those of rural hospitals in other southern states before and after the policy change. Using financial data from Medicare cost reports, I find that rural hospitals invest subsidy dollars in physical capital. Rural hospitals put 75 cents of every additional subsidy dollar into fixed assets like medical equip-

[1] Profit margin is the ratio between overall hospital profits and all hospital revenue.

ment and facilities. Notably, I find that in the years following subsidization, hospitals see increased demand and profitability. Compared to rural hospitals in other states, subsidized Georgia hospitals see a 10 percent increase in patient volumes and a 3 percent increase in annual profits earned from medical services. Finally, I consider the impact of subsidization on access to healthcare in rural communities. Using administrative data from the FDA on radiology equipment installations, I find that rural hospitals use subsidy dollars to purchase new diagnostic tools, which increases access to care in rural communities. Compared with rural hospitals in other southern states, subsidized hospitals are more likely to purchase new imaging tools, such as 3D mammography and bone density scanners. My results suggest that rural hospitals respond to increased subsidization by making investments in physical capital that bolster profits and increase access to locally available care in rural communities.

Over time, rural areas have seen a reduction in the supply of local healthcare. Depopulation and increased competition from urban providers generated demand volatility, lowering profit margins at rural hospitals. From 2008-2010, 60 percent of rural hospitals earned negative annual profits, and since 2013, 8 percent of rural hospitals have closed. (Sheps Center, 2024). Surviving rural hospitals have responded to financial strain by downsizing and delaying investment in new technologies, which reduces access to care in these communities (Dobis and Todd, 2022; Joynt et al., 2011). These trends have been compounded by the credit constraints that these hospitals face. The average rural hospital's annual revenues are too small to gain access to the bond market, forcing them to seek debt financing at less favorable interest rates (American Hospital Association, 2007; Jennings and Hughes, 2008). Hospitals with thin profit margins may struggle to pay these debts, which can linger on their balance sheet for years. As debt burdens mount and borrowing costs rise, hospitals may be unable to finance equipment upgrades or invest in new service lines. These constraints may lower long-term profitability, as previous work has shown that hospitals rely on the profits earned from new procedures and medical technologies to cross-subsidize existing service lines (David et al., 2014). Given these dynamics, we might expect capital spending at rural hospitals to be especially responsive to changes in government subsidization. My results support this hypothesis as I find that rural hospitals use government subsidy dollars to invest heavily in physical capital.

This paper contributes to several strands of literature. First, I extend previous research into how hospitals allocate government funding windfalls. Duggan et al. (2022) and Duggan (2000) investigate how California hospitals use surplus funds generated by state policy changes. Both papers find that hospitals keep the proceeds from these policy changes as financial reserves rather than reinvesting them in physical capital or increasing labor expenditure. Gupta et al. (2024) study how hospitals allocate the revenue obtained from exploiting a loophole in the Medicare outlier payments program and find that nearly half of the additional revenue flowed into operating costs through increased spending on patient care. However, they detect no change in the level of physical capital. Like Gupta et al. (2024), I use financial data from hospital balance sheets to trace the flow of subsidy funds into mutually exclusive categories. My paper differs from the existing literature in two important ways. First, my paper examines the allocation of subsidy funds among rural hospitals. Given the well-documented financial differences between rural and urban hospitals, rural hospitals might respond differently to government subsidization (Younis et al., 2001; Turner et al., 2015). Second, I provide the first estimates of the effect of lump-sum government subsidies on rural hospital investment. The funding variation exploited by earlier studies was driven by changes in government subsidies for treating low-income patients, expansions in Medicaid eligibility, and changes in Medicare reimbursement rates. Since RHTC subsidies are not associated with broader changes in hospital payment incentives or public insurance eligibility, this policy intervention allows me to cleanly identify how rural hospitals respond to changes in government funding levels. Using this variation, I find that rural hospitals invest subsidy funds in physical capital rather than keeping them as financial reserves. Differences between my results and those in the existing literature may be explained by stricter credit constraints faced by rural hospitals.

Second, this paper contributes to the literature examining the impact of government subsidization on the financial viability of rural hospitals. Balvin (2016) and Lindrooth et al. (2018) examine Medicaid expansion's impact on the financial health of rural hospitals with a focus on whether the expansion prevents rural hospital closures. Similarly, Carroll (2023) assesses how the Critical Access Hospital Program, a national payment reform that increased Medicare reimbursements, impacted the financial stability of participating hospitals. She finds that this program led to a reduction in the rate of rural hospital closures. My paper extends this literature by estimating how lump-sum payments to rural Georgia hospitals affect financial stability at rural hospitals. I find that the cash transfers distributed through the RHTC provide a critical financial buffer for rural Georgia hospitals, as hospitals that receive these lump sum subsidies see a 20-percentage point increase in the probability of earning positive profits.

Third, my results provide evidence that government subsidies can increase access to locally available health care in rural communities. While rural residents have a higher incidence of cancer, heart disease, and stroke, the geographic distribution of healthcare is concentrated around urban centers (Moy, 2017). Rural areas have fewer doctors per capita, and residents of these communities are twice as likely to live in a county without a hospital (Dobis and Todd, 2022). To help maintain the supply of care in rural communities, state and federal governments have enacted several subsidies to keep rural hospitals open (Carroll et al., 2022). However, even when a local hospital is present, rural residents may still need to travel outside their communities to receive appropriate medical care, as rural hospitals are typically smaller and less likely to offer the full suite of medical services. Unlike previous rural hospital subsidies that targeted funds toward emergency care, the policy I consider gave rural hospitals complete autonomy over how to spend subsidy funds. Interestingly, I find that rural Georgia hospitals used these unrestricted subsidy dollars to invest in imaging tools that enabled them to deliver new diagnostic services, such as 3D mammography and osteoporosis testing. Since Scoggins et al. (2012) show that patients facing higher travel times see delayed diagnosis, increased access to locally available screening services could improve health outcomes for patients across rural Georgia.

Finally, my paper extends the work done in two previous analyses of the RHTC. The first analysis of the RHTC was a qualitative exploration of its impact, where executives from participating hospitals were interviewed (Opoku et al., 2021). The second analysis used a difference-in-differences empirical strategy to examine the impact of the RHTC on the financial health of Georgia hospitals, where financial health is measured by total margin, days cash on hand, and debt-asset ratio (Apenteng et al., 2021). I extend this work by examining the RHTC's impact on hospital physical capital investment and labor expenditures, as well as on patient volumes. By focusing on patient volumes, this paper will help to determine if receiving RHTC funds makes participant hospitals a more attractive option for patients. Previous work has shown that it can be difficult for hospitals with low patient volumes to cover their operating costs (Giancotti et al., 2017; Dranove, 1998). If the RHTC has a positive effect on patient volumes, then it may make hospitals more financially sustainable. My results suggest this dynamic is at play, which means that previous estimates of the policy's impact may understate the benefits.

My results show that rural hospitals have a high propensity to invest government subsidy dollars in physical capital. These subsidies increase access to care in rural communities by enabling hospitals to offer a broader menu of health services. Finally, I find that after making new investments in physical capital, rural hospitals see increased demand and earn higher profits from medical services. Overall, my results suggest that government subsidies have a tangible impact on the care delivered at rural hospitals. By providing cash infusions to credit-constrained providers, these subsidies generate investments in physical capital that increase access to locally available care and bolster financial stability at rural hospitals.

The rest of this paper is structured as follows. Section two provides institutional background on the RHTC. Sections three and four describe the data sources used in this paper, along with the empirical strategy. Sections five and six present the results of the main specification and robustness checks. Section seven concludes.

2 Background

2.1 The Rural Hospital Tax Credit

In 2016, Georgia lawmakers passed Senate Bill 216, creating the RHTC. The RHTC aims to increase charitable donations to rural Georgia hospitals by allowing individuals and corporations to deduct 100% of donations to qualifying rural Georgia hospitals from their state tax bill. Because charitable donations are generally not deductible from Georgia taxes, the RHTC creates an incentive to donate to these hospitals.[2] This tax credit became available in 2017, and in 2019 it was extended by the state legislature until 2024. Each year, the state sets a cap on the total dollar amount of tax credits available. This cap was set at $10 million in 2017, $60 million in 2018-2021, and $75 million in 2022. Hospitals are eligible to receive RHTC donations if they operate as a government or non-profit organization, provide inpatient services, accept Medicare and Medicaid patients, and are located in a county with a population level below the eligibility cutoff or designated as Critical Access Hospitals.[3] In 2017, the county population cutoff was 35,000, but it was raised to 50,000 in 2018. Following this change, the total number of recipient hospitals increased from 49 to 58. Every hospital eligible to participate in the RHTC program from 2017–2019 received funding each year.

Table 1 presents summary statistics on total RHTC funding from 2017-2019. Column 3 reports total annual donations made to rural hospitals through the RHTC. This credit was immediately effective in incentivizing donations to rural hospitals, as the annual statewide credit cap was nearly reached in the first two years of the program. Additionally, the

[2]Even though RHTC funds are distributed as charitable donations, the state loses the full tax value of donations. Therefore, RHTC funds can reasonably be considered a government subsidy.

[3]To be designated as a Critical Access Hospital, a hospital must be located more than 35 miles from the next closest hospital. Critical Access Hospitals receive more generous reimbursement rates from CMS for some services.

donations distributed to hospitals through this program provided hospitals with a substantial funding boost. In 2018, qualifying RHTC hospitals received $1 million on average, which constituted an average revenue increase of 4.6%.

2.2 Accounting Identities

A defining feature of this program is that hospitals have total discretion over how to spend RHTC funds. Hospitals can also choose not to spend RHTC dollars and keep them as financial reserves. Using accounting identities, I trace the flow of RHTC dollars across mutually exclusive and exhaustive categories. First, I exploit the fact that subsidy dollars must be used to increase operating expenditure, increase assets, or reduce liabilities. Increased operating expenditures indicate that hospitals put subsidy dollars toward patient care. Since labor cost represents the largest component of hospital operating expenditure, I examine the effect of this policy on total operating expenditure and employment levels. To determine whether hospitals use the subsidy to increase assets or decrease liabilities, I examine the effect on total assets and net worth.[4] If hospitals hold RHTC funds as cash reserves, then total assets will mechanically increase as cash is an asset. I distinguish whether hospitals treat RHTC as financial reserves or reinvest them in physical capital by examining the effect on fixed assets.[5] I further decompose fixed asset investment by examining the value of hospital equipment, which is the component of physical capital most directly related to patient care.

3 Data

3.1 Hospital Cost Reports

The primary data used is from the Hospital Cost Report Information System (HCRIS) from 2013–2019. Collected annually by the Center for Medicare and Medicaid Services, this data set contains yearly information on expenses, revenues, debts, assets, charitable donations, government appropriations, and patient volumes for the universe of Medicare-eligible hospitals in the United States. HCRIS is the most comprehensive record of financial outcomes for US hospitals. Since HCRIS data is reported in fiscal year intervals, which may not align with the calendar year, I rebase the data so that it aligns with calendar time. While annual hospital reports are subject to CMS audit, HCRIS is known to suffer from misreporting or non-reporting of some outcomes. To mitigate the effect of misreporting, I

[4] Net worth is defined as total hospital assets minus total liabilities.

[5] Fixed assets include the value of land, buildings, and hospital equipment.

winsorize all cost report variables at the 1st and 99th percentiles within each year.

I use the HCRIS variable, total charitable contributions, to determine the magnitude of the funding increase hospitals receive under the RHTC. To assess the direct impact of the RHTC on hospital financial stability, I use HCRIS data to calculate annual hospital profit margins. Profit margin, also known as excess margin, is the ratio of all hospital revenues minus operating expenses to all hospital revenues.[6] I also use HCRIS to construct an indicator variable for whether a hospital earns positive profits each year. I measure hospitals' use of RHTC funds with data recorded on HCRIS balance sheets. Relying on the accounting identities outlined in section 2.2, I measure the RHTC's impact on total operating costs, full-time equivalent employees (FTE), average employee salary, net worth, fixed assets, and hospital equipment value. Finally, I use total inpatient days to determine whether subsidized hospitals see increased demand for inpatient services, and I construct hospital operating margins to examine whether subsidized hospitals experience increased financial viability.[7] Operating margin differs from profit margin in that it only includes revenues earned from services to patients; thus, it is a measure of the profitability of a hospital's medical operations.

3.1 Imaging Equipment Installation Data

To examine the effect of the RHTC on investment in new medical equipment, I use administrative data on medical imaging installations collected by the FDA. These data record the installations of any new radiation-emitting imaging equipment at medical providers across the United States. I use hospital-level variation in the installation of imaging equipment over time to assess whether subsidized hospitals use RHTC funds to invest in new diagnostic tools or to upgrade existing imaging equipment.

4 Empirical Strategy

Sample Selection

I define treated hospitals as rural Georgia hospitals that started receiving funds in 2017 or 2018. 49 hospitals began receiving RHTC funds in 2017, while an additional 9 received initial funding in 2018. The increase in the number of recipient hospitals from 2017 to 2018 is

[6](Net patient revenues less total operating expense + total other income) / (net patient revenue + total other income)

[7](Net patient revenues less total operating expense) / net patient revenues

explained by a change to the population eligibility threshold. From 2017–2019 every Georgia hospital that was eligible for participation in the RHTC program received funding in each year. I chose control hospitals from non-Medicaid expansion states in the southeast that would be eligible for treatment if the policy existed in their state, i.e., non-private hospitals located in counties with populations below 50,000. I exclude hospitals that undergo ownership changes, mergers, or acquisitions from 2013-2019, since I cannot reliably separate the effect of a change in ownership from that of increased subsidization. I also exclude hospitals with incomplete HCRIS surveys from 2013-2019. This leaves me with 46 treated and 87 control hospitals.[8] Since Critical Access Hospitals do not report data on employee compensation, I have fewer observations for my analysis of average employee salary. Appendix A reports estimates without these sampling restrictions, and the results are similar to those from my main specification.

Panel A of Table 2 shows pre-period means of HCRIS variables for treated and control hospitals. To account for size differences across hospitals, all hospital-related variables are scaled by the number of discharges in the pre-period. There are no statistically significant differences in the pre-period between the treated and control hospitals' values. Panel B of Table 2 shows pre-period means for county demographics across treated and control hospitals. On average, control hospitals are located in counties that are slightly larger. However, Table 6 shows that there are no statistically significant differences across demographic variables between the pre- and post-periods.

4.1 Identification Strategy

For my main results, I estimate difference-in-differences models. Since the rollout of treatment is staggered between 2017 and 2018, I estimate this model using the imputation estimator proposed by Gardner (2022), which avoids the bad comparisons known to bias standard two-way fixed effects estimators. The static model estimated in my main specification includes hospital and year fixed effects, along with an indicator for exposure to the RHTC. Under the assumption that, in the absence of treatment, the outcomes for treated hospitals would have evolved similarly to those of control hospitals, β_1 identifies the average treatment effect over the post-treatment period. I supplement static difference-in-differences with event-study estimates for each of my outcomes of interest.

[8] Six treated hospitals are excluded because they undergo ownership changes, and six are excluded because they fail to report certain dependent variables over my sample period.

$$Y_{ht} = \beta_0 + \beta_1 Post \times Treat_h + \alpha_h + \tau_t + \epsilon_{ht} \tag{1}$$

In this model, none of the control hospitals are in Georgia. Thus, if there are state-level policies or economic changes impacting Georgia hospitals that occur concurrently with the RHTC, I cannot separately identify the effect of the RHTC from these state-level changes in the policy or economic environment.[9] Section 6 presents evidence that there are no Georgia-specific changes in county demographics or government funding for hospitals that occur simultaneously with the rollout of the RHTC, but we still might be concerned that the effects ascribed to the RHTC are actually attributable to other Georgia-specific factors. To account for this possible bias, I estimate the following triple-difference model.

$$Y_{ht} = \beta_1(Post \cdot GA \cdot Rural) + \beta_2(Post \cdot GA) + \beta_3(Post \cdot Rural) + \alpha_h + \tau_t + \epsilon_{ht} \tag{2}$$

The third difference selects non-private Georgia hospitals that are ineligible for treatment because they are in counties with populations above 50,000 and compares them with non-private hospitals in control states in counties with populations above 50,000. This specification will capture any Georgia-specific factors, other than the RHTC, that affect hospital outcomes in the post-treatment period. Reported in equation 2, this model includes hospital and year fixed effects, the two-way interaction between Post and an indicator for being located in Georgia (GA), the two-way interaction between Post and an indicator (Rural) that equals one if a hospital in any state meets the criteria for RHTC eligibility, and the three-way interaction between Post, GA, and Rural. In this model, β_2 should capture the effect of any non-RHTC-related factors that affect Georgia hospitals between the pre- and post-treatment periods. Formally, β_1 identifies the effect of the RHTC if the difference in outcomes between rural hospitals in Georgia and the control states had evolved in parallel with the difference in outcomes between non-rural hospitals in Georgia and the control states in the absence of treatment.

[9] In 2016, Georgia implemented the Rural Hospital Support Program. This program provides lump sum grants of $750,000 to three rural hospitals a year. There is overlap between hospitals that receive RHTC funds and those that receive these grants. For the 9 treated hospitals that receive these grants, I will likely overestimate the impact of RHTC funds. In section 6, I find that treatment effects are robust to the inclusion of an indicator variable that controls for the additional effect of these grants.

5 Results

5.1 Financial Stability

First, I quantify the direct effect of RHTC subsidies on the financial stability of rural Georgia hospitals. Panel A of Table 3 presents difference-in-differences estimates of the impact of the RHTC on hospital-level financial outcomes. Column (1) shows that relative to control hospitals, treated hospitals see an average increase in total donations of $499,000 after the roll-out of the RHTC. Column (2) shows that treated hospitals experience a 0.05 unit increase in annual profit margin. This is a large effect compared to those reported in the literature. Balvin (2016) estimates that one year of exposure to Medicaid expansion increases hospital profit margin by 0.01 units. Column (2) shows that the RHTC increases the probability of positive annual profits by 20 percentage points. Based on this estimate, RHTC funds lifted approximately 9 of the 46 treated hospitals in my sample into positive profitability. These results suggest that the RHTC generates a substantial profit boost for rural hospitals and that this policy is effective in moving them across the profitability threshold. Event-study estimates displayed in Figure 2 show no evidence of differential pre-trends between treated and control hospitals. The estimated treatment effects for profit margin are strongest in the second post-treatment period, which aligns with the fact that total donations are largest in that period. Triple difference estimates are shown in panel B of Table 2. The effects increase in magnitude across outcomes, suggesting that the effects shown in panel A are not driven by a time-varying factor common to all Georgia hospitals.

5.2 Use of Funds

To determine how hospitals allocate RHTC funds, I first examine whether subsidized hospitals have higher operating costs in the post-treatment period. Column (1) of Table 4 shows an estimated increase of $1,846 per base period discharge, a 5% increase from the pre-treatment average, but this estimate is statistically indistinguishable from zero and flips signs in the triple-difference specification. While average post-treatment effects are null, Panel A of Figure 3 shows a statistically significant increase in the third post-treatment period. Estimates for FTE follow a similar pattern, suggesting that increases in operating cost are driven by increased spending on hospital staffing. Panel C shows the estimated effect on average compensation of hospital employees, which is null in all post-treatment periods. Taken together, these results show that hospitals did not use subsidy dollars to increase operating expenses until the third year of exposure to the policy, and that this increase appears to be driven by higher staffing levels. It should be noted that this time period aligns with the passage of legislation that extended the RHTC until 2024. Since hiring new employees incurs long-run costs, hospitals may have delayed staffing increases until they knew the program would continue.

Since I fail to detect a meaningful change in operating costs, the accounting identities in section 2.2 predict that hospitals must be putting subsidy funds toward net worth. Reassuringly, estimates in column 4 of Table 4 confirm this. Treated hospitals see a statistically significant increase of $4,451 in net worth per base period discharge. Total assets rise by $3,057, suggesting that 70% of the change in net worth is due to an increase in hospital assets. Fixed assets per base period discharge increased by $2,214, roughly 72% of the increase in total assets. These results show that rural hospitals use RHTC funds to increase their asset holdings and that they reinvest a large portion of these funds into physical capital rather than holding them as cash reserves. Finally, I find that equipment value per base period discharge increases by $1,467. This estimate implies that hospitals allocate $0.52 of every RHTC dollar toward hospital equipment. Since hospital equipment includes all medical equipment, this result suggests that hospitals use RHTC subsidies to update existing equipment or purchase new equipment to expand their service offerings. This finding has interesting implications for the quality of care and patient outcomes at subsidized hospitals.

Triple-difference estimates for these outcomes are less precisely estimated but are qualitatively similar to my main estimates, indicating that the effects estimated in panel A are not driven by some time-varying factor common to all Georgia hospitals. Event-study estimates for these outcomes are shown in Figure 4. I find no statistically significant differences between treated and control hospitals in pre-treatment periods for fixed assets and equipment value. Event studies for net worth show a violation of parallel trends in the third period before treatment, but tests for violations of pre-trends in Figure 6 show that post-treatment effects for this outcome are robust up to a post-treatment violation of parallel trends 1.2 times larger than the violation of pre-trends in relative year -3 (Rambachan and Roth, 2023). Finally, I examine how investment levels vary with RHTC funding levels. Figure 7 separately plots event-study estimates of the effect of treatment on equipment value for hospitals that received above vs. below the median annual donation. Blue depicts hospitals receiving a high dose of treatment, while orange depicts those receiving a lower dose. To account for size differences among treated hospitals, donation levels are scaled by the number of discharges in the base period. This normalization reflects the fact that smaller donation values may have a higher impact at smaller hospitals. Intuitively, hospitals receiving an above-median treatment dose have estimated treatment effects that are larger than those of hospitals receiving a below-median dose. This suggests that rural hospitals allocate more funding toward hospital equipment as the size of the subsidy increases.

5.3 Patient Volume and Profit

In this section, I quantify the downstream effects of RHTC subsidization on demand for hospital services and hospital profitability. The large estimated increase in hospital equipment value suggests that treated hospitals use RHTC subsidies to update existing equipment or purchase new equipment to expand their service offerings. These investments may improve the quality of care at treated hospitals or enable them to implement new services that were previously unavailable. This behavior could increase demand for health care at treated hospitals, leading to higher patient volumes. Quantifying the effect of the RHTC on patient volumes is crucial to understanding the full impact of these subsidies. Given their high fixed costs, hospitals are not easily able to scale down operational costs. Thus, declining patient volumes that decrease revenue make it difficult for hospitals to remain financially solvent. If RHTC subsidies enable hospitals to invest in services that increase demand for their services, this policy may make hospitals more financially sustainable in the long run. Panel A of Table 5 presents difference-in-differences estimates of the effect of the RHTC on demand for hospital services and hospital operating margin, which is a measure of the profit a hospital earns from business operations net of any charitable donations, investment income, or government subsidies. I find that treated hospitals see a statistically significant increase of 0.75 in inpatient volume per base period discharge. This represents an 11% increase relative to the pre-treatment mean. Panel B of Figure 5 shows treatment effects that are small in the first post-treatment period but grow over time. If these increases in patient volume are attributable to the RHTC, we might expect the effects to increase over the post-treatment period, as it would take time for patients to recognize quality improvements or for hospitals to establish new services. Finally, column 2 of Table 5 shows a statistically significant increase of 0.036 in average operating margin. Since the pre-treatment average for this variable is -0.041, my estimate suggests that this policy intervention led to meaningful improvements in the financial performance of rural Georgia hospitals. Triple-difference estimates for these outcomes are qualitatively similar but smaller in magnitude.

5.4 Access to Care

Finally, I estimate the effect of the treatment on the acquisition of imaging equipment at rural hospitals. The large increase in equipment value that I find in section 5.2 suggests that hospitals may use subsidy funds to invest in new care lines. Empirical evidence shows that rural hospitals struggle to cover the high fixed costs of adopting service lines, so the influx of unrestricted RHTC funds may have given them the liquidity needed to make these new investments. I investigate this possibility using administrative data on medical imaging installations collected by the FDA. These data record the installations of any new radiation-emitting imaging equipment at medical providers across the United States. Figure 8 shows event-study estimates comparing the probability of new equipment installation at treated and rural control hospitals in other southern states. Because these equipment purchases are dispersed over time, I group years into three-year periods. These results show no distinguishable difference between treated and control hospitals prior to 2017, but the probability of imaging equipment additions jumps by 18 percentage points in the post-subsidy period. Table 6 shows the difference-in-differences estimates across different types of equipment. I find statistically significant effects for three-dimensional mammograms and bone density scanners. Compared with control hospitals, the probability that subsidized Georgia hospitals have new installations of these equipment types increases by 11 and 5 percentage points, respectively. This is consistent with Khaliq et al. (2015), who show that rural hospitals are less likely to supply this care due to its high fixed cost. My estimates suggest that hospitals use RHTC funds to subsidize the high up-front cost of diagnostic imaging tools.

6 Robustness Checks

To provide evidence that my results are not being driven by non-RHTC Georgia policy changes, I perform two robustness checks. First, I estimate equation (1) with government funding as the dependent variable. Government funding is a variable reported in HCRIS that includes any grants or subsidies that hospitals receive from government sources. Difference-in-differences estimates from this falsification exercise are reported in row 1 of Table 7. I find no statistically distinguishable change in government funding between treated and control hospitals, which supports the idea that our results are not being driven by non-RHTC Georgia policy changes. In row 2, of Table 6 I estimate equation (1) with an indicator for 340B participation as the dependent variable. Hospitals participating in Medicare's 340B program can purchase pharmaceuticals from manufacturers at discounted rates. Owsley and Bradley (2023) finds a causal link between participation in this program and investment at rural hospitals, as the discounts provided substantially reduce the fixed cost of service expansion. I find no evidence that treated hospitals are more likely to participate in the 304B program post-2016, which suggests that my results are not confounded by this policy. In Panel B, I present results from tests of changes in county demographics between the pre- and post-periods. All estimates except county uninsurance rate are statistically indistinguishable from zero, but the estimated change in this variable is small in magnitude.

In Table 8, I control for the effect of Georgia's rural hospital stabilization program. This program was implemented in 2016 and provided one-year $250,000 grants to selected rural Georgia hospitals. Nine of the hospitals receiving these grants also received RHTC funds. These grants are substantially smaller than what the average hospital received through the RHTC, but to ensure that my results are not confounded by this policy, I estimate equation (1) with an additional indicator for having received a rural hospital stabilization grant. As seen in Table 8, treatment effects are robust to the inclusion of this indicator. Given the similarity between these estimates and my main estimates, it does not seem that this other policy drives my results.

7 Conclusion

From 2017 to 2019, Georgia's RHTC disbursed $115 million to rural hospitals throughout the state. I use this sharp funding increase to measure how rural hospitals allocate government subsidy dollars and to study the impact of increased subsidization on rural hospital profitability and access to care in rural communities. I find that, on average, rural hospitals choose to reinvest subsidy dollars in physical capital rather than holding them as cash reserves. After making these investments, rural hospitals adopt new diagnostic imaging tools and experience increased patient demand. With higher patient volumes, subsidized hospitals earn higher profits from medical services, suggesting that this policy bolstered financial stability at rural hospitals.

Structural barriers in access to credit markets raise the cost of physical capital investment and service line expansion at rural hospitals. This disparity makes it difficult for rural hospitals to compete with better-resourced urban providers that house more advanced medical technologies and offer a wider variety of specialty services (Joynt et al., 2011). Over the past decade, the share of rural residents traveling outside of their local communities to receive care has spiked (Friedman, 2022). This threatens the financial viability of rural hospitals and has contributed to their rising closure rate (Carroll et al., 2023). My results show that by providing cash infusions to credit-constrained providers, rural hospital subsidies spur investments in physical capital that increase access to locally available care and bolster rural hospitals' financial stability. This pattern suggests that increasing resources available to rural hospitals, through subsidies, offers an effective policy solution to the structural challenges of care delivery in rural communities. However, given concerns about the quality of care at rural hospitals, the estimated increase in patient volumes could be welfare-reducing if patients are routed away from higher-quality providers. Future work is needed to fully understand this trade-off.

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Table 1: RHTC Donations Across the First Three Years of the Program

Year	Recipients	Total Donations	Average Benefit Received	Average Share of Revenue
2017	49	$9,227,000	$188,360	1.5%
2018	58	$59,506,270	$1,025,940	4.6%
2019	58	$46,516,000	$802,000	4.0%

Notes: The table reports aggregate information on funding receipts from the RHTC over time. *Source:* Department of Community Health.

Table 2: Summary Statistics

	Treated	Control	*p-value*
Panel A: Hospital			
Net Worth	14,417.7	16,359.51	(0.428)
	[21,544.1]	[29,247.45]	
Fixed Assets	14,537.8	13,876.4	(0.69)
	12,426.8	14,227.5	
Hospital Equipment	11,760.7	11,342.4	(0.56)
	[7,438.6]	[8,906.7]	
Operating Cost	36,543.6	39,372.1	(0.37)
	[32,350.3]	[36,159.9]	
FTE	0.25	0.29	(0.37)
	[0.16]	[0.32]	
Inpatient Days	6.65	7.18	(0.475)
	[6.42]	[8.54]	
Beds	51.4	49.5	(0.80)
	[41.00]	[56.49]	
Government Owned	0.63	0.64	
Hospital Count	46	87	
Panel B: County			
County Population	23,808.9	27,623.9	(0.01)
	[13,700.7]	[17,244.8]	
Percent Uninsured	18.7	16.7	(0.01)
	[3.2]	[3.6]	
Percent Above 65	15.9	16.5	(0.05)
	[4.1]	[2.7]	
Percent Employed	89.6	87.5	(0.01)
	[2.9]	[3.9]	

Notes: This table displays the mean 2016 characteristics for subsidized rural Georgia hospitals and rural control hospitals from other southern states. Standard deviations are shown in brackets, and p-values are shown in parentheses. County demographic variables are taken from the American Community Survey. Source: HCRIS.

Table 3: Effect on Hospital Financial Stability

	Donations	Profit Margin	Probability of Positive Profit
Panel A: DID Estimates			
	498,741***	0.050***	0.199***
	(87,483)	(0.018)	(0.075)
Observations	931	931	931
Pre-Treat Mean	238,037	0.003	0.508
Panel B: Triple Difference Estimates			
	1,087,690*	0.053***	0.226***
	(659,222)	(0.021)	(0.092)
Observations	2,231	2,231	2,231

Notes: The table reports estimates of the RHTC's effect on measures of hospitals' financial stability. Standard errors are clustered at the hospital level and are shown below the point estimates; stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$. Panel A shows difference in differences results from the imputation estimator using the rural control group. Panel B shows the results from the triple-difference specification. *Source: HCRIS*

Table 4: Effect on Use on Hospital Expenditure Across Categories

	Operating Cost	FTE	Average Salary	Net Worth	Total Assets	Fixed Assets	Equipment Value
Panel A: DID Estimates							
	1,846	0.013	878	4,451**	3,057*	2,214***	1,467**
	(1,743)	(0.011)	(1,367)	(2,142)	(1756)	(818)	(654)
Observations	931	931	547	931	931	931	931
Pre-Treat Mean	36,543	0.251	60,125	21,544	32,663	14,537	11,760
Panel B: Triple Difference Estimates							
	-498	0.012	2,557	4,115	4,961	1,938	2,333*
	(2,160)	(0.016)	(1,722)	(3,036)	(1,713)	(2,891)	((1,263)
Observations	2,231	2,231	1,847	2,231	2,231	2,231	2,231

Notes: The table reports estimates of the RHTC's effect on hospital spending across categories. Standard errors are clustered at the hospital level and are shown below the point estimates; stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$. Column (1) shows results from the imputation estimator using the rural control group. Column (2) shows the results from the triple-difference specification. All dependent variables are normalized by the number of discharges in the base period. *Source: HCRIS*

Table 5: Effect on Patient Volume and Profit

	Inpatient Days	Operating Margin
Panel A: DID Estimates		
	0.743**	0.036**
	(0.362)	(0.015)
Observations	931	931
Pre-Treat Mean	6.651	-0.041
Panel B: Triple Difference Estimates		
	0.569	0.032
	(0.515)	(0.019)
Observations	2,231	2,231

Notes: The table reports estimates of the RHTC's effect on inpatient volume and hospital operating margin. Standard errors are clustered at the hospital level and are shown below the point estimates; stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$. Panel A shows difference in differences results from the imputation estimator using the rural control group. Panel B shows the results from the triple-difference specification. Inpatient days are normalized by the number of discharges in the base period. *Source: HCRIS*

Table 6: Effect on Probability of Imaging Equipment Installations

	Any Imaging	3D-Mammogram	X-Ray	CT	Bone Densitometer
	0.181***	0.113***	0.004	0.011	0.053**
	(0.001)	(0.012)	(0.029)	(0.025)	(0.021)
State FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Pre-Treat Mean	0.517	0.086	0.201	0.121	0.075
Observations	532	532	532	532	532

Notes: The table reports estimates of the RHTC's effect on imaging equipment installations. Standard errors are clustered at the hospital level and are shown below the point estimates; stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$. *Source: FDA*

Table 7: Robustness Checks

	(1)	Pre-Mean
Panel A: Alternate Funding Sources		
Government Funding	-95.24	649.07
	(258.83)	
340B Participation	-5.31	71.12
	(4.23)	
Panel B: County Demographic Changes		
County Population	157.72	23,808.92
	(277.68)	
Percent Uninsured	0.41***	18.78
	(0.13)	
Percent Employed	-0.36	89.61
	(0.38)	
Percent Above 65	0.01	15.95
	(0.12)	
Observations	931	

Notes: The table reports robustness checks which test for changes in confounding factors at the timing of the RHTC. Standard errors are clustered at the hospital level and are shown below the point estimates; stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$.

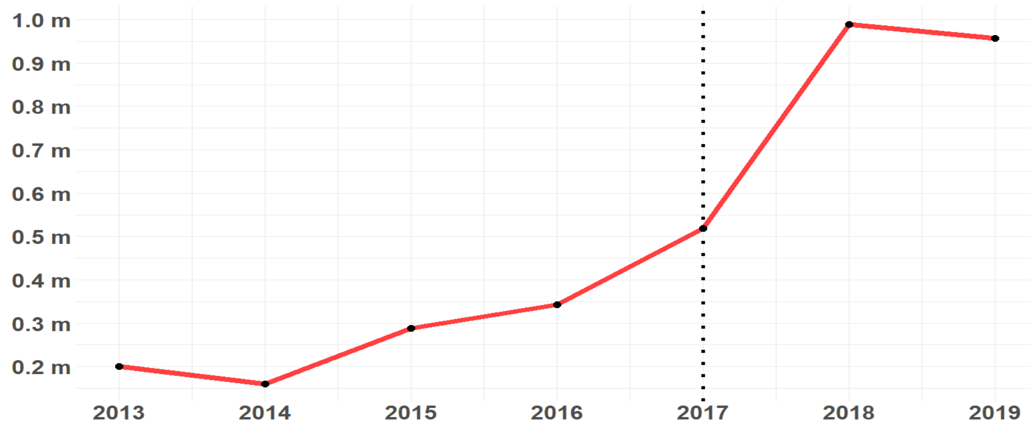
Table 8: Controlling for Participation in Rural Hospital Stabilization Program

	Net Worth Worth	Fixed Assets	Equipment Value	Inpatient Days	Operating Margin
	4,172**	2,207***	1,323**	0.789**	0.038**
	(2,079)	(814)	(632)	(0.361)	(0.016)
Observations	931	931	931	931	931

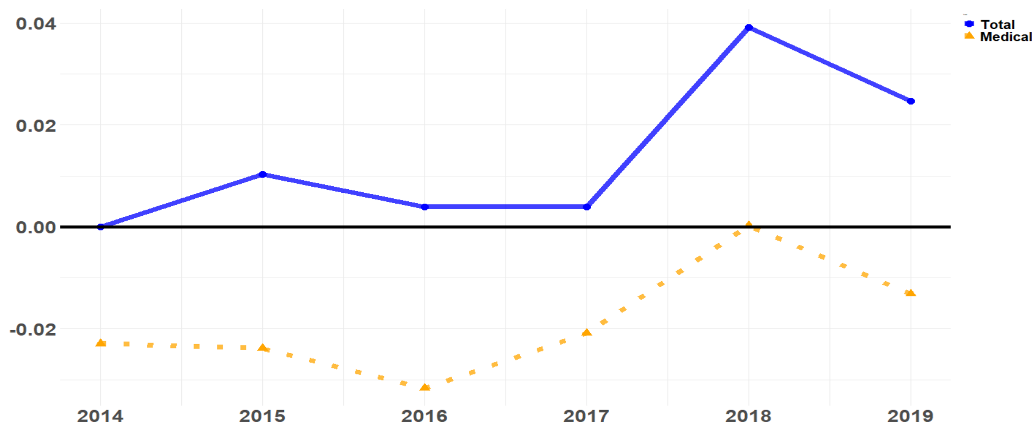
Notes: The table reports show differences in differences estimates using the rural control group with the inclusion of an indicator for participation in the Rural Hospital Stabilization Program. Dependent variables in the first four columns are normalized by the number of discharges in the base period. Standard errors are clustered at the hospital level and are shown below the point estimates; stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$.

Figure 1: Evolution of Donations and Profit Margins at Rural Georgia Hospitals

Panel A: Average Donations

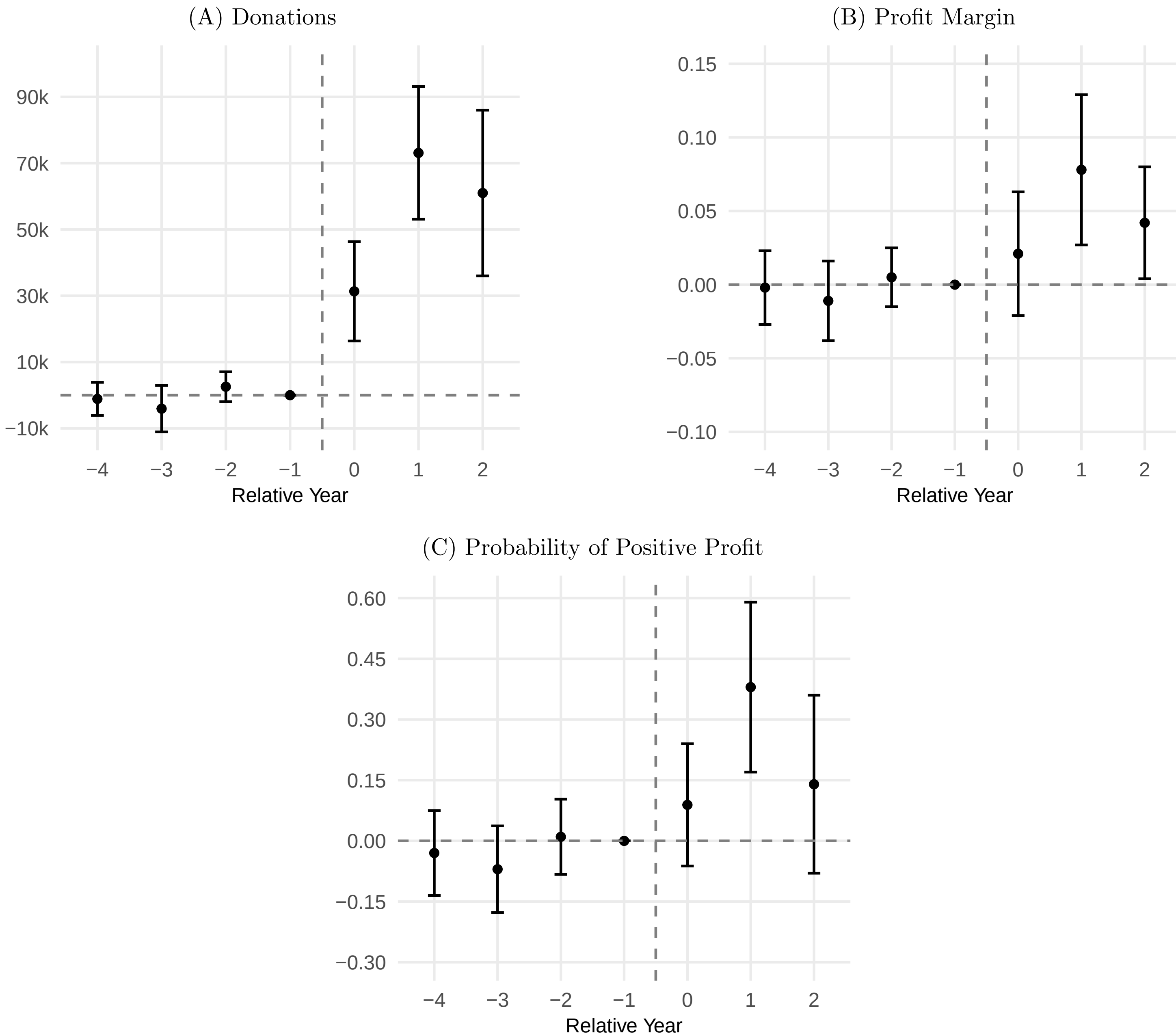


Panel B: Total and Medical Profit Margin



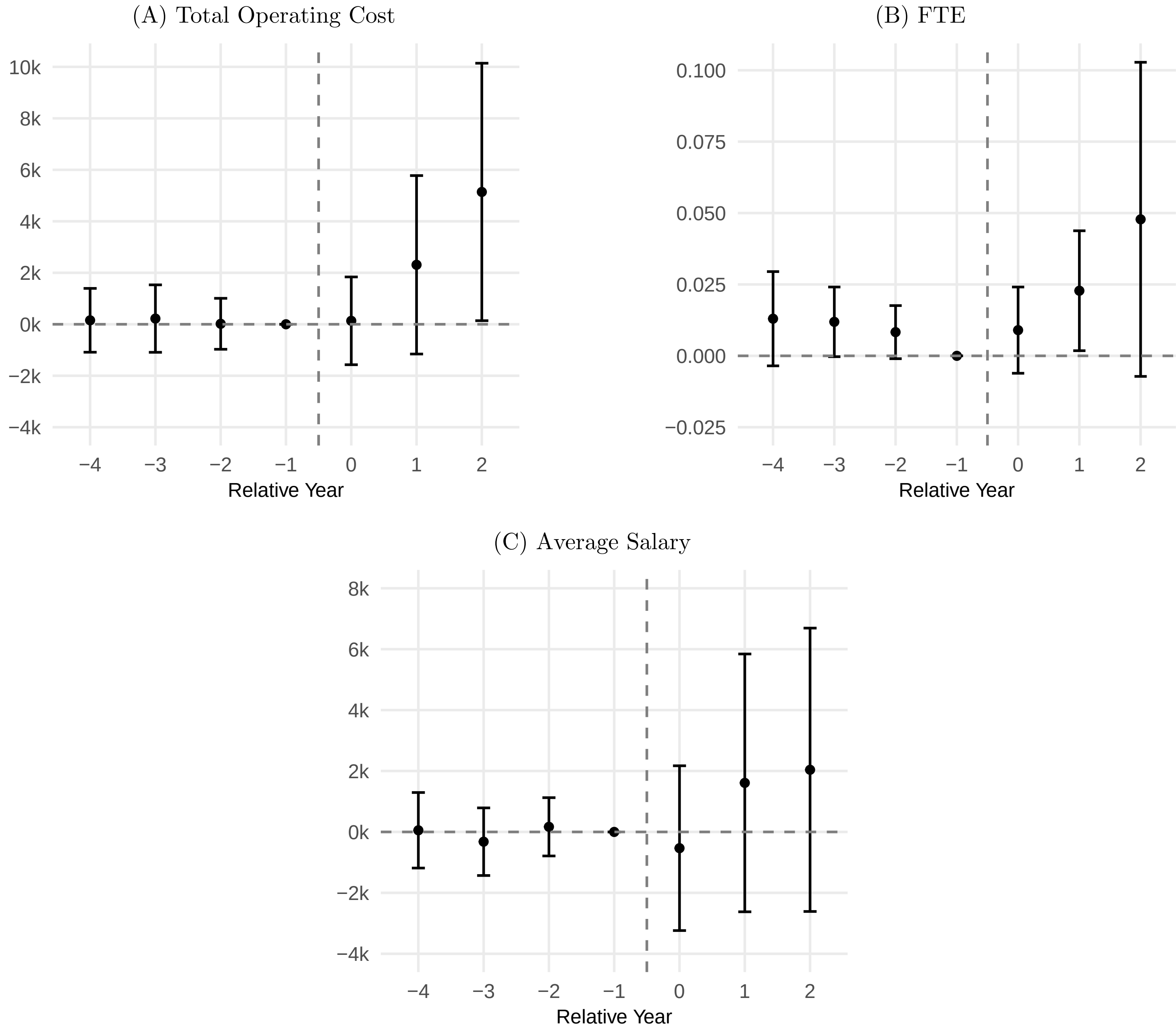
Notes: Panel A shows average charitable donations received by RHTC hospitals over time. Panel B shows, over time, the average total profit in blue and the average medical profit margin in orange for RHTC recipient hospitals. Source: HCRIS.

Figure 2: Event Studies: Financial Stability



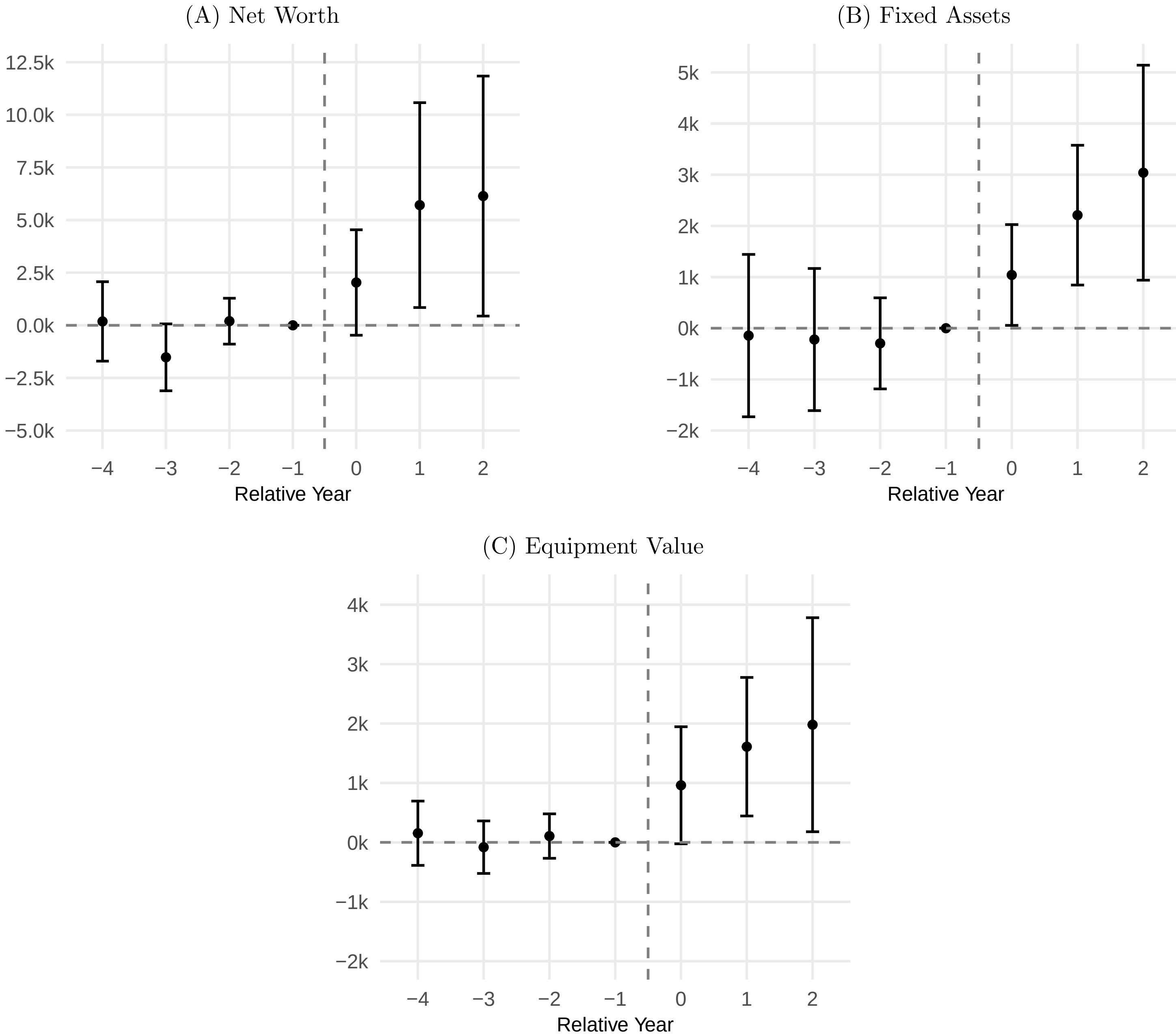
Notes: This figure shows event study estimates using the imputation estimator and the rural control group. The confidence intervals displayed are at the 95% level. Standard errors are clustered at the hospital level.

Figure 3: Event Studies: Use of Funds (Labor and Operating Costs)



Notes:This figure shows event study estimates using the imputation estimator and the rural control group. The confidence intervals displayed are at the 95% level. Standard errors are clustered at the hospital level. Dependent variables are normalized by discharges in the base period.

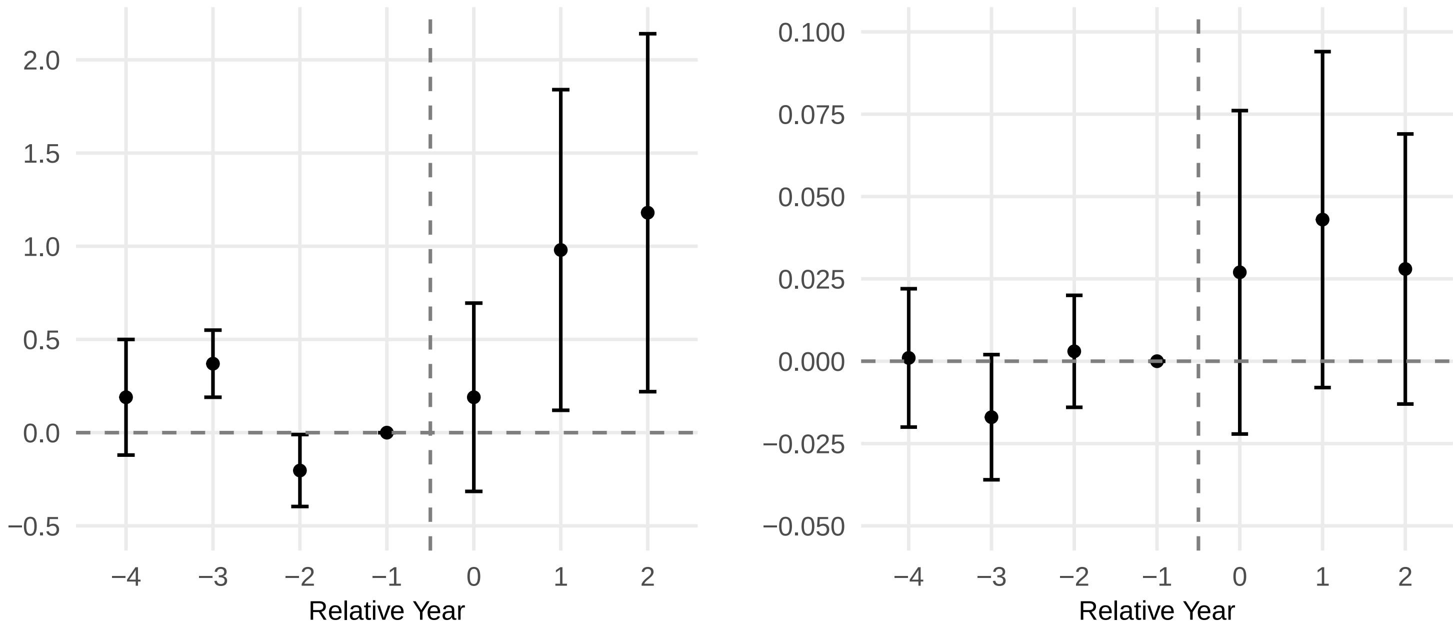
Figure 4: Event Studies: Use of Funds (Investment)



Notes: This figure shows event study estimates using the imputation estimator and rural control group. The confidence intervals displayed are at the 95% level. Standard errors are clustered at the hospital level. Dependent variables are normalized by discharges in the base period.

Figure 5: Event Studies: Patient Volume and Profit

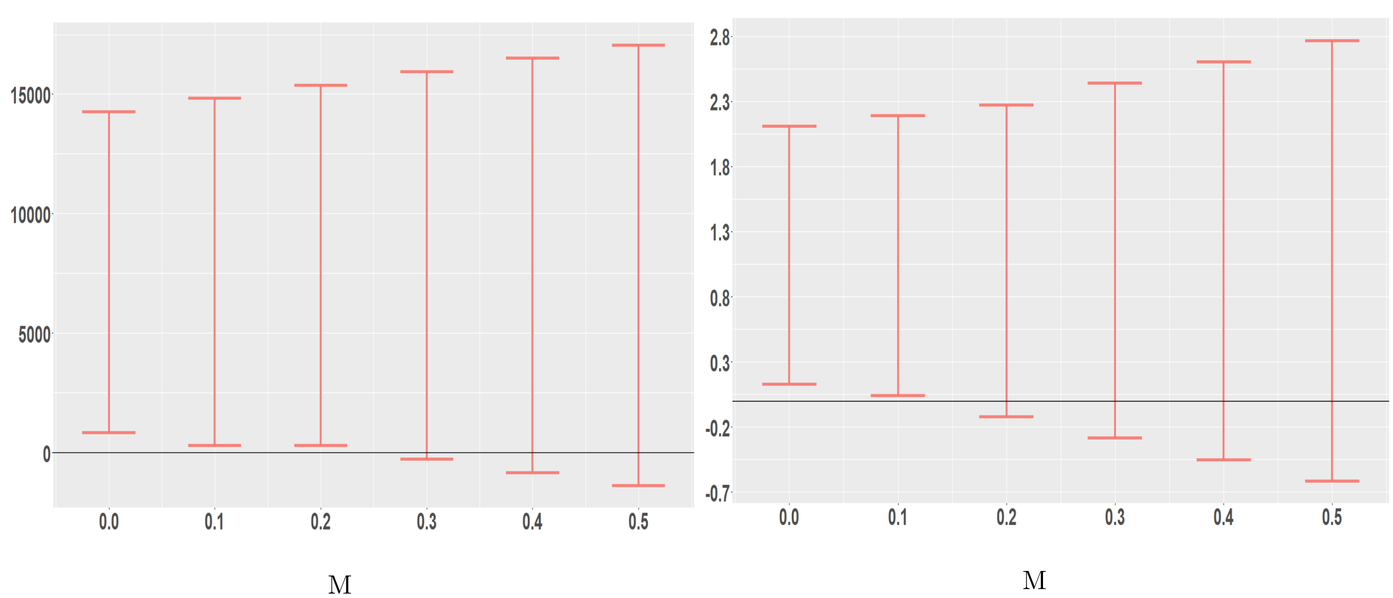
(A) Inpatient Days (B) Operating Margin



Notes: This figure shows event study estimates using the imputation estimator and rural control group. The confidence intervals displayed are at the 95% level. Standard errors are clustered at the hospital level. Inpatient days are normalized by discharges in the base period.

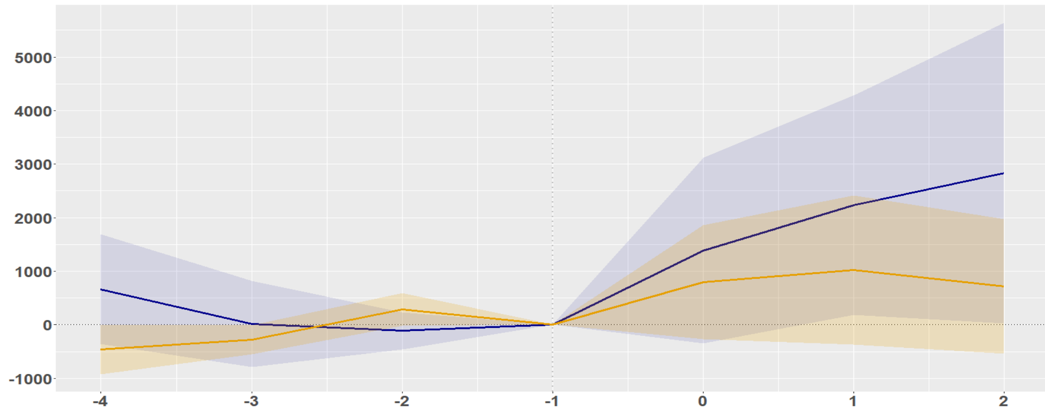
Figure 6: Robustness to Violations of Pre-Trends

(A) Net Worth (B) Inpatient Days



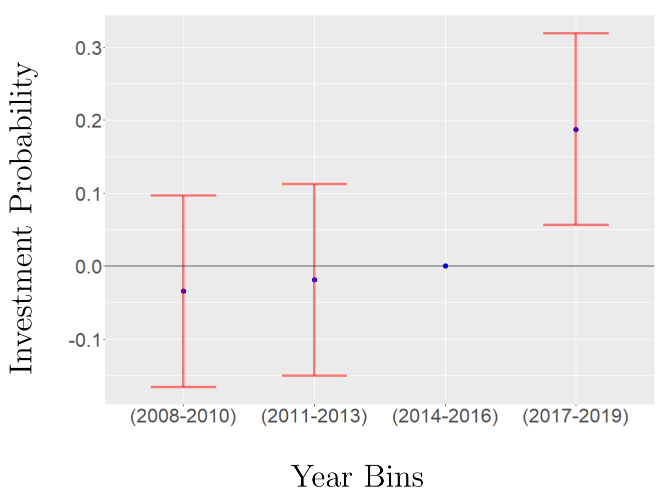
Notes: This figure shows results from the Rambachan and Roth test for pre-trends. This test conducts a sensitivity analysis by computing confidence intervals for the treatment effect under the assumption that the post-treatment violation of parallel trends is M times larger than the maximum pre-treatment violation.

Figure 7: Equipment Value Estimates Across Donation Size



Notes: This figure shows event-study estimates of the effect of treatment on equipment value for above- and below-median donation hospitals. Blue depicts hospitals receiving a high dose of treatment, while orange depicts those receiving a lower dose. To account for size differences among treated hospitals, donation levels are scaled by the number of discharges in the base period. These estimates are computed using the method for event studies with continuous treatment outlined in Callaway and Sant'Anna (2024)

Figure 8: Event Study: Imaging Equipment Investment



Notes: This figure shows event study estimates of the effect of the RHTC on hospital investment in imaging equipment. Point estimates show the average probability of investment at rural Georgia hospitals relative to the control group of rural hospitals in other southern states. The confidence intervals displayed are at the 95% level. Standard errors are clustered at the hospital level. *Source*: FDA X-Ray Installer Files.

Appendix: A

Table 9: DID Results: No Sampling Restrictions

	Operating Costs	FTE	Net Worth	Total Assets	Fixed Assets	Equipment Value	Inpat Days	Operating Margin
	2,935	0.025**	5,565*	5,530	2,581**	1,743**	0.859*	0.043***
	(1,882)	(0.011)	(3,329)	(3,646)	(1,264)	(713)	(0.515)	(0.013)
Observations	1,267	1,265	1,242	1,242	1,240	1,197	1,267	1,256
Pre-Treat Mean	39,289	0.275	14,643	56,345,793	17,581	12,154	7.93	-0.047
Observations	724	724	710	710	708	675	724	717

Source: HCRIS, (SE) are clustered at hospital level and shown below point estimates, stars indicate: $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$. Panel A shows difference in differences results from the imputation estimator using the HCRIS data with no sampling restrictions on ownership change or complete cost reports.